Problem Structuring with the Systemic Enterprise Architecture Method: Representation of Systems and Value in Business Contexts and Integration with Operations Research Methods

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To those who create

To *create* an artifact,
the *designer* needs to be
a *scientist* to model reality,
an *epistemologist* to metamodel the design process, and
an *artist* to contemplate the result.

John P. van Gigch

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Abstract

In many cases, managers must solve problems in the face of ambiguities and uncertainty about objectives and outcomes of their decisions. These cases are the result of the existence of multiple actors with different perspectives, conflicting interests and important intangibles that cannot be quantified or measured. A major step in addressing such complexities is to answer the following questions: "What is the real problem?"; "How do we know we are working on the right problem?"; "How do we decide what to do about the problem?"; and "How do we set limits to the area of investigation in a problem solving initiative?". In the operations research (OR) literature, the methods that aid the managers in answering these questions are broadly categorized as *problem structuring methods* (PSMs).

The research presented in this dissertation is centered on problem structuring with the systemic enterprise architecture method (SEAM) a graphical modeling technique developed by the Laboratory for Systemic Modeling (LAMS) at École Polytechnique Fédérale de Lausanne (EPFL). Prior to this research, SEAM was mainly applied as a qualitative modeling technique in Business-IT alignment and Requirements Engineering projects.

With this research we have two objectives: (1) to augment SEAM with the requisite theory, notational elements and modeling constructs to enable its use in business contexts; (2) to complement SEAM's qualitative representations with quantitative aspects. To reach the first objective, we develop four PSMs that are designed to help depict the structure of a problem, thereby demonstrating why a situation is problematic in the service science and strategic management contexts. To reach the second objective, we research the application and investigate the use of SEAM combined with two quantitative operations research methods: systems dynamics (SD) and analytic hierarchy process (AHP). Here, SEAM operates as an intermediary layer between the problem and the OR method.

Our research contributes to the organizational decision making in two major ways. Firstly, we develop PSMs that provide qualitative representations of a problem situation. These representations enable the stakeholders to carry out a dialog and exchange their points of view and concerns, thereby establishing a common base of understanding about the problem situation. Research in decision making and problem solving suggests that such discussions and dialog can positively contribute to the effectiveness of the problem solving intervention and the quality of the decisions. The second contribution of our research is to make the quantitative OR methods more accessible for the decision makers. This is achieved by using PSMs as an intermediary layer between the problem and the OR method such that the decision makers can map or connect the problem situation to its representation by the OR method. This renders the OR methods more understandable and paves the way for their application in the organizational decision processes.

Keywords: Analytic Hierarchy Process (AHP), Operations Research (OR), Problem Structuring Methods (PSMs), Systemic Enterprise Architecture Method (SEAM), System Dynamics (SD), Systemic Thinking.

Résumé

Dans de nombreux cas, les managers doivent résoudre des problèmes dont les objectifs sont ambigus ou incertains. Ces cas sont la conséquence de l'existence de multiples acteurs ayant des perspectives différentes, des intérêts contradictoires et des valeurs qui ne peuvent être quantifiés ou mesurés. Une étape importante dans pour gérer cette complexité est de répondre aux questions suivantes: «quel est le vrai problème?», «comment savons-nous que nous travaillons sur le problème correct?», «comment pouvons-nous décider que à propos de ce problème? » et « comment fixons-nous les limites d'investigation dans une initiative de résolution de problèmes ?". Dans la littérature de recherche opérationnelle (OR pour « Operation research »), les méthodes qui aident les gestionnaires à répondre à ces questions sont généralement appelée méthodes de structuration des problèmes (PSM pour « Problem Structuring Method »).

La recherche présentée dans cette thèse est centrée sur la structuration de problème dans le contexte de la méthode SEAM (SEAM pour « Systemic Enterprise Architecture Methodology »), une technique de modélisation graphique développé par le Laboratoire de modélisation systémique (LAMS) à l'École Polytechnique Fédérale de Lausanne (EPFL). Avant cette étude, SEAM a été principalement appliquée comme une technique de modélisation qualitative dans des problèmes de Business-IT alignement et dans la définition des exigences dans le cadre de projets d'ingénierie.

Avec cette recherche, nous avons deux objectifs: (1) d'augmenter SEAM avec la théorie nécessaire, des éléments de notation et les constructions de modélisation pour permettre son utilisation dans des contextes d'affaires, (2) de complémenter les analyses qualitatives faites avec SEAM avec des aspects quantitatifs.

Pour atteindre le premier objectif, nous avons développé quatre PSM qui sont conçus pour faciliter la description d'un problème, d'illustrer pourquoi une situation est problématique dans le contexte de la science des services et de la gestion stratégique. Pour atteindre le deuxième objectif, nous avons étudié comment SEAM peut être combiné avec deux méthodes de recherche opérationnelle: la dynamique des systèmes (SD) et le processus hiérarchique analytique (AHP). Ici, SEAM fonctionne comme une couche intermédiaire entre le problème et les méthodes OR.

Notre recherche contribue à la prise de deux manières principales décisions organisationnelles. Tout d'abord, nous développons PSM qui fournissent des représentations qualitatives d'une situation problématique. Ces représentations permettent aux intervenants d'effectuer un dialogue et d'échanger leurs points de vue et préoccupations, établissant ainsi une base commune de compréhension de la situation problématique. La recherche dans la prise de décision et de résolution de problèmes montre que de telles discussions et dialogues peuvent contribuer positivement à l'efficacité de l'intervention problème de résolution et la qualité des décisions. La deuxième contribution de notre recherche est de faire du quantitatif ou des méthodes plus accessibles pour les décideurs. Ce résultat est obtenu en utilisant PSM comme une couche intermédiaire entre le problème et avec une méthode telle que les décideurs puissent carte ou connecter la situation du

problème de sa représentation par la méthode OR. Cela rend la ou les méthodes plus compréhensible et ouvre la voie à leur application dans les processus de décision de l'organisation.

Mots-clés: processus hiérarchique analytique (AHP), Recherche Opérationnelle (RO), méthodes de structuration de problèmes (PSM), Systemic Enterprise Architecture Methodology (SEAM), System Dynamics (SD), Pensée Systémique.

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Introduction

Overview: *This Ph.D. thesis focuses on problem structuring with the systemic enterprise architecture method (SEAM) and its integration with Operations Research (OR) methods. Prior to this research, SEAM was mainly applied as a qualitative modeling technique in software and IT engineering fields such as business-IT alignment and requirements engineering. With this research we had two objectives: (1) to augment SEAM with the requisite theory, notational elements and modeling constructs to enable its use as a problem structuring method in business contexts; (2) to complement SEAM's qualitative representations with quantitative aspects provided by OR methods.*

In this chapter, we elaborate on the objectives and define the overall contribution of the research conducted, clarifying the role that each chapter in the thesis plays in making that contribution. Next, we present the structure of the thesis, summarizing the research questions addressed, theoretical perspectives employed, and the research methodologies applied. The insights developed and the lessons learned through the course of this doctoral work are also presented in this chapter. Finally, most of the material presented in this thesis has been published before. These publications are also outlined in this chapter.

1. Research Objectives

The research presented in this thesis is centered on the Systemic Enterprise Architecture Method (SEAM) (Wegmann, 2003). SEAM is graphical modeling technique developed by the Laboratory for Systemic Modeling (LAMS) at École Polytechnique Fédérale de Lausanne (EPFL). Prior to this research, SEAM was mainly applied as a qualitative technique in IT and software engineering fields such as business-IT alignment, see for e.g. (Wegmann et al., 2005a; Wegmann et al., 2007a), enterprise architecture, see for e.g. (Wegmann et al., 2007b), and requirements engineering see for e.g. (Regev & Wegmann, 2007). Apart from its industry application, SEAM had also been used for teaching enterprise architecture and requirements engineering (Wegmann et al., 2007c; Regev et al., 2008).

SEAM is composed of three representations: the System Diagram, the Goal-Belief Model and the Supplier Adopter Relationship Diagram. The System Diagram (Rychkova et al., 2007; Wegmann et al., 2007d) represents the hierarchy of the *systems* that compose an organization (the departments, management system, etc.) and in which the organization is embedded (value networks, market segments, etc.). It can be used to delimit the problem in focus and identify the decision stakeholders i.e., organizational participants to a choice situation. The Supplier Adopter Relationship Diagram (Wegmann et al., 2007a) represents the technical details of the service offered in terms of the service features the *value* they create for the customer. The Goal-belief Model (Regev, 2003; Regev & Wegmann, 2004) represents and makes explicit the goals and the beliefs held by the organizational participants with respect to a choice situation. More information on SEAM, its theoretical grounding and representations are provided in Chapter 1, Section 3.1, Research Background.

Based on our research on the application of SEAM in enterprise architecture and requirements engineering, the industry practitioners found the graphical representations and the notational elements in SEAM to be cognitively effective. In addition, our experience shows that the systemic principles underlying SEAM such as black-box and white-box representations of systems and behavior, provide useful insights when applied in modeling an organization and result in building a common understanding of the problem in focus. This motivated the LAMS research group to extend SEAM so that it could be used as a problem structuring method (PSM) in other domains. Problem structuring is about reducing the risk of finding the right solution to the wrong problem. This risk is acknowledged and seriously considered by the practitioners (Woolley & Pidd, 1981). To this end, PSMs aim to assist decision makers in articulating what they should achieve, why they should achieve it and how they might achieve it (Brysonet, et al., 2004). In addition to exploring the application of SEAM as a PSM in contexts other than IT and software engineering, we decided to complement the qualitative representations of SEAM by integrating it with quantitative Operations Research (OR) methods.

From the organizational decision making perspective our research serves two main purposes. Firstly, it develops PSMs that provide qualitative representations of the problem situation. These representations enable the stakeholders to carry out a dialog and exchange their points of view and concerns, thereby establishing a common base of understanding about the problem situation. Research in decision making and problem solving suggests that such discussions and dialogs can positively contribute to the effectiveness of the problem solving intervention and the quality of the decisions.

The second purpose of the present research is to make the quantitative operations research (OR) methods more accessible for the decision makers. This is achieved by using PSMs as an intermediary layer between the problem and the OR method such that the decision makers can map or connect the problem situation to its representation by the OR method. This renders the OR methods more understandable and paves the way for their application in the organizational decision processes.

1.2 Applying SEAM as a PSM in New Contexts

IT systems are crucial elements in managing the relationships within the organization (e.g. resources, employees, departments) and between the organization and its environment (e.g. suppliers, competitors, regulators, customers, shareholders). The concept of organizational strategy designates the way by which an organization *manages these relationships* and thereby *maintains its identity by sustaining its value creation and capture activities* (Sanchez & Heene, 1997, 2003). These relationships are often quite dynamic (e.g. a customer can become a competitor) and multifaceted (e.g. a supplier can be a customer and a competitor at the same time). In the strategic management literature, this is referred to as coopetition (Brandenburger & Nalebuff, 1996). Coopetition is an inter-organizational relationship that combines competition and cooperation (Brandenburger & Nalebuff, 1996). It transcends the traditional paradigms of cooperation and competition in an effort to achieve the advantages of both. Such a relationship is of a higher complexity than either simple competition or cooperation, and it presents both conceptual and practical challenges for business managers and researchers in the marketing and strategy field.

Moreover, instead of being viewed as entities that create value in separation, organizations are increasingly conceptualized as *service systems* in which value is viewed as being co-created with the contribution of other organizations, customers, and actors. This perspective results from the development of *service science* as an interdisciplinary approach to the study, design, and implementation of services systems. From the service science perspective, the concept of service is extended beyond a “particular” kind of intangible good and goods are broadly viewed as delivery mechanisms for services (Vargo & Lusch, 2004).

Organizations therefore face the challenging task of continually aligning their IT services with their inter-organizational relations and create and capture value within their service systems. Thus, establishing an understanding of inter-relations and the interconnectedness of the value creation and capture of organizations as well as the dynamics and the multifacetedness of their inter-organizational relations are central to the design and development of their IT systems. This motivated our research group to enable the application of SEAM as a PSM that can provide analytical aid in conceptualizing service systems, value creation and capture and inter-organizational relations. This helps engineers to understand organizational strategy, devise IT strategy, determine the required IT services and define IT requirements.

As already stated the System Diagram and Supplier Adopter Relationship in SEAM represented systems and value. However, These representations were originally developed for the enterprise architecture and requirements engineering. Thus, to achieve the abovementioned research objective, we decided to augment their existing modeling constructs and underlying theoretical perspectives with the notational elements and the theoretical grounding suitable for the representation of *systems* and *value* in the inter-organizational relations, broadly discussed in the *strategic management* and the service system perspective of the organizations, introduced in the *service science*.

Our work resulted in the creation of four SEAM-based PSMs (hereafter referred to as PSMs) on the basis of the nature of the representations they embody (i.e., representing systems or value) and the context of their application (i.e., Service Science and Strategic Management): the Value Map, the Customer Value Model, the Viable Service System Model and the Value Network Model.

As illustrated in Figure 1, The Value Map and the Customer Value Model represent value, and the Viable Service System Model and the Value Network Model represent systems in the service system and the strategic management contexts respectively.

		Nature of Representations	
		Value	**Systems**
Business Contexts	**Service Science**	**The Value Map** Modeling value creation and capture in service-oriented business models	**The Viable Service System Model** Diagnosing and designing viability in service systems
	Strategic Management	**The Customer Value Model** Modeling the incentives of coopetition	**The Value Network Model** Modeling the alternative design of coopetitive value networks

Figure 1. Problem structuring with SEAM: The four SEAM-based PSMs, the nature of their representations and the contexts of their application

The Value Map and the Customer Value Model are based upon the Supplier Adopter Relationship Diagram. The Viable Service System Model and the Value Network Model are derived from and/or are extensions to the System Diagram.

1.3 Integration of SEAM with OR Methods

The second category of our work involves complementing the qualitative representations provided by SEAM with quantitative methods. To this end, we researched the application and investigated the use of the System Diagram and the

Goal-belief Model combined with two quantitative operations research methods: systems dynamics (SD) (Forrester & Wright, 1961) and Analytic Hierarchy Process (AHP) (Saaty, 1980).

SD is a methodology for understanding the behavior of complex systems over time. It provides fundamental contributions to framing, understanding, and discussing complex issues and problems. System Dynamics originally developed by Jay Forrester's work at MIT in the 1950s, is centered on modeling and simulating complex systems through systemic representation of the system in terms of stocks, flows, and feedback loops. SD methods provide "essential insight into situations of dynamic complexity," especially when experimenting the real systems is impossible or not feasible (Sterman 2000).

AHP is a Multicriteria Decision Making Method (MCDM) that aids in the ranking and evaluation of alternatives based on a given number of criteria. MCDM methods are characterized by the evaluation of a finite set of alternatives based on multiple criteria. The main objective of an MCDM method is to measure the overall preference values of the alternatives. In the AHP process, after identifying the criteria and the alternatives, the decision makers conduct pairwise comparisons of criteria. This way, the weight for each criterion is calculated. Next, the decision makers do pair-wise comparisons of the alternatives based on each criterion (Saaty, 1980).

In the OR literature, the combined application of multiple methodologies for a problem solving intervention is referred to as "Multimethodology" (Mingers & Brocklesby, 1997). Thus, it can be stated that the second category of our research work was focused on developing multimethodologies composed of SEAM and the two OR methods.

2. Structure of the Thesis

This Ph.D. thesis is divided into three parts that include a total of six chapters. In the following sections, we outline the contents of each chapter summarizing the research questions addressed, theoretical perspectives employed, and the research methodologies applied.

2.1 Part 1- Problem Structuring with the Systemic Enterprise Architecture Method

Part 1, includes the first chapter of the thesis. In this chapter, first to provide a better understanding of the context of our research we review the literature on organizational decision making and problem structuring. Secondly, to establish the importance of our research we present the results of a survey we conducted to empirically test the theoretical propositions we derived from the literature review. Finally, we present the research background and position the work we have done in the context of this doctoral work relative to the prior research conducted by the LAMS research group.

2.2. Part 2 - Representation of Value and Systems in the Service Science and Strategic Management Contexts

The second part of this thesis includes Chapters 2 - 4. In Chapter 2, we introduce the Value Map, a PSM to represent value creation and capture in service-oriented business models. The Value Map provides analytical assistance in answering the following research questions: "How is value created for and with the customers in service-oriented business models?" and, "How is value captured by the service provider in the service-oriented business models?" These questions are fundamental to understanding how service systems sustain their existence. In order to provide a rigorous analysis of value creation and capture, theoretical perspectives from microeconomics such as (Brandenburger & Stuart, 1996) and the literature on value creation and capture see for instance (Bowman & Ambrosini, 2000) were invoked and incorporated in the Value Map.

In Chapter 3, we present the Viable Service System Model, a modeling method that contributes to the diagnosis of viability in service systems. To develop the Viable Service System Model, we drew on theoretical insights from general systems thinking (GST) (Weinberg, 1975) and Viable System Model (VSM) (Beer, 1979, 1984).

The Value Map and the Viable Service System Model were developed as design artifacts based on methodological insights from design science research (Hevner et al., 2004). Case studies with primary and secondary data were used to illustrate the applicability of the PSMs. Their practicality and usefulness were evaluated by means of empirical studies and user feedbacks from modeling sessions. In addition, the Value Map has been instantiated in an online platform for business design called www.tradeyourmind.com.

In Chapter 4, we focused on inter-organizational relationships in general and coopetition in particular as the phenomenon of interest in the strategic management context. Coopetition is an inter-organizational relationship that entails simultaneous competition and cooperation (Brandenburger & Nalebuff, 1996). Two PSMs are presented in this chapter: the Customer Value Model that helps in exploring the drivers and strategic incentives of coopetition, and the Value Network Model that provides insights into the design of the value network structure suitable for accommodating the complexities inherent to coopetition. Both PSMs incorporate important conceptualizations adapted from competence-based strategic management (CBSM) theory (Sanchez & Heene, 1997, 2003) and value network approach as well as the coopetition literature. The usability of the representations generated from the Customer Value Model was illustrated by their application to modeling the coopetition between IBM and Apple in the development of PowerPC CPU (Duntemann & Pronk, 1994). To provide a better understanding of how customer value can be modeled, we also present the results of applying the Customer Value Model in a project we undertook in a social networking platform called Webdoc. The Value Network Model is applied to represent empirical examples of four coopetitive value networks mainly derived from an in-depth longitudinal case study of Amazon.com coopetitive business models.

Table 1 summarizes the research objectives, methodology and the key theoretical perspectives employed in developing the models in the second part of this thesis.

Table 1. Research objectives, research methodology and the key theoretical perspectives employed in the research

	Business Context	
	Service Science	Strategic Management
Research Objectives *SEAM Models were developed to …*	- Analyze value creation and capture in service-oriented business models - Design and diagnose viability in service systems	- Analyze drivers and strategic incentives of coopetition - Analyze and design the organizational and network structure for coopetition
Theory Base *Theoretical perspectives employed from …*	- Viable System Model - Microeconomics	- Competence Based Strategic Management (CBSM) - Coopetition literature
Research methodology *Methods for developing / illustrating and evaluating the usefulness the SEAM models*	- Case study - Empirical Study - Feedbacks from users - Design science research	- Case study of Amazon.com coopetition-based business models with secondary data sources - Case study of Webdoc with primary data sources
Thesis Structure *Presented in*	Chapters 2 and 3	Chapter 4

2.3 Part 3 - Integration of the Systemic Enterprise Architecture Method with Operations Research Methods

Part 2 includes the second category of research carried out in the course of this Ph.D. This category focuses on exploring the application of SEAM combined with two quantitative OR methods: System Dynamics (SD) and Analytic Hierarchy Process (AHP) as multimethodologies (Mingers & Brocklesby, 1997).

In Chapter 5, we research the integration of SD with the PSMs that are widely applied in the SD community. We also included the Goal-belief Model, as a potential PSM, that can be used by the SD community in the study we conducted. Despite a growing literature on the application of PSMs with SD, very limited research has been undertaken to assess and compare the relative performance of alternative PSMs, when it comes to establishing and facilitating a communication within the organizational participants in a group model building session. This communication is deemed crucial to an effective SD intervention. Our first research objective was to develop a framework to measure the performance of the PSMs used in SD modeling. Then, we investigated the relationship between the performance of a PSM and the conceptualization of the problem situation. In other words, we sought to understand whether a PSM with high performance results in a better representation of the problem situation. Our results on the integration of SEAM with SD showed that the Goal-belief Model was not as cognitively effective as the rest of the PSMs applied in the community. Thus, we proposed the integration of the Stock and Flow Diagram in SD with the System Diagram in SEAM as an alternative. An example elaborating how the two models can be combined is presented in this chapter.

Building on the research on multimethodologies, we investigated the integration of Analytic Hierarchy Process (AHP) (Saaty, 1980) with the System Diagram and the Goal-belief Model in SEAM. AHP is a multi-criteria decision method that aids in the ranking of alternatives based on a number of criteria. The main topic we addressed here was, where do the criteria and the alternatives come from? We integrated the Goal-belief Model and the System Diagram with AHP in a requirements engineering project we did in a major bank in Switzerland. Chapter 6 includes the details of this research.

Table 2 summarizes the objectives, the methodology and key theoretical perspectives applied in the research presented third part of this thesis.

Table 2. Research objectives, research methodology and the key theoretical perspectives employed in the research

	OR Method	
	System Dynamics (SD)	Analytic Hierarchy Process (AHP)
Research Objectives *Multimethodologies were developed to*	- Compare and assess the effectiveness SEAM and the PSMs used in System Dynamics modeling	- Assess the integration of SEAM with AHP
Theory Base *Theoretical perspectives employed from ...*	- Cognitive science - Visual notation theory	- Requirements Engineering
Research methodology *Methods for assessing the integration of SEAM with OR methods*	- Exploratory laboratory study - Case study	- Case study of a large Swiss bank with primary data sources
Thesis Structure *Presented in*	Chapter 5	Chapter 6

3. Contribution of the Thesis

Our research has four distinct categories of contributions: first to the work conducted by the LAMS research group on the development of SEAM modeling technique; second, to the organizational decision making and problem solving and, to the coopetition and service systems (i.e., the new business contexts in which SEAM was applied) and lastly to SD and AHP (i.e., the OR methods with which SEAM was integrated).

Our contributions to SEAM are two-fold. First, we contributed to SEAM by modifying and augmenting it with the requisite theoretical perspectives and notational elements to enable its use as a PSM in two new application contexts (i.e., strategic management and service science). Our work resulted in the creation of four SEAM-based PSMs: the Value Map, the Customer Value Model, the Viable Service System Model and the Value Network Model. These PSMs can be categorized based on the nature of the representations they embody (i.e., representing systems or value) and the context of their application (i.e., Service Science and Strategic Management).

The resulting PSMs were positioned relative to the related modeling frameworks or and other PSMs in the field and validated empirically by means of surveys and application in problem solving interventions. Our second contribution to SEAM was to complement SEAM's qualitative representations with quantitative aspects by integrating it with OR methods. System Dynamics and Analytic Hierarchy Process were the two OR methods that were integrated with SEAM.

Our research also contributes to the decision making and problem solving processes in organizations in three major ways: First, by providing theoretically grounded propositions on the nature of problem solving and decision making activities and the role of problem structuring methods. These propositions were empirically tested in a survey. Second, by providing qualitative models that decision makers can use to clarify ambiguities in the problem solving process and make decisions by identifying a mutually agreed upon framework for the problem that needs to be addressed. Finally, by making the quantitative OR methods more accessible through providing an intermediary layer for the decision makers to bridge the gap between the problem situation and the OR methods. This can pave the way for adoption and use of OR methods in decision making and problem solving processes in organizations.

The first category of research (representations of value and systems) contributes to fields of service systems and coopetition research. In the service systems context for instance, we conducted a literature review that serves to discover the important concepts relevant to value creation and capture and explore the relationship among and these concepts. The literature review contributes to the field by providing a new perspective into the structure and the dynamics of value creation and capture in service systems. As another example, in the coopetition context, we develop a typology of coopetition between and within value networks that helps in understanding where and how coopetition appears in value networks.

In the second category of our research work (i.e., forming multimethodologies), we contribute to the two OR methods i.e., System Dynamics and AHP. To be more exact, we contribute to the SD literature, by providing a theoretical framework for measuring the cognitive effectiveness of the PSMs that are applied by the community to conceptualize the problem situation. Our contribution to the AHP method providing an intermediary layer that enables the decision makers to trace the decision criteria based on which the alternatives are ranked to the requirements and the preferences of the decision makers.

In the next sections we clarify and elaborate on the role that each chapter plays in making these contributions. More detailed discussions are presented in the chapters.

3.1. Contributions of Part 2 - Representation of Value and Systems in the Service Science and Strategic Management Contexts

The four PSMs developed in the second part of the thesis have their distinct contributions to their fields of application, i.e. service science and strategic management and to the practice of organizational decision making. In the following sections we clearly define, assess these contributions.

3.1.1 Chapter 2 - The Value Map: Modeling Value Creation and Capture in Service-Oriented Business Models

In this chapter we have two main contributions: a conceptual model, derived from the literature, that captures the structure and the dynamics of value creation and capture, and a PSM referred to as the Value Map that embodies the conceptual model to represents value in service-oriented business models.

To develop the Value Map, we conducted a literature review that helped us discover the important concepts relevant to value creation and capture and explore the relationship among and these concepts in order to gain a new perspective into the structure and the dynamics of value creation and capture in service-oriented business models. As the correct selection of the published materials is a vital element of a literature review, we followed Baker (2000) and developed a number of criteria for selection of the work to be included in the literature review. Having identified the concepts and their relationships, we graphically represented them in form of a conceptual model made up of boxes (i.e., the concepts) and arrows (i.e., their relationships). According to Whetten (1989: 491), “box and arrow representations often clarify the author's thinking and increase the reader's comprehension”. Based this conceptual model, we then developed a PSM referred to as the Value Map to represent value creation and capture in service-oriented business models.

To evaluate the usefulness of the Value Map, we conducted an empirical study in which we also compared the Value Map with Business Model Canvas, one of the most established methods in business model design. The results, in general, suggest that Value Map is a useful visualization tool that contributes to managerial decision making processes of business practitioners in the choice situations that entail value creation and capture in an organization’s business model. We learned that the Value Map complements and augments the Business Model Canvas by aiding the business practitioners in representing the necessary building blocks of business model of an organization and their inter-relations and interconnectedness. We also drew the conclusion that the Strategy Canvas can be used as an input to the Value Map in designing the value creation and capture processes in a business model.

3.1.2. Chapter 3 - The Viable Service System Model: Modeling and Analyzing Viability in Service Systems

Service science researchers have recently shown an increasing interest in studying the viability of service systems. Following systems inquiry, this body of research uses systems theory and cybernetics to understand the factors that can contribute to the viability of a service system, see for example (Barile et al., 2010; Saviano et al., 2010).

Banathy and Jenlink (2004) proposed to conceptualize systems inquiry into three sub-parts: systems philosophy, systems theory and systems methodology. While most of the work conducted by the researchers in the field can be categorized as having systems theoretical contribution, we contribute to the service systems field by following a systems methodological approach. Systems methodology aims at the instrumentalization of systems theory and its application to a functional context (ibid). To this end, we augmented the System Diagram with theoretical insights from the Viable System Model (VSM) (Beer, 1979, 1984) and developed the Viable Service System Model as a problem structuring method for analyzing the viability of a service system or for designing a viable service system.

To validate the applicability of the modeling artifact, we applied it to model and analyze viability in the context of a utility company’s service system. We have also applied the Viable Service System Model in a number of consulting projects. We present our reflections on the usefulness and practicality of the Viable Service System Model based on our experience from the group model building sessions with the organizational participants in these consulting projects.

3.1.3. Chapter 4 - The Customer Value and the Value Network Models: Modeling the Incentives and Design of Coopetitive Value Networks

In this chapter, we contribute to coopetition as a stream of research in strategic management by developing the Customer Value and the Value Network Models to represent the incentives and design of coopetitive Value Networks. In addition, we conduct a longitudinal case study to explore the potential advantages of coopetition-based business models.

Coopetition (i.e., collaboration between competing firms) is a phenomenon that has recently captured a great deal of attention due to its increasing relevance to business practice. However, current research on coopetition is still short on providing tools that can aid organizations assess the potential merits of establishing a coopetitive relationship and explore the alternative designs of the value network structure capable of accommodating the complexities inherent in such a multi-faceted inter-organizational relationship. Doing so requires a shift from a positivistic / theory building approach that aims at describing various aspects of coopetitive interaction towards research focused on developing normative recommendations for initiating and sustaining coopetitive strategies and relations. Our research contributes to bridging this gap by developing the Customer Value Model and The Value Network Model. Both models incorporate important conceptualizations from the competence-based strategic management (CBSM) (Sanchez & Heene, 1997, 2003). CBSM theory provides precise and consistent definitions of the primitive entities that serve as the building blocks of its conceptual foundation for representing markets, organizations, and their cooperative and competitive interactions, etc. grounding our models in CBSM enabled the identification and analysis of the internal and external systems relationships and their interactions that are deemed indispensible for generating relevant representations of a coopetitive strategy. CBSM also enabled us to derive more broadly generalizable and more theoretically defensible findings from our model developments.

The Customer Value Model, contributes to our understanding of why companies engage in a coopetitive relationship. By applying the Customer Value Model, we analyze the value companies can create for the customers when they join forces with the competition. The Value Network Model, assists in exploring the design of value networks that can accommodate the complexities of coopetition as a multi-faceted inter-organizational relationship. The applicability of the models was demonstrated by means of case studies of coopetitive value networks with secondary data sources. The Customer Value Model was also applied to improve customer value in a project with an online social networking platform called Webdoc. We also position the Customer Value Model and the Value Network Model relative to the existing modeling frameworks in the strategic management.

Finally, in order to gain insights into the potential advantages of coopetition, we conducted a longitudinal, in-depth case study on the coopetition-based business models of Amazon.com. This case study provided the data required to demonstrate the applicability of the Value Network Model in this chapter. The case study itself has a number of contributions. We found evidence on three distinct coopetition-based business models of Amazon.com: (1) Amazon Marketplace, (2) Amazon Services and Web Services, and (3) the collaboration between Apple and Amazon.com on digital text platforms. The findings from the case study helped us to put forward several propositions on how the potential advantages of coopetition can be realized by involving competitors within a firm's business model. As a whole, the results contributed to the current understanding of how firms—as well as their stakeholders—can better benefit from coopetition.

3.2. Contributions of Part 3 - Integration of the Systemic Enterprise Architecture Method with Operations Research Methods

In this section, we discuss the contributions of this doctoral work to the application of two operations research methods, System Dynamics (SD) and Analytic Hierarchy Process (AHP) in decision making and problem solving interventions.

3.2.1. Chapter 5 - Comparing the Performance of Problem Structuring Methods in System Dynamics Modeling

In this chapter, we contribute to the field of System Dynamics in two major ways. First, by suggesting the characteristics of a PSM that can result in a better representation of the problem situation by the organizational participants in group model building with System Dynamics, and secondly by measuring the cognitive effectiveness of four of the PSMs that are mainly used in the community and exploring the relationship between the cognitive effectiveness of the PSMs and the conceptualization of the problem situation.

Over the course of time, a number of PSMs were employed in the SD community to facilitate problem situation conceptualization. A key research question facing the SD community is how to usefully compare and assess the relative performance of these actual and other potential PSMs, given the facilitative role PSMs play in the establishment and increase of the quality of the communication within the participants and between the participants and the SD modelers (Akkermans & Vennix, 1997; Eden, 1994). This communication is indispensable to the effectiveness of the intervention.

We applied theoretical insights from cognitive science, in particular cognitive fit theory (Shaft & Vessey, 2006; Vessey, 1991), and visual notation analysis (Moody, 2009) to suggest the characteristics of a PSM that are likely to be cognitively effective in conceptualizing problem situations in building System Dynamics models. Then, we conducted an exploratory laboratory study to measure the cognitive effectiveness of the four PSMs that are widely used by the SD community: (i) Causal Loop Diagrams (CLDs) (Senge, 1994; Sterman, 2000), (ii) Influence Diagrams (ID) (Coyle, 1998, 2000), (iii) Cognitive Maps (Eden, 1989, 1994), and (iv) (Magnetic) Hexagons (Hodgson, 1992; Lane, 1993; Wong et al., 2011) as well as the Goal-belief Model from SEAM. In this study, we also explored whether cognitive effectiveness of a PSM results in a better conceptualization of the problem situation. Finally, we integrate the System Diagram in SEAM and the Stock and Flow Diagram in SD.

3.2.2. Chapter 6 - Integrating SEAM with the Analytic Hierarchy Process: A Pilot Study in a Large Swiss Bank

In this chapter, we contributed to multi-criteria decision making methods in general and AHP in particular by showing how alternatives are developed and the decision criteria are defined in a group decision making process in an organizational setting. Most of the work in the application of AHP focus only on ranking of the alternatives with respect to a set of criteria and do not capture the decision processes that lead to the development of the alternatives and the definition of the criteria.

We developed a multi-methodology by integrating the Goal-belief Model and the System Diagram in SEAM with AHP. The multimethodology was then applied in a requirements engineering project in Credit Suisse one of the major banks in Switzerland. The objective of the project was to select a common SOA tool that could satisfy the needs of two of the bank's main business units, investment and private banking. SEAM provided help in identifying stakeholders, eliciting their requirements, and analyzing these requirements. The resulting requirements were then grouped and translated into selection criteria for the alternative SOA tools. Based on these criteria, the stakeholders chose the tool to be purchased using AHP.

4. Insights and Lessons Learned

I divide the insights I developed and the lessons I learned during my Ph.D. into three major phases: describing and understanding new and emerging phenomena such as coopetition and service dominant logic; employing theoretical perspectives to explain the logic underlying such paradigm shifts, and building graphical models that can help instrumentalize such theoretical perspectives and conceptualizations by applying them to a concrete context.

At the beginning of my Ph.D., I was interested in understanding and describing emerging topics in management science such as coopetition, service dominant logic etc. mainly by going through the publications. Such topics helped me in developing a perspective that was different from the one I previously had. For instance, prior to my Ph.D., I did not think of collaboration between competitors as a viable inter-organizational relationship. What I learnt at the beginning of my studies was that an inter-organizational relationship that combines cooperation and competition is indeed the most viable form of relationship.

By the passing of time, I understood the importance of theoretical conceptualizations in explaining the rationale underlying such phenomena. I got acquainted with theoretical perspectives as diverse as systems theory, organizational cybernetics, competence-based strategic management, etc. By invoking such theoretical insights, I could then explain why coopetition is linked to the viability of an organization and how it can sustain an organization's value creation and capture activities.

When I started my Ph.D. in 2009, I already had around 5 years of experience as an industrial engineer in planning and monitoring technology transfer projects in an international scale. As I wanted to maintain my relationship with the industry, each year

I did a number of workshops when I traveled to Iran. At the beginning, in these workshops I familiarized the audience with the concepts such as coopetition and service-dominant logic etc. and explained their underlying rationale and potential advantages. The main question I was asked by the audience was "how can we apply these concepts in our company?" Almost half way through my Ph.D., I started developing models that embodied the theoretical insights to be used by the practitioners. I began publishing the models I generated and based on the reviewers' comments and feedbacks from the presentation sessions I improved the constructs and the conceptualizations in the models. I realized that the magic happens with iteration. This process took me two years before I built enough confidence to bring my models to the workshops and present them as thinking tools and facilitative devices that can provide analytical assistance in understanding and representing the structure of a problem or a choice situation in an organizational setting.

The results from the workshops were really encouraging and I found myself to be on the right track. Seeing that the models I developed can contribute to the thought processes of executives and managers in the decision making process was the most rewarding outcome of my doctoral work. The major pre-occupation that I have now is how to make the models more cognitively accessible for people with a range of backgrounds without requiring them to go through lengthy training. This takes me to the work I intend to do after my doctoral study, which is striking the right balance between the theoretical rigor and the practical relevance from one side and the cognitive effectiveness of the modeling frameworks from the other.

5. Publications

Table 3 provides the outline of the publications based on the structure of the thesis. The numbers in quotations refer to a detailed bibliography in the "Publication List" as an appendix to this chapter.

Chapters 2-6 of this thesis evolved through a series of publications. The research results for each topic were published in conferences/journals. Based on the comments from reviewers and the participants to the presentation sessions, adjustments were made and the amended work was republished. Chapters 2-6 are the final outputs of the research/publication iteration.

I hereby acknowledge the contribution of the co-authors of the articles (listed in alphabetical order): Prof. Ann Van Ackere, Aoife Hegarty, Gil Regev, Gorica Tapandjieva, Julien Ramboz, Paavo Ritala, Philippe Laparde, Prof. Ron Sanchez, Sérgio Viana, Valerian Hanser, Vijay Viswanathan, Wided Guédria.

Table 3. The Outline of Publications based on the chapters in the thesis

	Publications
Chapter 2 *The Value Map*	- 1st International Conference on Exploring Services Sciences (IESS 1.0), Geneva, Switzerland. **[1]** - International Journal of Service Science, Management, Engineering, and Technology (IJSSMET). **[2]** - 3rd International Conference on Exploring Services Sciences (IESS 1.2), Geneva, Switzerland. **[3]** - International Association for Management of Technology Conference 2012 (IAMOT 2012), Hsinchu, Taiwan. **[4]** - 2nd International Symposium on Business Modeling and Software Design (BMSD 2012), Geneva, Switzerland. **[5, 6]** **-** 3rd International Symposium on Business Modeling and Software Design (BMSD 2012), Geneva, Switzerland. **[7]**
Chapter 3 *The Viable Service Systems Model*	- 2nd International Conference on Exploring Services Sciences (IESS 1.1), Geneva, Switzerland. **[8]** - International Journal of Service Science, Management, Engineering, and Technology (IJSSMET). **[9]**
Chapter 4 *The Customer Value and the Value Network Model*	- The 2nd ISPIM Innovation Symposium, New York, New York, USA. **[10]** - 4th Workshop on Coopetition Strategy, Montpellier, France. **[11]** - INFORMS 2010 Annual Meeting, Austin, Texas, USA. **[12]** - 21st Nordic Workshop on Interorganizational Research, Vaasa, Finland. **[13-14]** - International Association for Management of Technology Conference 2012 (IAMOT 2012), Hsinchu, Taiwan. **[15]** - 5th Workshop on Coopetition Strategy, Katowice, Poland. **[16]** - First Conference on Competence-Based Strategic Management, Copenhagen, Denmark. **[17]** - International Journal of Business Environment (IJBE). **[18]**
Chapter 5 *Integrating SEAM with System Dynamics*	- The 28th International Conference of The System Dynamics Society, Seoul, Korea. **[19]** - The 29th International Conference of The System Dynamics Society, Washington D.C, USA. **[20]** - The 30th International Conference of The System Dynamics Society, St. Gallen, Switzerland. **[21]**
Chapter 6 *Integrating SEAM with Analytic Hierarchy Process*	- The 21st IEEE International Requirements Engineering Conference (RE). **[22]**

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PART 1

PROBLEM STRUCTURING WITH THE SYSTEMIC ENTERPRISE ARCHITECTURE METHOD

Chapter 1: Problem Structuring and the Systemic Enterprise Architecture Method

Abstract: *The purpose of this chapter is three-fold. First, to provide a better understanding of the context of our research, we review the literature on organizational decision making and problem solving to gain insights into the nature of managerial decision making and the role and contribution of problem structuring methods in the decision making processes in organizations. Secondly, to establish the importance of our research we present the design and the results of a survey we conducted to provide empirical evidence for the theoretical discussions in the literature review. Finally, we present the research background and position the work conducted in the course of this doctoral thesis relative to the prior work undertaken by our research group.*

1. Organizational Decision Making and Problem Structuring: A Review of Literature

In this section, we review the literature on organizational decision making and problem structuring. The literature review contributes to our understanding of the divergence of organizational decision making form theories of rational choice. It also aims at explaining the role and contribution of problem structuring methods (PSMs) in the managerial decision processes.

1.1 Organizational Decision Making: Divergence from the Rational Choice Model

According to Simon (1992) the work of managers within organizations mainly involves choosing issues that require attention, setting goals, finding or designing suitable courses of action, and evaluating and choosing among alternative courses of actions. The first three activities are referred to as “problem solving” and the last two are called “decision making”. Making decisions and solving problems are the main functions of the managers in organizations. The effective performance of these functions can greatly contribute to the viability of the organization (ibid).

The effectiveness and the quality of the decision making and problem solving processes depend upon the availability of the following informational elements: a list of action-outcome pairs (i.e. alternatives and their possible future states); a probability associated with each outcome; and a desirability associated with each outcome (i.e. pay-off) (Bross, 1953). The selection of alternatives (i.e. actions) is made on the basis of the expected utility (EU) of each alternative. The EU is calculated based on the probability, and desirability of an action-outcome pair. To insure effectiveness and rationality in the organizational decision making, the alternative with the highest EU should be selected (Radner, 1972). However, research in the organizational decision process sheds light on the divergence of decision making in organizations from the rational choice model elaborated in (Radner, 1972). We present a number of theoretical perspectives that contribute to our understanding of such divergences.

Simon (1955) brings in a behavioral perspective to the decision making process that diverges from the traditional rational choice process as outlined in (Radner, 1972). Simon argues that most decision makers have limited capacity and resources for gathering and interpreting the information required for meeting the rationality criteria. Hence, they decide rationally within their bounds. This means that, instead of deciding based on the maximum utility the decision maker chooses a satisfactory alternative, thereby sacrificing the economically optimal alternative. Simon (1955) refers to this behavioral perspective as *satisficing*.

When it comes to organizational decision making, even if the decision makers are not bounded by their computational capacities, ambiguities about their preferences can hinder the application of the rational choice model. In organizations, decision makers mostly develop preferences through experience. Such preferences can be primarily vague and ill-defined due to their time-variant and dynamic nature, which can render development and evaluation of alternatives (i.e. the courses of action) impractical (March & Shapira, 1992). More importantly, even if the preferences are well-defined, there are cases where the individuals within organizations have conflicting interests and preferences. Knowing that the stakeholders' demands are conflicting and inconsistent in nature, the decision maker thus resembles a "political broker" who should attempt to accommodate a coalition of preferences (March, 1962; Mingers & Rosenhead, 2004).

Etzioni (1988) points out that in organizations, emotional involvements and value commitments sometimes replace rationality as a basis for decision making. This means that, information processing, which is integral to the rational choice process, can be excluded from the decision making process. He asserts that there are cases in the organizational decision making that normative/affective (N/A) factors outweigh the logical/empirical (L/E) factors. Etzioni (1988, P. 129) adds "Oftentimes, where values are involved, consideration of L/E factors is tabooed. For instance, no company considers bombing the competition". In the organizational decision process, even when all factors are considered, N/A factors can influence the decision process by assigning weights to alternatives that result in a different ranking when only the L/E factors are taken into account. In essence, in the organizational choice situation, in many cases, the decision maker does not complete the decision sequence as (s)he cannot process and analyze all the facts and data while thinking on L/E grounds. This is primarily due to cognitive limits, identified by Simon (1955) and thus results in jumping to solutions and making selections on the basis of N/A considerations.

The works of March and Shapira (1987) and Tversky and Kahneman (1974) suggest that cognitive perspectives and judgmental heuristics should be surfaced to understand why and how decision makers bypass the decision sequence. They state that to gain a better understanding of how decisions are made in an organizational setting, the underlying mental models and cognitive biases should be surfaced, understood and fitted in the investigation of organizational decision making.

Mintzberg et al. (1976) define the organizational decision process as a set of actions and dynamic factors that begins with the identification of a stimulus for action and ends with specific commitment of resources to an action resulting from the evaluation of the developed alternatives. In the 25 strategic decision processes studied in their research, they found judgment as the prime ingredient when it came to evaluating the alternatives in the selection phase of the decision making process. In their research, they found that out of 83 instances of evaluation activity in only 18, evaluation could be distinguished from choice. In other words, evaluation and choice are intertwined (i.e., the alternatives are evaluated the moment they are generated) and evaluation is more in the form of bargaining, intuition and judgment than rational analysis.

Intuition is defined as "the preconscious recognition of the pattern and/or possibilities inherent in a personal stream of experience" (Weick, 1995: 25). We burrow the definition of judgment from Vickers (1995:27) "Irrespective of any views or doubts we may have about the degree of freedom with which choices are made, we can hardly escape the universal assumption that they are the expression of a mental activity that may be exercised with greater or less skill. I will call this activity *judgment.*" Vickers (1995) identifies three types of judgments made by decision makers: reality judgments that concern what is or is not the case; value judgments: what ought or ought not be the case-including wants and desires, individual and collective goals, and instrumental judgments: the best means available to reduce the mismatch between what ought or ought not be the case".

Table 1 summarizes the sources and the nature of divergence from the theories of rational choice in the organizational decision processes."

Table 1. The source and the nature of the divergence from the rational choice model

Source of divergence	Nature of Divergence	References
Limited computational capacity of the decision maker	Bounded rationality and satisficing	(Simon, 1995)
Dynamic and ambiguous nature of preferences	Development and evaluation of alternatives are impractical	(March & Shapira, 1992)
Conflicting and inconsistent interests among decision makers	Political brokerage, accommodating a coalition of preferences	(March, 1962; Mingers & Rosenhead, 2004)
Normative/affective (N/A) factors outweigh the logical/empirical (L/E) factors	Omitting alternatives or assigning weights to certain alternatives	(Etzioni, 1988)
Decision maker's Judgment	Judgment is the prime ingredient in evaluation of alternatives	(Tversky & Kahneman, 1974; Mintzberg, 1976)

To explain the divergences between organizational decision process and the theories of rational choice, in the next section, we investigate the nature of the problems that arise in organizations, in light of the theoretical insights from systems thinking. Systems thinking is a discipline that can contribute to our understanding of the factors that give rise to the complexities inherent in organizational decision making and problem solving, thereby clarifying why a mode of inquiry and analysis, alternative to the rational choice model, is indispensable.

1.2. Swamps, Messes and Wicked!!

Systems thinking (Weinberg, 1975; Klir, 1991) identifies three different types of systems (see Figure 1): organized simplicity, disorganized complexity and organized complexity. Each of these system types exhibits their idiosyncratic problem categories. In systems of organized simplicity, a limited number of components are interconnected in predictable ways. For instance analyzing the motions of an ivory ball on a billiard table can be exemplified as a problem that belongs to the systems of organized simplicity. (Van Gigch, 1991). Systems of disorganized complexity are the systems that exhibit a behavior that can be perceived as chaotic by the observer. In such systems, a large number of components are in interaction in unpredictable ways, like a gas in a container, with the gas molecules as the parts. If we are to predict the motions of hundreds or thousands of ivory balls rolling on the surface of a large billiard table we are faced with a problem that stems from a system of disorganized complexity. Ackoff (1971) refers to systems of organized simplicity and disorganized complexity as purposive systems. A purposive system is a system for which the observer conceives a purpose. Such systems do not have objectives of their own (ibid).

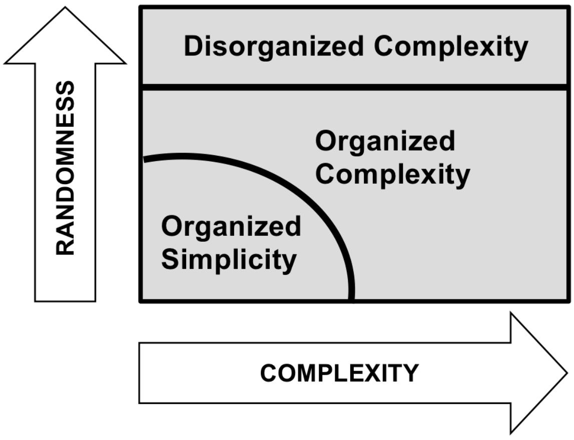


Figure 1. Typology of systems based on the degree of complexity and randomness (Weinberg, 1975; Klir, 1991)

Systems of organized complexity are composed of a finite number of components that are irreducible wholes. In such systems, the whole represents more than the sum of its parts, thus the behavioral property of the systems cannot be inferred and derived from the behavioral properties of its constituent parts (Weinberg, 1975; Klir, 1991). Ackoff (1971) refers to these systems as purposeful systems. Systems of organized complexity exhibit goal-oriented behavior and behavioral properties that are perceived to be absent from the systems of organized simplicity or disorganized complexity to which purposive behavior pertains. Examples of systems of organized complexity include organizations, a neighborhood or a community or any other human social systems (Van Gigch, 1991).

Systems theory establishes a link between the complexity in systems of organized complexity (i.e. purposeful systems such as the organizations or other human-social systems) and the situations of uncertainty and ambiguity. In situations of certainty, the decision maker has complete knowledge of the values of the outcomes and of the occurrences of the states. In uncertainty, however, the decision maker might know the values of the action-outcome pairs, but no information on the probability associated with outcome is available. This means that the decision-makers have to deal with the occurrence or nonoccurrence of a well-defined, specific phenomenon. When facing ambiguity, the decision maker has to cope with an event that is ill-defined, vague, and difficult to specify (Van Gigch, 1991). According to Mingers and Rosenhead (2004), the existence of multiple actors with multiple perspectives and conflicting interests, as well as the important intangibles that cannot be quantified or measured, give rise to situations of ambiguity and uncertainty in the organizational decision making and problem solving processes. Thus, in some cases, due to this inherent ambiguity and uncertainty in the organizations decision making and problem solving are closer to the concept of a *mess* than to a problem, which is structured and well-defined (ibid).

In the operations research (OR) literature, a distinction is made between the problems where the decision maker is dealing with high uncertainty and ambiguity compared to the situations where the decision maker is dealing with a well-defined problem and is aware of alternatives, the outcomes and their associated probabilities.

According to Ackoff (1979: 93), "Managers are not confronted with problems that are independent of each other, but with dynamic situations that consists of complex systems of changing problems that interact with each other. I call such situations *messes*. Problems are abstractions extracted from messes by analysis; they are to messes as atoms are to tables and charts … Managers do not solve problems, they manage messes."

Rittel and Webber (1973) described the concept of "wicked" problems contrasting them with relatively "tame" problems as confronted in mathematics, the game of chess, or solving puzzles. They mention a number of characteristics to delineate wicked from tame problems (Rittel & Webber, 1973; Conklin, 2005):

- Wicked problems have no stopping rule. In other words the problem solving process terminates when the organization runs out of resources not when the optimal or the correct solution emerges.
- The solutions to wicked problems are not true-or-false, but rather better, worse, good enough or not good enough. Thus, testing whether the solution is the best possible solution is impractical.
- One cannot learn about a wicked problem without trying solutions but trying a solution to a wicked problem is tantamount to implementation as there is little or no opportunity for proactive experimentation.
- Wicked problems do not have an exhaustive set of potential solutions.
- Every wicked problem is unique and thus non-recurrent in nature. Thus, the solutions to the wicked problems should be custom-designed.
- Wicked problems are often considered to be a symptom of another problem. So addressing the wicked problem requires finding the root cause.
- The way a wicked problem is represented or explained determines the nature of the problem's resolution and there is no definitive representation or formulation of a wicked problem.

Other terms have been developed to refer to wicked and tame problems: swamps versus high grounds (Schon, 1987), practical versus technical problems (Ravetz, 1971), and unstructured versus structured problems (Mingers & Rosenhead, 2004). In the remainder of this paper we refer to these the two distinguished categories of problems as wicked versus tame based on the definition made by Rittel and Webber (1973). Examples of wicked problems include: devising strategies for dealing with crime and violence, formulating strategy in organizations, defining product features and etc. (Conklin, 2005).

In this section, based on insights provided by systems thinking we identified three different systems (i.e., organized simplicity, organized complexity and disorganized complexity). We categorized organizations and other human social systems as systems of organized complexity wherein the situations of ambiguity and uncertainty give rise to a category of problems known as "wicked" problems. In the next section, we discuss the methods that are applied for problem solving and decision making in the context of tame problems. We will then explore whether these methods provide the right means of analysis for the wicked problems that managers face in organizations.

1.3. Traditional Paradigms of Analysis: the Right Tool for the Job?

Quantitative and computational methods such as statistical mechanics and probability can be applied to explain and predict the behavior of purposive systems. In dealing with the tame problems exhibited in the purposeful systems, operations research (OR) methods are one of the most established means of problem solving (Weinberg, 1975; Van Gigch, 1991). In these cases, most of the solutions are algorithmic in nature and applied in form of consistent steps that are repeated routinely to reach an optimum solution. However, OR methods do not provide sufficient aid in solving the wicked problems exhibited by the purposeful systems. Such problems are in most cases addressed by the decision maker's problem handling skills, mainly formed by prior experience, that lead to a satisfactory solution that is not necessarily an optimum one (Simon, 1965).

According to Churchman et al., (1957), the process of problem solving with OR is composed of six stages: (1) formulating the problem, (2) constructing a mathematical model; (3) deriving a solution, (4) testing the model and the solution, (5) establishing controls over the solution and (6) putting the solution to work (i.e. implementation). In this process, the very first stage is often glossed over and is treated as a given. This stage needs to be dealt with greater detail as it includes important sub-stages such as identifying decision makers and their objectives, delimiting the system and its environment, considering the consequences of alternative courses of action, synthesizing the objectives and actions, and defining the objectives (ibid).

Ackoff (1979) characterizes the traditional OR methods as "mathematically sophisticated but contextually naïve". OR methods focus on applying standard techniques to standard (i.e., tame) problems and in many cases do not offer adequate support to facilitate the kind of decision making and problem solving required in circumstances where the problems are of a wicked nature. As illustrated in Figure 2, Burchell et al. (1980) develop a typology of methods that can be used in the organizational decision process. They cluster the methods based on two types of uncertainties: uncertainty over the consequence and uncertainty over the objectives of an action, see Figure 2. According to them, computation is suitable for situations in which both types of uncertainties are low. The problems that arise from such situations can be solved by computation. Burchell et al. (1980: 14): "As cause consequences of action become more uncertain however, the potential for computation diminishes and decisions are made in a judgmental manner, with organizational participants subjectively appraising the array of possible consequences in the light of the relatively certain objectives. With consequences of action presumed to be known, uncertainty over the objectives of action would result in a political rather than computational rationale for the decision making process. A range of interests in action are articulated in such circumstances and decision making, as a result, tends to be characterized by bargaining and compromise. When even consequences of action are uncertain, decision making tends to be of an inspirational nature. With so little known beforehand rationales for action were seen as emerging in the course of the decision making process itself."

		Uncertainty over the Consequence of Action	
		Low	High
Uncertainty over the Objectives of Action	Low	Computation	Judgment
	High	Bargaining	Inspiration

Figure 2. Typology of methods to aid in organizational decision process (Burchell et al., 1980)

To provide insights into the suitability and usability of the methods and analytical approaches applied in the organization decision processes, Jackson and Keys (1984) develop an alternative categorization. Their categorization is based on two dimensions: the context of the problem and the relations between the stakeholders. The context of the problem can be simple or complex. The relations between stakeholders can be "unitary" (i.e. existence of general consensus among stakeholders), "pluralist" (i.e. conflicting but reconcilable views) and "coercive" (i.e. conflicting and irreconcilable views). According to Jackson and Keys (1984), OR methods are suitable for handling the problems where context is simple and there is a general agreement between the stakeholders. Research by Rosenhead and Mingers (2004) reports similar results.

Indeed, OR methods create much value in many organizations because they address important problems. OR methods play a central role in the analyses carried out by the individuals within these organizations, thus contributing a great deal to increasing efficiency and productivity and avoidance of infeasibility (Rosenhead & Mingers, 2004), production planning, inventory management, forecasting and etc. include some applications of OR methods. Nevertheless, wicked problems do not fall in the comfort zone of OR methods and that cannot be addressed by such methods. Sometimes these problem situations have enormous effect on the viability of the organization in particular when they are "strategic" in nature (Ackoff, 1979; Checkland, 1985; Mingers & Rosenhead, 2004; Mintzberg et al., 1976) and primarily appear in the realm of middle-to- upper management and can impact the direction and the nature of the operations in the lower organizational levels (Simon, 1965). Mintzberg et al. (1976:1) defines "strategic" as "important, in terms of the actions taken, the resources committed or the precedents set". Thus, devising methods for addressing the wicked problems can contribute to the viability of an organization. The question now is "What are the operating characteristics of the methods that are appropriate and can aid in addressing wicked problems?"

1.4. The Call for an Alternative Paradigm of Analysis

''A problem well put is half-solved.''(Pidd, 2003: 64). What needs to be clarified now is how a problem can be put well. For many years in the operations research community, quantification was considered the best means of putting a problem well (Rosenhead & Mingers, 2001). But as explained in the previous section, it can fall short of addressing the inherently important wicked problems.

Van Gigch (1991) compares the methods of inquiry, which should be invoked to address wicked problems, with the analytical methods that support structured and tame problems. He asserts that dealing with wicked problems demands: (1) a mode of reasoning and judgment which is informal rather than formalized logio-mathematical reasoning, (2) evidence that is based on intuitive perceived facts rather than facts that are highly confirmed by observations, (3) models that are more intuition-based than algorithmic and mathematical, and (4) methods that are more heuristic-based than solid foundations for predictions.

Rosenhead and Mingers (2001) compare the key characteristics of OR (broadly representative of modes of inquiry appropriate for tame problems) with an alternative paradigm that addresses wicked problems. A synthesis of this information is presented in Table 2.

Table 2. Comparison of the characteristics of operations research methods and the methods in the alternative mode of inquiry that address wicked problems, adapted from (Rosenhead & Mingers, 2001).

	Traditional Paradigm of operations research	**Alternative Paradigm**
Focus	Finding optimum solutions	Seeks acceptable solutions,
Objectives in the analysis	Single objective, multiple objectives with trade-off	Multiple objectives without trade-off
Role of data	Demands hard quantitative data	Uses soft data and judgments
Stakeholders	Passive objects in consensus	Active subjects that have conflicts
Decision implementation	Assumes a single decision maker high at the hierarchical chain of commands	Facilitates decision implementation by bottom-up involvement of decision stakeholders
Uncertainty	Attempts to abolish uncertainty	Accepts uncertainty and keeps options open

In the alternative paradigm of analysis, the underlying idea is that problems are artifacts of the human imagination. To reach a solution, a method should elicit the construct and the cognitive system that decision makers and stakeholders employ to conceptualize the problem situation. This facilitates the decision-making process in the following ways: generating and articulating propositions, allowing multiple interpretations, understanding and illuminating the views of reality held by others, making use of these differences; and finally, engaging the stakeholders in a discussion about the possible course of action that needs to be followed to tackle the problem

(Eden, 1994). Thus, although most of the OR methods try to find the best or the optimum solution, methods based on the alternative mode of inquiry simply focus on helping the decision makers decide what the problem is and find an acceptable and not necessarily the optimum solution (Rosenhead & Mingers, 2001).

In cases where finding an optimum solution is a technical possibility, the question that comes up is "What assurance can be in place that the optimum solution will be put to action and implemented?" In the cases where the decision makers are not in a subordinate-superordinate organizational hierarchy and are considerably autonomous, when the solution does not match the interests of all decision makers, knowing an optimum solution can be of limited use (Rosenhead, 1996). Eden (1994) also suggests that the nature of the problem cannot be and is not separable from the practicalities involved in the implementation of the solution.

Organizational problem solving is predominantly characterized as a social activity wherein a problem cannot be solved without persuading others to support the implementation of the solution. Thus, the involvement of the problem stakeholders changes not only the nature of the solution but also the problem that needs to be addressed, as new knowledge is discovered and explored in the problem-solving process. To ensure the effective implementation of a solution, the problem should be defined jointly by all the organizational participants who can affect and/or are affected by the implementation of the solution (Pidd, 2003). Emphasizing the social nature of organizational decision making and problem solving, Mintzberg (1973, 1989) asserts that successful managers in organizations do not work in isolation from other people. Instead, they are in constant interaction with other people who can influence and/or be influenced by the decisions they make. As a result, social interaction is integral to the success of organizational decision making. Therefore, the methods based upon this alternative paradigm of analysis should explore and accommodate the disagreements and uncertainties that exist between the decision makers involved in a problem solving initiative. This can result in achieving an agreed consensus among the decision makers, and enabling commitment to implement the solution. In other words, such methods should be facilitative in nature and should not hinge on the assumption that the stakeholders share the same view and perception of "reality". Instead, they should aim at eliciting the perceptions and the conflicts between those involved in the choice situation. Next, to discover the areas in which consensus and commitment to action are possible, the consequences of these different perceptions and the relationships between them should be made explicit (Pidd, 2003).

Moreover, wicked problems feature multiple stakeholders. So, as a shared understanding is achieved among the problem stakeholders, the very nature of the problem continuously transforms in the course of exploration and problem solving process. In many cases, it is the different perceptions that the stakeholders have of the problem situation that give rise to conflict and disagreement rather than the difference in the interests and preferences per se. Therefore, the complexity of problem definition sometimes derives from the differences in the stakeholders' interpretation and perception of a problem situation (Ackoff, 1979; Pidd, 2003). Thus, enabling the stakeholders to carry out a dialog and exchange their points of view and concerns and to establish a common base of understanding about the problem situation can immensely contribute to the processes of decision making and problem solving (Rosenhead & Mingers, 2001). To this end, methods based on the alternative paradigm of analysis must encourage and allow the decision makers to participate and interact, accommodate various alternative perspectives and bring them into conjunction with each other, operate iteratively, help decision makers identify improvements, generate ownership of the problem formulation; and develop commitment to action implications (Rosenhead, 1996; Rosenhead & Mingers, 2001).

At the outset, the abovementioned characteristics seemed to be theoretical in nature and to be impracticable. But, methods embodying these characteristics existed even before the emergence of this theoretical orientation. However, these methods were in fact fragmented and underdeveloped, in most cases. Gradually, the development of these methods gained momentum, and their contribution to addressing wicked problems became evident in practice (Rosenhead, 1996). In the OR literature, these methods are broadly categorized as problem structuring methods. PSMs are applied to assist in structuring rather than directly solving the so-called wicked problems (Mingers & Rosenhead, 2004; Rosenhead, 1996; Rosenhead & Mingers, 2001; Pidd, 2003; Woolley & Pidd, 1981; Eden & Ackermann, 2006; Rosenhead 1996; Eden, 1994; Smith, 1988). PSMs are designed to help depict the structure of a problem and illustrate why it is problematic. Thus, it can be concluded that PSMs are about reducing the risk of finding the right solution to the wrong problem. This risk is acknowledged and seriously considered by the practitioners (Woolley & Pidd, 1981). To this end, PSMs aim to assist decision makers in articulating what they should achieve, why they should achieve it and how they might achieve it (Brysonet, et al., 2004).

Based on Woolley and Pidd (1981), problem structuring is an attempt to answer the following fundamental questions in the problem solving process: “What is the real problem?” “How do you know you are working on the right problem?” “How do you decide what to do about the problem?” “How do you set limits to the area of investigation in a problem solving initiative?”

The development and the application of individual PSMs date back to mid 1960s. However, in the past two decades they have been recognized as a disciplined field of inquiry that is important for the prospects of OR in organizational decision making and problem solving (Rosenhead, 1996). While the role of PSMs in problem solving seems to be trivial, it is widely accepted that in the organizational problem solving, clarification of the issues that give rise to the problem in focus is at least half the battle (Bryson, et al., 2004). Research shows that nearly half of the strategic decisions in organizations fail due to: failure to envision, think through and explore the consequences of the courses of action developed by the decision makers to address the problem situation; and failure to meet and address stakeholders’ interests and concerns (Nutt, 1999). Nowadays, PSMs have become widely accepted as a significant new direction for operational research and the systems movement. Table 3 lists some key PSMs, summarizing what they aim to do and the representations they embody.

For more information regarding the practical application of PSMs see (Rosenhead & Mingers, 2001; Mingers & Rosenhead, 2004; Mingers, 2003). In the next section, we provide the process and technical requirements of an effective PSM and that can contribute to the organizational decision processes.

Table 3. A summary of key PSMs, their objective and the representations

PSM	Focus	Representations
Strategic Options development and analysis (Eden et al., 1983; Eden, 1989)	Surfacing and eliciting beliefs to reach consensus on the possible courses of action	Cognitive and construct systems and their interconnections
Soft Systems methodology (SSM) (Checkland, 1999, 2000)	System redesign by comparing different views and reaching consensus on the feasibility and desirability of changes	Conceptualizations, perceptions, and viewpoints
Strategic Choice Approach (Friend & Hickling, 1987)	Managing and structuring decisions under uncertainty, developing commitments for action	Interconnectedness and uncertainties of decisions areas
Robustness analysis (Rosenhead, 1980)	Maintaining flexibility under uncertainty	Compatibility of committed courses of action with future changes
Viable System Model (Beer, 1979, 1984)	Diagnosing, improving and designing viability in organizations	Organizations five inter-related sub-systems and the communication channels
Strategic assumption surfacing and testing (SAST) (Mason & Mitroff, 1981)	Comparing and synthesizing, conflicting viewpoints about strategic decisions	Strategy preferences, options, interests, underlying assumptions

In the OR literature, two distinct application of PSMs are identified: PSMs can directly lead the decision makers to the solution or define the problem such that an OR method can be applied. In the latter case, PSMs operate as an intermediary layer between the problem and the OR method (Mingers & Rosenhead, 2002; Rosenhead, 1996). In the OR literature, combining and integrating methods for conducting an intervention is referred to as "Multimethodology" (Mingers & Brocklesby, 1997). More on the integration of PSMs with OR methods is discussed in (Lane, 1994). Figure 3 illustrates the two distinct applications of PSMs in the decision making and problem solving process.

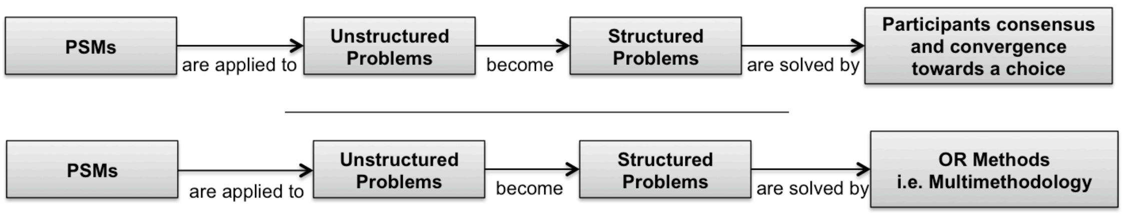


Figure 3. The two distinct applications of PSMs in the problem solving process

1.5. Requirements of an Effective PSM

According to Simon (1992), one of the first steps in problem solving is to answer the question "How can the problem be represented to facilitate the solution?" Simon considers problem representation as the most crucial step, which is least understood in the problem solving process. Problem representation can play a more pivotal role in problem-solving tasks when the problem is of a wicked nature. Central to problem representation, is the practice of modeling. Considering the importance of problem representation and the process requirements for an effective PSM, we formulate the technical requirement that an effective PSM should be model-based (Rosenhead & Mingers, 2001). The discussion in this section brings the following questions to the agenda: "What is a model?" and "How can modeling assist in the structuring of problems that are wicked in nature?"

A model is a representation of a part of "reality" as perceived by the people who want to use it to understand, to change, to manage and to control that part of perceived "reality" (Pidd, 2003). Modeling is defined as constructing systems that account for some aspect of the domain to be investigated (Klir, 1991). Models are simplifications, abstractions of those aspects of the perceived "reality" that are deemed to be important by the modeler. Pidd (2003) refers to models as ''tools for thinking" that are used to add leverage to human thought and analysis. A model therefore serves to make explicit or concrete the aspect of the perceived "reality" that is being investigated in order to understand, describe and explain how it operates. In this sense, modeling is closely linked to the concept of "framing" as introduced by Goffman (1974), defined as "employing an interpretation scheme or framework to make sense of a phenomenon in which are interested".

Modeling instrumentalizes theoretical insights by providing a means to apply theory in a functional context to enlarge our understanding of a theory and improve our ability to make predictions or retrodictions based on the theory (Klir, 1991). Thus, it can help individuals understand a situation better and act effectively on it (Pidd, 2003). Models are used in business and academia in the description, analysis, and communications of concepts. Modeling a system is required if sense is to be made of the system's behavior and the appropriate problem-solving measures are to be implemented (Jackson, 2000).

In the modeling process, the modeler observes some aspect of reality, as perceived by him, known as the "universe of discourse" through a set of conceptualizations. The modeler then distinguishes the entities that compose the universe of discourse and the relationship between them. Next, a model is developed in the representation domain (Tarski & Corcoran, 1983). The model is composed of a set of entities called modeling constructs (Vernadat, 1996, 2002). The conceptualizations employed in representing the entities enable a "mapping" between the modeling constructs in the representation domain and the entities observed in the UoD thereby grounding the modeling constructs in specific interpretations of the "real world." (Moody, 2009). Figure 4 represents this conceptual progression in the process of systems modeling.

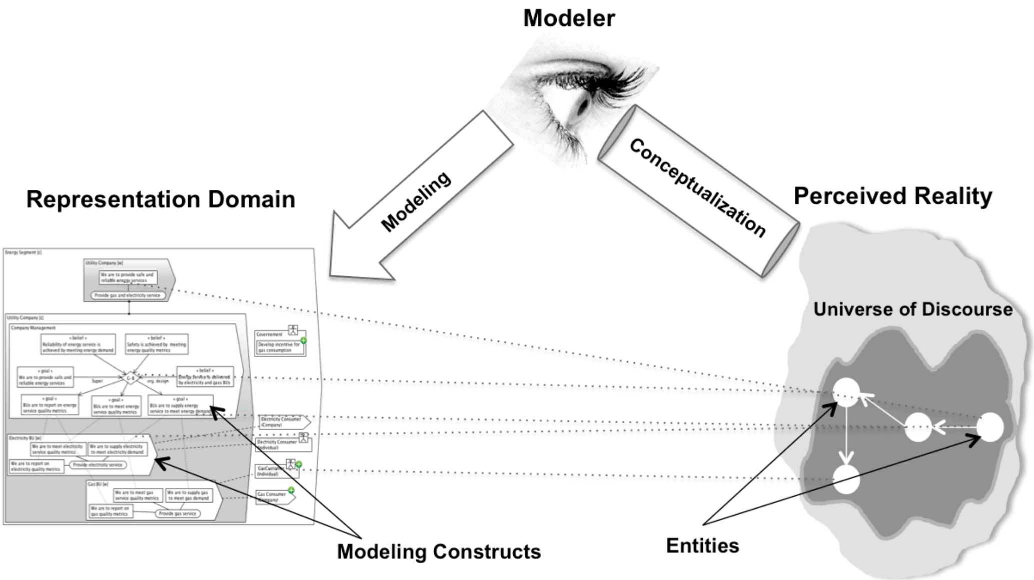


Figure 4. The modeling process

A model provides an abstraction of the problem situation that serves as a reference point in the problem solving process. This allows participation and interaction of the decision makers and thus enables the stakeholders to engage in discussion. Such discussions facilitate the elicitation and articulation of ideas and their interconnections so that the stakeholders reach a common understanding of the problem in which the choice situation resides (Mingers & Rosenhead, 2004). In this sense, the task of the modeler is to take the ill-defined and implicit viewpoints of the stakeholders and refine them such that they can be understood and argued over. A better understanding of an area of concern helps stakeholders reach a consensus on what to do about the problem situation, what it would take to operationalize the initiatives, and what they would like to achieve by having done so. Such informational elements clarify the ambiguities about objectives and reduce uncertainty about outcomes of the decision or the solution (Rosenhead & Mingers, 2001).

A model-based PSM can be a particularly powerful tool for making sense of the wicked nature of a problem and for communicating to others what might or should be done about the problem in focus and to explore the possible consequences of decisions and plans before taking any action. It also facilitates the identification of local or partial improvements through helping decision makers to explore and iterate several alternative perspectives to the choice situation (Pidd, 2003; Bryson, et al., 2004; Eden, 1994).

The models employed to structure problems should be facilitative devices that enable dialog between the participants to a decision making initiative who intend to act upon it. Therefore, a model is a means of representing the problem structure. It is in essence a learning device that enables people to explore alternative ideas, refine their thoughts, build confidence in their views, and finally develop commitment to action (Pidd, 2003). A model-based PSM should therefore serve to communicate or "connect" cognitively with a given group of participants in the decision making process. In order for this to happen, the models representing the problem structure should be easily understood by the decision makers and should be cognitively accessible to decision makers from a range of backgrounds without requiring special training (Mingers & Rosenhead, 2004).

Larkin and Simon (1987) suggest that the ease and accuracy with which a representation can be processed by the human mind determines the cognitive effectiveness of the representation. Graphical representations, in particular graphical models and diagrams, are more cognitively effective than other forms representation such as sentential or verbal representations in conveying both qualitative and quantitative information of a complex nature (Larkin and Simon, 1987;Tufte, 1990). Diagrams facilitate problem-solving by assembling all pieces of information and thereby reducing the time required to make inferences. Additionally, such representations support cognitive operators that can recognize features easily and make inferences directly (Larkin & Simon, 1987).

From a cognitive standpoint, models are external representations employed by individuals to carry out problem solving tasks (Zhang, 1997; Zhang & Norman, 1994) The knowledge emphasized in a model should trigger the elicitation and the retrieval processes of the tacit knowledge, mental models and causal structures residing in the stakeholders' mind and thus resulting in a cognitive fit it problem solving (Shaft & Vessey, 2006; Vessey, 1991). Employing mathematical, logical or other forms of quantitative models in representing the structure of a problem situation may render the analysis incomprehensible for the decision makers and cannot sufficiently help the stakeholders in the interpretation and understanding of the problem in which the choice situation resides

The construction of graphical and diagrammatic models that represent a problem situation is central to problem structuring methods. In the realm of problem structuring where interconnectedness and causality between the events and decisions are emphasized, employing diagrams as superior modes of representations is hardly surprising (Rosenhead & Mingers, 2001). Diagrams, in effect, facilitate the representation, communication and discussion of causal assumptions. When employed in problem structuring, a diagram can be referred to as an evolving thinking tool. It can represent an individual's qualitative understanding of a problem situation through the linkages between the decision elements and clarifies ambiguities by communicating the assumptions held by the individuals back to them, eventually leading to a well-defined and commonly understood problem definition (Lane, 2008).

2. Survey of Managerial Decision Making and Problem Structuring in Organizations

We conducted a survey to provide empirical evidence for the theoretical discussions in the previous sections on the nature of managerial decision making and the role and contribution of problem structuring methods in the decision making processes in organizations.

A questionnaire was designed as the survey instrument, see Figure 5. The questionnaire included 5 propositions that were derived from the discussions in the previous sections. The respondents had to state whether they strongly disagreed, disagreed, were undecided about, agreed or strongly agreed with the five propositions.

SURVEY ON MANAGERIAL DECISION MAKING IN ORGANIZATIONS

Name and Surname		Respondent's Signature
Organization		
Type of Business		
Organizational Position		
Years of Experience		

1	Strongly disagree	2	Disagree	3	Undecided	4	Agree	5	Strongly Agree

		1	2	3	4	5
1	The strategic choice situations managers face in organizations are unstructured and ill-defined in nature.					
2	The quantitative techniques broadly represented by operations research (OR) methods do not sufficiently aid managers in making such strategic decisions.					
3	The managers' judgment driven by prior experience and intuition play an important role in decision-making processes that are strategic in nature.					
4	A problem structuring method can create a common language among the decision makers and improve the quality of their discussions by facilitating the processes for assumption surfacing.					
5	Such dialogs, discussions and communication among decision makers in a choice situation can help surface and bring into conjunction their judgments and hidden assumptions.					

Figure 5. The survey questionnaire

Proposition 1, *"The strategic choice situations managers face in organizations are unstructured and ill-defined in nature."*, was about the nature of strategic decisions, see Section 1.2.

Proposition 2, *"The quantitative techniques broadly represented by operations research (OR) methods do not sufficiently aid managers in making such strategic decisions"* addressed the contribution of OR methods to strategic decision making, see Section 1.3.

In Proposition 3, *"The managers' judgment driven by prior experience and intuition play an important role in decision-making processes that are strategic in nature."* , the key ingredients of strategic decisions were mentioned, see Section1.1.

Finally, Proposition 4, *"A problem structuring method can create a common language among the decision makers and improve the quality of their discussions by facilitating the processes for assumption surfacing."* and, Proposition 5, *"Such dialogs, discussions and communication among decision makers in a choice situation can help surface and bring into conjunction their judgments and hidden assumptions."* captured the role and contribution of PSMs in managerial decisions that are strategic in nature, see Section 1.4.

For Propositions 4 and 5 the underlying assumption was that the PSM meets the effectiveness requirements, is thereby model-based and embodies representations that are cognitively effective as discussed in Section 1.5.

Three workshops were held in Iran in between end of December 2012 and the beginning of January 2013. Each workshop lasted for a minimum of two hours and a total of 30 participants attended the workshops. The goal of the workshops was to familiarize the participants with the context of the research (i.e., problem structuring and managerial decision making in organizational settings).

The participants in the workshops were from a range of industries including automotive, pharmaceutical, gold production, power generation and investment. They all held executive and senior management positions in their companies and had a minimum of 8 years of experience. Based on the discussions in the workshops, we realized that the participants were also familiar with at least one quantitative method and its application in decision making. At the end of the workshops, despite the good command of English of the participants, to ensure a common understanding of the questionnaire, each proposition was explained and the key terminologies and concepts were defined. The participants then filled out the questionnaire.

Table 4. Results of the survey - frequency of responses for each proposition in percentage

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Proposition 1	0.0%	10.0%	0.0%	50.0%	40.0%
Proposition 2	0.0%	13.3%	3.3%	66.7%	16.7%
Proposition 3	0.0%	3.3%	0.0%	46.7%	50.0%
Proposition 4	0.0%	0.0%	3.3%	40.0%	56.7%
Proposition 5	0.0%	3.3%	0.0%	46.7%	50.0%

Results in Table 4 show that around 90% of respondents either agree or strongly agree with the propositions. There is no proposition that is strongly rejected. In Figure 6, we represent the results of the survey for each proposition in bar and pie charts.

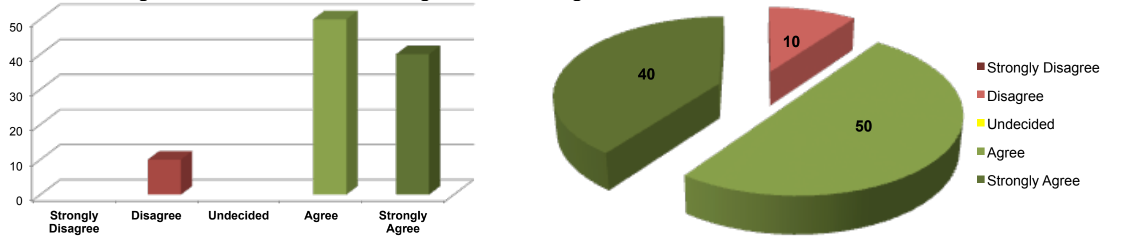
As shown in the questionnaire (see Figure 5), to be able to carry out the statistical analyses, we mapped a five-point scale onto the responses given (i.e., strongly disagree 1, disagree 2, … strongly agree 5).

Table 5. Summary of the statistics of the survey

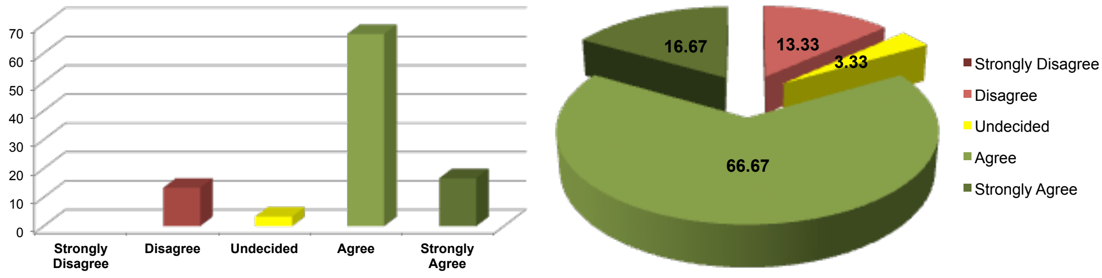
	Mean	Median	STD	Skewness
Proposition 1	4.20	4.00	0.887	-1.374
Proposition 2	3.87	4.00	0.860	-1.122
Proposition 3	4.43	4.50	0.679	-1.513
Proposition 4	4.53	5.00	0.571	-0.732
Proposition 5	4.43	4.5	.679	-1.513

Table 5 illustrates a summary of the statistics of the survey. As shown, the average (mean) of all propositions are about 4 (i.e., on average all the propositions are either agreed with or strongly agreed with by the participants) and their corresponding standard deviations (STD) are relatively small with negative skewness values.

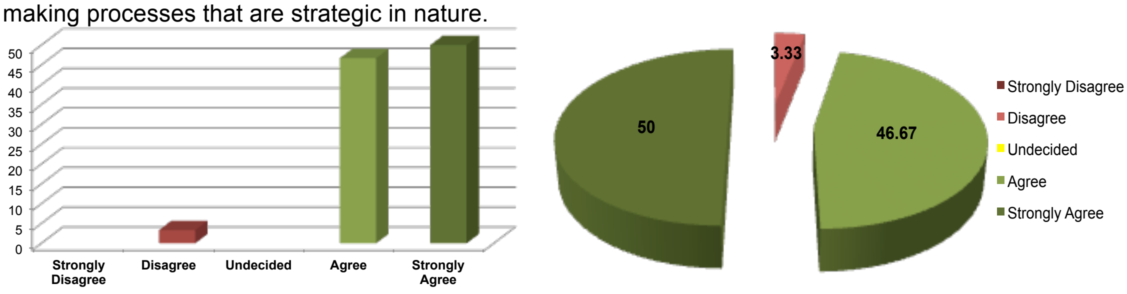
1. The strategic choice situations managers face in organizations are unstructured and ill-defined in nature.



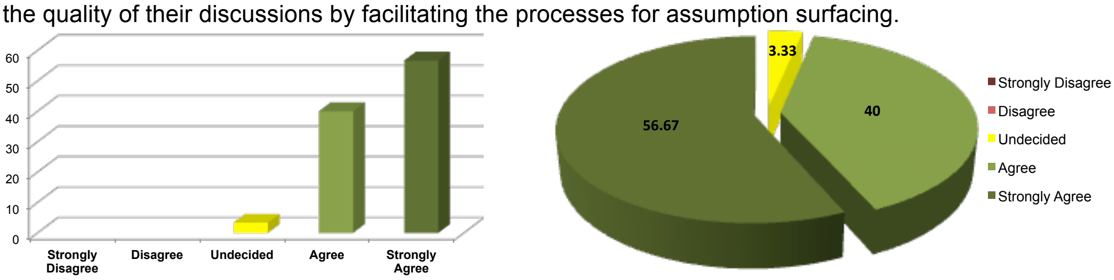
2. The quantitative techniques broadly represented by operations research (OR) methods do not sufficiently aid managers in making such strategic decisions.



3. The managers' judgment driven by prior experience and intuition play an important role in decision making processes that are strategic in nature.



4. A problem structuring method can create a common language among the decision makers and improve the quality of their discussions by facilitating the processes for assumption surfacing.



5. Such dialogs, discussions and communication among decision makers in a choice situation can help surface and bring into conjunction their judgments and hidden assumptions.

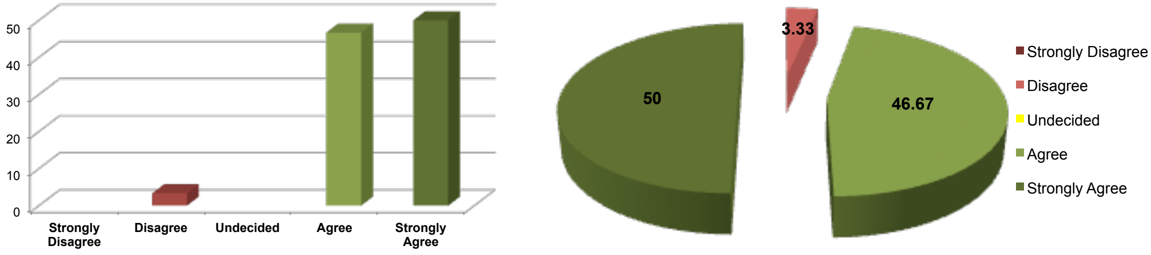


Figure 6. Graphical representation of frequency of responses for each proposition in percentage

In addition, the average of responses to the propositions in the questionnaire is 4.30 (i.e., between agree and strongly agree) with the relatively small standard deviation of 0.73. Finally, to determine the reliability of the survey instrument the Cronbach's alpha of the questionnaire was calculated and was reported 0.608, which falls in the acceptable range (Cronbach, 1951). Increase in the number of respondents could improve the Cronbach's alpha. Thus, we can draw the conclusion that the respondents either agree or strongly agree with the propositions in the questionnaire.

3. Problem Structuring with the Systemic Enterprise Architecture Method

The results of the survey, in general, shed light on the importance of problem structuring methods. Now that the importance of the research context is established, in this section, we present the background of our research. We also elaborate on and outline the research we conducted in the course of this doctoral work positioning it relative to the work previously done by our research group.

3.1 Research Background

Our research is centered on the Systemic Enterprise Architecture Method (SEAM) (Wegmann, 2003). SEAM is composed of three representations: the System Diagram, the Goal-Belief Model and the Supplier Adopter Relationship Diagram.

The System Diagram (Rychkova et al., 2007; Wegmann et al., 2007d) represents the hierarchy of the systems that compose an organization (the departments, management system, etc.) and in which the organization is embedded (value networks, market segments, etc.). It can be used to delimit the problem on focus and identify the decision stakeholders or the organizational participants to a choice situation.

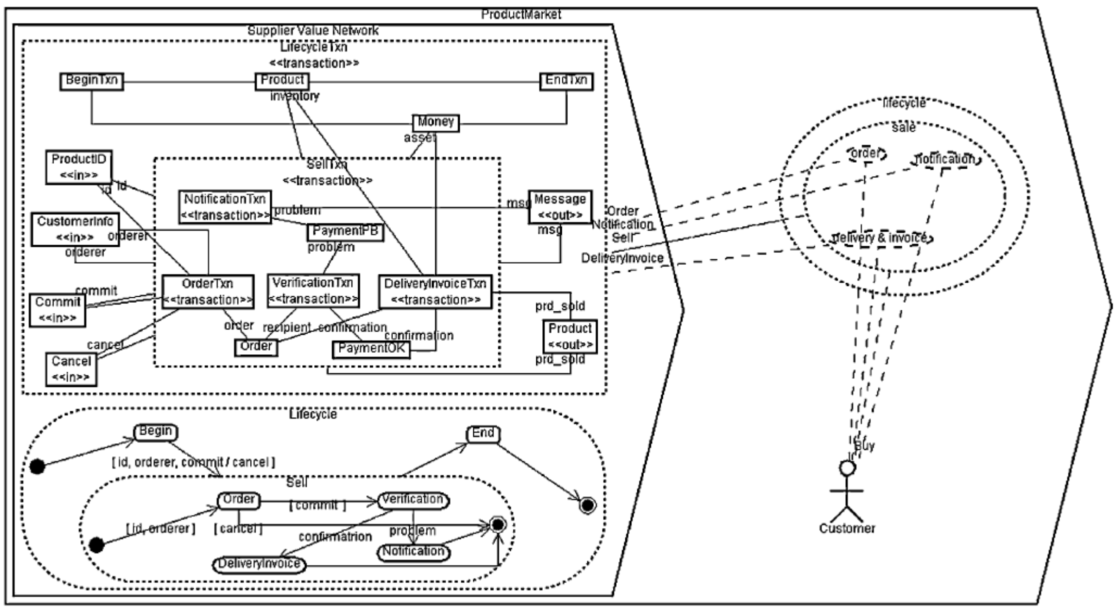


Figure 7. The System Diagram adapted from (Wegmann et al., 2007d)

The Goal-belief Model (Regev, 2003; Regev & Wegmann, 2004), see Figure 8, represents and makes explicit the goals and the beliefs held by the organizational participants with respect to a choice situation.

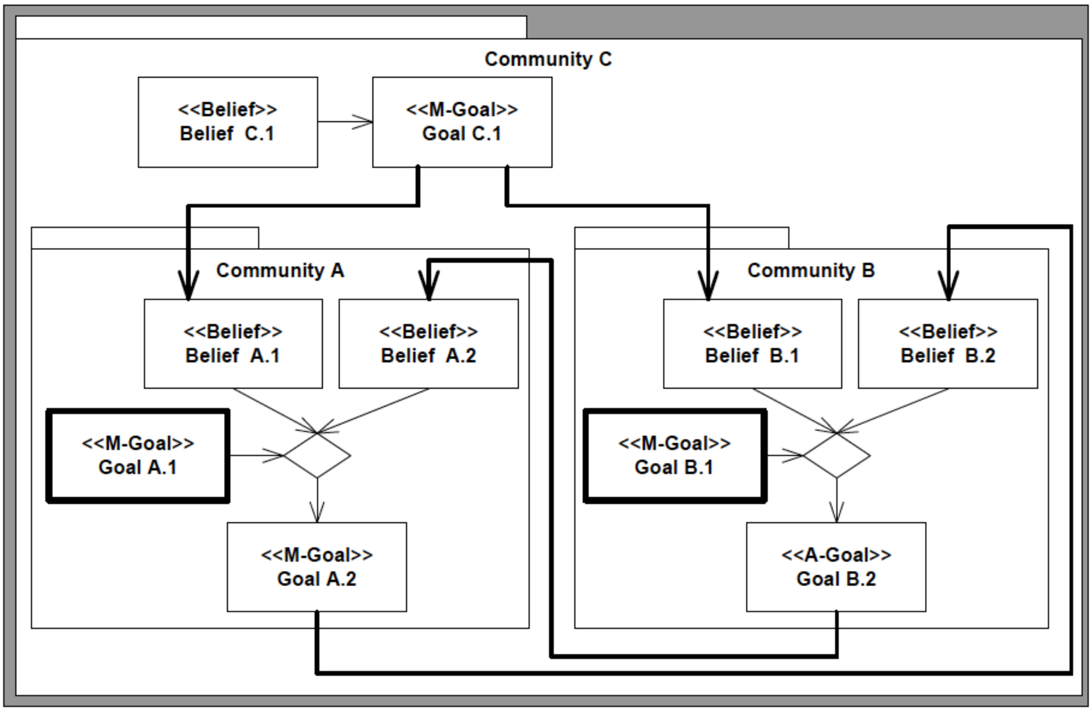


Figure 8. The Goal-belief Model adapted from (Regev, 2003)

The Supplier Adopter Relationship Diagram (Wegmann et al., 2007a), see Figure 9, represents the technical details of the service offered in terms of the service features the value they create for the customer.

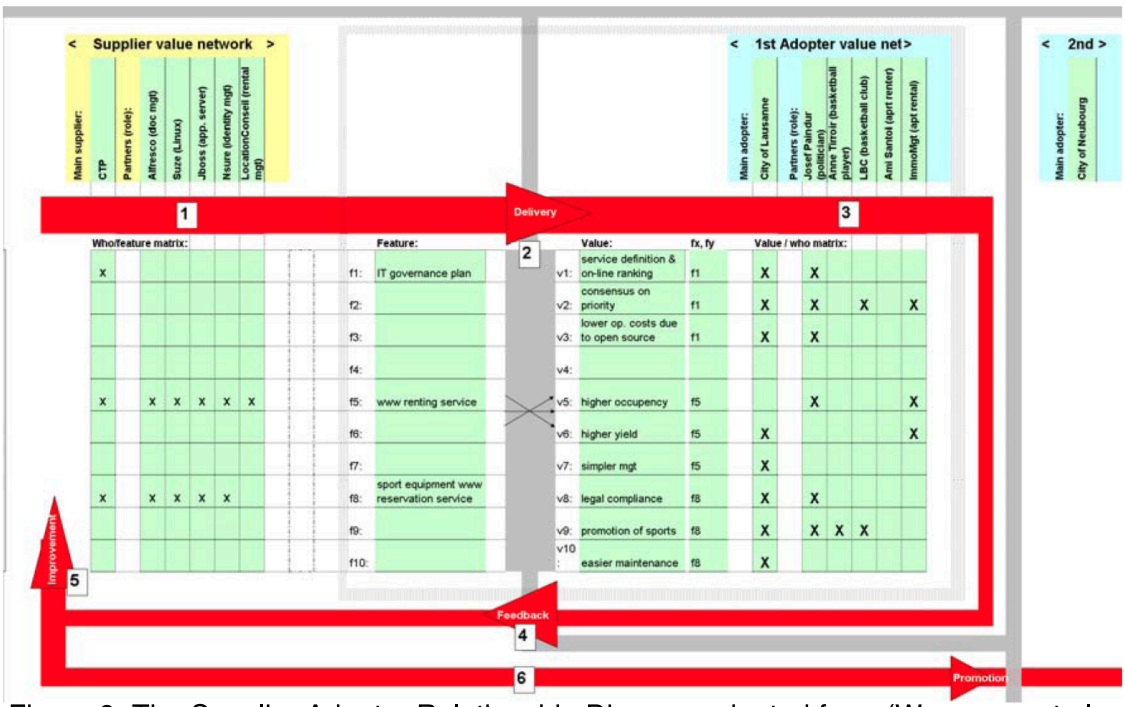


Figure 9. The Supplier Adopter Relationship Diagram adapted from (Wegmann et al., 2007a)

SEAM was designed and applied for business-IT alignment, see for e.g. (Wegmann et al., 2005a; Wegmann et al., 2007a), enterprise architecture, see for e.g. (Wegmann et al., 2007b), and requirements engineering see for e.g. (Regev & Wegmann, 2007). Apart from its industry application, SEAM had also been used for teaching enterprise architecture and requirements engineering (Wegmann et al., 2007c; Regev et al., 2008).

The foundations of SEAM are in General Systems Thinking (GST) (Weinberg 2001) and in RM-ODP (ISO Standard 1995). GST is the study of principles that are applicable to any kind of system (e.g. business system or IT system). RM-ODP is a software engineering ISO standard that provides solid definitions for the SEAM concepts (e.g. process, state, property). SEAM is rigorously defined based on these systemic and software engineering concepts and federates multiple modeling techniques (such as discrete behavior and goals). Thus, SEAM provides a consistent set of modeling principles and constructs to model an enterprise at different abstraction levels.

In SEAM, systems can be represented as black boxes modeling the emergent properties of the system or white boxes showing the constituent elements of the system. Black-box and white-box representations help the modeler in drawing the boundaries around the system in focus and thus simplify the conceptualization of the structural complexities inherent in the business environments. In the next section we

3.2 Research Positioning Relative to Prior Work

In the next sections we elaborate on and outline the categories of research conducted in the course of this doctoral work. We also position the research presented in this thesis relative to the prior work conducted by our research group.

3.2.1 Representation of Value and Systems in Business Contexts

Our research on problem structuring with SEAM resulted in the creation of four SEAM-based PSMs, based on the context of application (i.e., service science or strategic management) and the nature of the representations (i.e., value or systems). The Value Map and the Customer Value Model represent value, and the Viable Service System Model and the Value Network Model represent systems in the service system and the strategic management contexts respectively.

Table 5 presents the outline of my research on value representation in business contexts. As illustrated in the table, the Supplier Adopter Relationship diagram which was inspired by the house of quality (Clausing & Hauser, 1988), was mainly applied for business and IT alignment, enterprise architecture and requirements engineering. In most cases, its applicability and usefulness was demonstrated by means of application examples of the consulting projects conducted.

The objective of the research presented in this thesis was to modify and/or augment the Supplier Adopter Relationship diagram so that it provides analytical assistance for structuring problems in the service science and strategic management contexts.

Table 5 – Research on the representation of value in business contexts

	Supplier Adopter Relationship Diagram	Value Map	Customer Value Model
Theoretical grounding	House of Quality	Literature on value creation and capture	Competence-based strategic management (CBSM) theory
Modeling Constructs	- Supplier value network - Feature - Value - Adopter value network	- Supplier value network - Service component - Net perceived customer value (NPCV) - Cost/benefits positioning - Net captured value (NCV)	- Value network - Resource - Capability - Feature - Net delivered customer value (NDCV)
Domain of Application	- Enterprise Architecture - Business – IT Alignment - Requirements Engineering	- Value Creation and Capture in Service Systems	- Analyzing the strategic incentives for coopetition
Method of Validation	Example of IT governance in a consulting company	- Instrumental Case study of Amazon Marketplace - Empirical Study	- Instrumental Case study of PowerPC CPU - Instrumental Case Study of Webdoc

In the service science context, our research resulted in a design artifact called the Value Map. The Value Map helps in answering the following research questions regarding the service-oriented business models: "How is value created for and with the customers in service-oriented business models?" and, "How is the value captured by the service provider in the service-oriented business models?" These questions are fundamental to understanding how service systems maintain their viability and competitiveness. In order to provide a rigorous analysis of value creation and capture, theoretical perspectives from microeconomics such as (Brandenburger & Stuart, 1996) and the literature on value creation and capture (Bowman & Ambrosini, 2000) were invoked and incorporated in the Value Map. Such theoretical insights resulted in the addition of new modeling constructs such as service components, net perceived customer value (NPCV), etc. The applicability of the Value Map was illustrated by modelling value creation and capture in Amazon Marketplace, one of the Amazon.com's business models in the period between 1997-2001. To evaluate the usefulness of the Value Map we conducted an empirical study in which we also compared the Value Map with Business Model Canvas (Osterwalder & Pigneur, 2010), one of the most established methods in business model design.

Representation of value in the strategic management context aims at providing analytical aid to explore the drivers and strategic incentives of coopetition by addressing the question "Why companies engage in a coopetitive relationship?" To be able to address this question, we incorporated important conceptualizations from competence-based strategic management (CBSM) theory (Sanchez & Heene, 1997, 2003). CBSM theory brought in a number of modeling constructs such as resource, capability, etc. in the Supplier Adopter Relationship Diagram. We refer to the resulting PSM as the Customer Value Model. The applicability of the representations generated from the Customer Value Model was illustrated by modeling the coopetition between IBM and Apple in the development of PowerPC CPU (Duntemann & Pronk, 1994). The data for the PowerPC case was mainly gathered through secondary sources. To better assess the usefulness of the Value Map, it was applied to model the design of value in a social networking platform called Webdoc.

Table 6 summarizes the research conducted on the representation of systems in business contexts using the System Diagram. As earlier stated, the System Diagram was theoretically grounded in General Systems Thinking (GST) and RM-ODP and had been applied to represent systems in business-IT alignment, enterprise architecture and requirements engineering fields. By grounding the System Diagram in organizational cybernetics theory in particular the viable system model (VSM) (Beer, 1979, 1984), we conceptualize the constituent elements of a service system such as the service system management, operational system, etc. These modeling constructs contribute to the diagnosis of viability in service systems and provide analytical assistance to address the question, "How can a service system remain viable?" We refer to the PSM resulting from our research as the Viable Service System Model. We illustrate the applicability of the Viable Service System Model by means of an instrumental case study (Stake, 1995) of a utility company service. This case study data was gathered during a consulting project we undertook for this utility company. The usefulness of the Viable Service System Model was assessed by means of user feedbacks from the consulting sessions in which we used the Viable Service System Model.

Table 6 – Research on the representation of systems in business contexts

	System Diagram	Viable Service System Model	Value Network Model
Theoretical grounding	- General Systems Thinking (GST) - RM-ODP	- Viable system model (VSM)	- Competence-based strategic management (CBSM) theory - Literature-driven typology of coopetition
Modeling Constructs	- Value network - Company - Customer - Regulator	- Service system - Service system management - Operational system - Identity property	- Competence building - Competence leveraging - Competition - Affiliation
Domain of Application	- Business – IT Alignment - Enterprise Architecture - Requirements Engineering	- Diagnosing and designing viability in service systems	- Analyzing the design of the coopetitive value network
Method of Validation	- Example of IT governance in Cambridge Technology Partners	- Instrumental Case study of Services Industriels de Genève (SIG) - Feedbacks from modeling sessions	- Four case studies of coopetitive value networks

In the coopetition context, we once more drew upon conceptualizations from the competence-based strategic management (CBSM) theory to visualize various alternatives of value network designs that can accommodate the complexities of a coopetitive relationship. To this end, we developed a literature-driven typology of coopetition within and between value networks. Here, we refer to the augmented System Diagram as the Value Network Model. The Value Network Model is then applied to represent empirical examples of four coopetitive value networks based on the categories identified in the typology. The data for the examples was mainly derived from an in-depth longitudinal case study of Amazon.com's coopetition-based business models.

3.2.2 Integration of the Systemic Enterprise Architecture Method with Operations Research Methods

As stated in Section 1.4, applying PSMs results in a well-defined problem. In some cases this well-defined problem can be solved by consensus among decision makers; this way, PSMs directly lead the decision makers to the solution. In other cases, an OR method is applied to formulate and solve the problem; here, PSMs operate as an intermediary layer between the problem and the OR method, this is referred to as multimethodology (Mingers & Brocklesby, 1997). The second category of research carried out in the course of this Ph.D. focuses on exploring the application of SEAM combined with traditional OR methods forming multimethodologies. Integrating the SEAM models with OR methods also adds a quantitative dimension to the qualitative representations of SEAM.

The first OR method in our study is System Dynamics (SD) (Forrester & Wright, 1961). SD dates back to the early 1960s and is one of the established modeling simulation methods in OR. Over the course of time, a number of PSMs were employed in the SD community to facilitate problem situation conceptualization. Despite the growing literature on the application of PSMs, very limited research has been undertaken to assess and compare the relative effectiveness of alternative PSMs. To this end, we apply theoretical insights from cognitive science, in particular cognitive fit theory (Shaft & Vessey, 2006; Vessey, 1991), and visual notation analysis (Moody, 2009) to suggest theoretical concepts and constructs capturing the characteristics of a PSM that are likely to be cognitively effective in conceptualizing problem situations in building System Dynamics models. Then, we conducted an exploratory laboratory study to measure these constructs for four of the PSMs that are widely used by the SD community: (i) Causal Loop Diagrams (CLDs) (Senge, 1994; Sterman, 2000), (ii) Influence Diagrams (ID) (Coyle, 1998, 2000), (iii) Cognitive Maps (Eden, 1989, 1994), and (iv) (Magnetic) Hexagons (Hodgson, 1992; Lane, 1993; Wong et al., 2011). We also included the Goal-Belief Model in this comparative study, but the initial results showed that the nature of the representations in the Goal-belief model are not as cognitively effective as the four other PSMs widely applied in problem solving with SD. As an alternative, we attempted to integrate SD with the System Diagram. We can conclude that the System Diagram provides suitable representations that can be used as a basis for developing the Stock and Flow diagrams of SD.

Building on our research on forming multimethodologies by integrating SEAM and the OR methods, we investigated the integration of Analytic Hierarchy Process (AHP) (Saaty, 1980) with the System Diagram and Goal-belief Model in SEAM. AHP is a multi-criteria decision method that aids in the ranking of alternatives based on given criteria. The main topic we addressed here was, "Where do the criteria and the alternatives come from?" Drawing on the theoretical insights from organizational decision making process, we integrated the System Diagram and Goal-belief Model in SEAM with AHP to untangle the complexities of a choice situation in an organizational setting. This research was applied to a choice situation in a bank in Switzerland.

4. Conclusions

In this chapter we reviewed the literature on organizational decision making and explained its divergence from the theories of rational choice. We then described the nature of the problems managers face in organizations by invoking theoretical insights from systems thinking, highlighting the need for a new paradigm of analysis to accommodate the complexities residing in such problem situations. This led us to the origins of problem structuring methods (PSMs) as an alternative paradigm of analysis, their characteristics and the type of the problem situations for which they are deemed suitable. Next, a synthesis of renowned PSMs was provided and the role of PSMs in the problem solving and decision making process in an organizational setting was explored. Finally, as representing the structure of the problem situation is integral to the practice of problem structuring, a brief account of modeling was given and the nature of the models that are appropriate in the realm of problem structuring was explained.

To provide some empirical evidence on the theoretical discussions, we derived five propositions from the literature review. Proposition 1 was about the nature of strategic decisions. Proposition 2, addressed the contribution of OR methods to strategic decision making, in Proposition 3, the key ingredients of strategic decisions were mentioned, and Proposition 4 and 5 captured the role and contribution of PSMs in managerial decisions that are strategic in nature. To test the validity of the five propositions, we designed a questionnaire as the survey instrument and conducted a survey among 30 executives and senior managers in Iran. The respondents expressed whether they strongly disagreed, disagreed, were undecided about, agreed or strongly agreed with the five propositions. The results suggest that the managers who participated in the survey believe that the strategic choice decisions are mostly unstructured and ill-defined and the quantitative methods do not provide them with adequate support in making such decisions. Based on their responses to the questionnaire, the key ingredient in making such decisions is the managers' judgment and intuition that rely on his prior experience. The results of the survey reflected the managers' belief that PSMs can create a common language among the decision makers in organizations and improve the quality of their discussions. It should be noted that we made the underlying assumptions that the PSMs meet the effectiveness requirements outlined in Section 1.5. The participants also agreed that the improvement in communication between the decision makers can then help surface and bring into the conjunctions the hidden assumptions and judgments of the decision makers in a choice situation. As stated in section 1.4, research shows that quality of the communication among decision makers can greatly contribute to the effectiveness of the decision making process (Rosenhead, 1996; Rosenhead & Mingers, 2001; Ackoff, 1979; Pidd, 2003; Mintzberg 1973, 1989). Results of the survey shed light on the importance of PSMs in the managerial decision processes. Thus, we can state that research in development and the application of PSMs can have practical relevance for the organizational decision processes.

The literature review and the empirical study presented in this chapter suffer from a number of limitations. Firstly the articles based on which the literature review was done are not exhaustive. Despite the fact that we synthesized over 60 well-cited articles on organizational decision making and problem structuring that were to the best of our knowledge seminal to the field, some relevant work may still have not been included in the review of the literature. Inclusion of such articles can fine-tune or have a moderating effect on the theoretical propositions in the chapter. The second limitation of this research concerns the empirical study. The fact that all the participants in the survey were from Iran and the relatively small sample size limit the generalizability of the findings of our research. To tackle this limitation, the same study should be conducted among executives and managers from different countries. Since the respondents' knowledge of the research context positively contributes to their understanding of the concepts in the propositions and thereby enhances the quality of the responses we decided to hold workshops in which we familiarize the participants with the research context. Thus the major reason behind the small sample size is the way the data was gathered. Sending out the questionnaire along with the definitions of the concepts in the propositions could have increased the sample size at the price of compromising the respondents' understanding of the propositions and consequently the quality and accuracy of their responses. As a side note we also tried to gather data from participants that belonged to different industries. Therefore, the sample size although relatively small, featured representatives from various industries. In our future work, we will focus on improving the literature review and the theoretical propositions by including other relevant work on organizational decision making and problem structuring. We will also gather more empirical evidence by holding workshops among managers and executives from different countries while maintaining the industry diversity of the participants.

The importance of PSMs in the decision processes motivated us to work towards the development of problem structuring methods that provide analytical assistance in business contexts. To this end, instead of developing a PSM from scratch we decided to modify and augment the systemic enterprise architecture (SEAM) an existing methodology for business-IT alignment, enterprise architecture and requirements engineering developed in 2001 by the Laboratory for Systemic Modeling (LAMS) at École Polytechnique Fédérale de Lausanne (EPFL). The cognitively effective notations of SEAM and the systemic principles embedded in SEAM were the main reasons behind basing the problem structuring method upon SEAM. SEAM comprises of three modeling representations: the System Diagram (representing the hierarchy of systems), the Supplier Adopter Relationship Diagram (representing the product/service features and the value for the customer) and the Goal-belief Model (representing the assumptions and the objectives of the actors within a system). In our research we focused on representation of value and systems and thus augmented and modified the Supplier Adopter Relationship Diagram and the System Diagram to structure problems in two business contexts, namely service science and strategic management. Our work resulted in the creation of four problem structuring methods: The Value Map and the Customer Value Model represent value, and the Viable Service System Model and the Value Network Model represent systems in the service system and the strategic management contexts respectively. In the subsequent chapters of this doctoral thesis we present the theoretical underpinnings, the details of the development and the methods of validations of the four PSMs. In a parallel stream of research we will investigate the integration of SEAM with two operations research methods, namely System Dynamics (SD) and Analytic Hierarchy Process (AHP) forming multimethodologies.

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PART 2

REPRESENTATION OF VALUE AND SYSTEMS IN BUSINESS CONTEXTS

Chapter 2: Value Map: Modeling Value Creation and Capture in Service-Oriented Business Models

Abstract: *Many firms redesign their business models to be service-oriented in light of the increasingly central role that services play in their businesses and strategies. Two fundamental questions should be addressed in designing service-oriented business models: "How is value created for and with the customers by the service provider?" and, "How is value captured by the service provider?" The first question deals with "value creation" and the second addresses "value capture", both of which are important facets of any business model. We suggest that a service-oriented business model that addresses these two questions can sustain the viability and competitiveness of the firm as a service provider. The extant research mainly focuses on the business model and service design from the value creation perspective. Thereby, service providers' value capture and its trade off with value created for and with service customers have not been adequately addressed. In this chapter, we introduce a modelling framework called the "Value Map" as a problem structuring method (PSM) that assists in understanding, analysis and design of value (i.e. value creation and capture and their interplay) in service-oriented business models. The Value Map is an extension to and an augmentation of the supplier adopter relationship (SAR) diagram in the Systemic Enterprise Architecture Method (SEAM). We followed the design science approach in the development of the Value Map as a design artifact. In this approach, the rigor in the design artifact comes from a knowledge base that includes the theoretical concepts and constructs, models, methods and instantiations required for building as well as evaluating and validating a design artifact. To develop the Value Map, we conducted a literature review and drew upon theoretical insights from marketing and microeconomics to derive the underlying conceptualizations. We also invoked notational elements and modelling constructs from a number of methods such as the House of Quality and the Strategy Canvas. We illustrated the applicability of the Value Map by modelling value creation and capture in Amazon Marketplace, one of the Amazon.com's business models in the period between 1997-2001. To evaluate the usefulness of the Value Map we conducted*

an empirical study. In this study, we also compared the Value Map with Business Model Canvas, one of the most established methods in business model design. The results of the study show that the Value Map helps business practitioners to understand and analyze customer value, customer value creation, and the value capture processes. This is achieved by creating a common language that enables the representation and the discussion of the as-is and the to-be situation of value creation and capture in an organization's business model. The results in general suggest that Value Map is a useful visualization tool that contributes to managerial decision making processes of business practitioners in the choice situations that entail value creation and capture in an organization's business model. We learned that the Value Map complements and augments the Business Model Canvas by aiding the business practitioners in representing the necessary building blocks of business model of an organization and their inter-relations and interconnectedness. We also drew the conclusion that the Strategy Canvas can be used as an input to the Value Map in designing the value creation and capture processes in a business model. Finally, the Value Map has been instantiated in an online platform for business model design called www.tradeyourmind.com, We present this instantiation as an appendix to this chapter.

1. Introduction

This study focuses on value creation and capture in service-oriented business models. A business model is defined as a generic platform between strategy and practice, describing the design or architecture of the value creation, delivery, and capture mechanisms a firm employs (Teece, 2009; Osterwalder & Pigneur, 2010). Due to the increasing and even focal role of services in their businesses and strategy (Freel, 2006; Tether & Hipp, 2002), many firms have been forced to completely re-think their business models (Teece, 2009). The recent tendency of business model redesign has led to the emergence of “service-oriented business models”. This development can be explained from the perspective of “service-dominant (S-D) logic” (Vargo & Lusch, 2004, 2009; Vargo et al., 2008) that attempts to view and extend the concept of service beyond a “particular” kind of intangible good as traditionally viewed in the “goods-dominant (G-D) logic”. S-D perspective conceptualizes a firm’s offerings not as an output, but as an input for the customer's value-creation process. Thereby, instead of viewing value as being created within companies, value is increasingly viewed as being co-created between companies, customers, and other actors within a service system. The co-creation of value in service systems has begun receiving increasing attention across several disciplines, see for e.g. (Grönroos & Ravald, 2011; Gordijn & Akkermans, 2003; Vargo et al., 2008; Weigand et al., 2009; Johannesson et al., 2009).

Central to the service-oriented business models are the concepts of *value creation* and *value capture*. In order to understand how a service-oriented business model remains viable and competitive, two fundamental questions should be addressed: “How is value created for and with the customers by the service provider?” and, “How is the value captured by the service provider?” (for discussion, see e.g. Grönroos & Ravald, 2011; Pitelis, 2009; Ritala et al., 2011). In the search for addressing such questions, the extant research has developed modeling frameworks such as (Gordijn & Akkermans, 2003; Weigand et al., 2009; Pijpers & Gordijn, 2007; Yu, 1997; Weigand, 2009; Osterwalder & Pigneur, 2010). These frameworks provide conceptual tools to support the design of service offerings in service-oriented business models. However, such tools and frameworks mainly address the service design from the service customers’ perspective and do not sufficiently address suppliers’ value capture in the service value equation. In general, the same gap can be broadly identified in the service literature, where value creation and co-creation issues have often been emphasized over value capture. In addition, the interplay between value creation for and with customers and value capture by the suppliers has not been explicitly investigated in the design and analysis of service offering in service-oriented business models. Therefore, studies taking these issues into account are called for.

To tackle the above mentioned research gap, in this study, we introduce the Value Map a framework for modeling value in service-oriented business models that takes into account both value creation (for and with customers) and value capture (by service providers). The Value Map can be broadly referred to as a problem structuring method (PSM) (Mingers & Rosenhead, 2004; Rosenhead, 1996; Rosenhead & Mingers, 2001) that aims to provide conceptual and practical assistance in analyzing, reconfiguring and designing value in service systems.

This chapter is organized in the following way. In Section 2, we discuss the design science research methodology that was employed to develop and illustrate and to evaluate the applicability of the Value Map. In Section 3, we elaborate on the literature review we conducted to discover the important concepts relevant to value creation and capture and to explore the relationship among and these concepts in order to gain a new perspective into the structure and the dynamics of value creation and capture. To gain a better understanding, the concepts and their relationships were formalized in 10 algebraic functions and were graphically represented in form of a conceptual model. In Section 4, we apply the Value Map to represent the design of value in Amazon Marketplace, one of Amazon.com's business model. Section 5 includes the details and the results of the empirical study we conducted to evaluate the applicability of the Value Map and to compare it with Business Model Canvas. In Section 6, we present the conclusion and the future work. Finally, in an appendix to this chapter we present an instantiation of the Value Map in www.tradeyourmind.com an online platform for business model design.

2. Research Methodology

The Value Map was developed following the design science framework proposed by Hevner et al. (2004). Design science addresses research through the building and evaluation of artifacts designed to meet an identified business need or a certain problem.

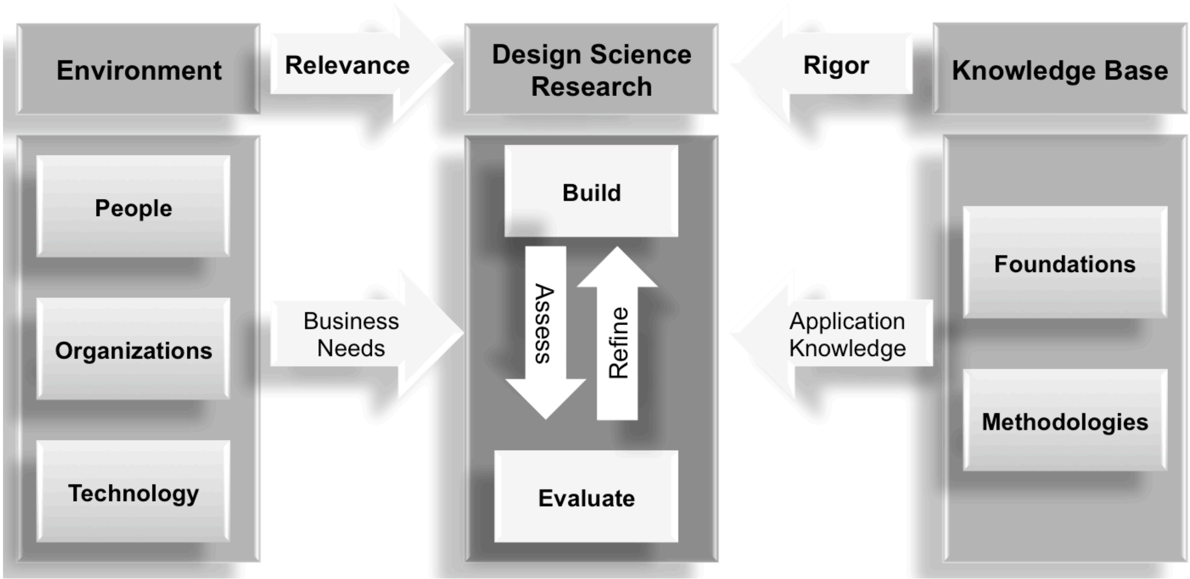


Figure 1. A framework for research in design science adapted from (Hevner et al., 2004)

As illustrated in Figure 1, relevance and rigor are central to research in design science. The environment defines the problem space in which resides the phenomenon of interest. In our case, the research gap identified in the previous section reflects the problem that needs to be addressed. As sustaining a business model depends on the value equation between the service provider and the customers, designing a method that can provide analytical assistance in understanding the dynamics involved in value creation and capture is of practical relevance. Therefore, the design artifact in this research reflects a business need that is shaped by the challenges many business models face when it comes to creating and capturing value.

In addition to practical relevance, design science research draws on the knowledge base of prior research results and theories from various disciplines. The knowledge base equips the research with theoretical rigor by providing the constructs, models, methods and instantiations required for building a design artifact. It also provides the means for evaluating the developed artifact based on a wide diversity of research validation methods such as qualitative interviews and case studies (ibid). In our study, the knowledge base is composed of the perspectives from the state of the art on value creation and capture from economics and (service) marketing literature (see for e.g., Bowman & Ambrosini, 2000; Brandenburger & Stuart 1996; Grönroos & Ravald, 2011; Kotler, 2000). Drawing on these insights, we develop a set of theoretically grounded conceptualizations that can represent the underlying logic and the constituent entities of the value equation in service-oriented business models.

The Value Map is an extension to the SAR (Supplier Adopter Relationship) Diagram in (Golnam et. al, 2010; 2011; Wegmann et al., 2007). The SAR is a part of the Systemic Enterprise Architecture Methodology (SEAM) (Wegmann, 2003). SEAM was designed from the ground up with general systems principles (Wegmann 2003). SEAM serves to analyze and to assist in the design of business and engineering strategies. Developed at Ecole Polytechnique Fédérale de Lausanne (EPFL), SEAM has been used for teaching (Wegmann et al., 2007) and consulting (Wegmann et al., 2005) since 2001.

In developing the Value Map, we are also inspired by the House of Quality (Clausing & Hauser, 1988), a quality improvement method, derived from Quality Function Deployment (QFD). We integrate the Strategy Canvas (Kim & Mauborgne, 2005) as a part of the Value Map. Strategy Canvas is a diagnostic framework for strategy development. It enables an organization to visualize the competitive factors and the current state of play of those factors within a market place and to compare the organization's offering with those of the industry in general.

We illustrate the applicability of the Value Map by means of a descriptive case study of the value creation and capture in one of Amazon.com's business models. In a descriptive case study, the researcher pursues to describe a phenomenon of interest that occurs within the data. This type of research begins with an a priori theoretical perspective. Then, a pattern matching is conducted to describe the phenomenon in the data in a rigorous way (Yin, 2009). More specifically, the descriptive case study we conduct can be labeled as an instrumental case study (Stake, 1995), where we illustrate the applicability of the suggested framework.

We have used data triangulation in order to gather rich evidence on Amazon.com, various aspects of its business model and its service offerings over time. We began the data gathering process in January 2009. Since then, a variety of secondary data sources were accessed, analyzed and synthesized in order to gain an accurate understanding of diverse facets of Amazon.com's service offerings and implementation. Such sources include:

- Amazon.com annual reports 1997–2010 (Amazon, 2011a); presentations and news releases (Amazon, 2011b).
- Books published on Amazon.com such as; Afuah & Tucci, 2002; Spector, 2002; Kalpanik & Zheng, 2011; Brandt, 2011), etc.
- Harvard Business Review (HBR) cases published between 2000 and 2010 such as (Applegate 2002, 2008)
- Journal articles such as (Heck & Vervest, 2007), etc.

There are several advantages in using secondary sources. Ambrosini et al. (2010) suggests that teaching cases are an unexplored and rich source of data that should be used when primary data is not available. They also suggest using reputable sources for teaching cases (we mainly use Harvard Business Review cases here) and using them in tandem with other sources to attain data triangulation. Analyzing multiple sources of objective and subjective evidence enabled us to gain an overall understanding of the research topic.

To evaluate the applicability and usefulness of the Value Map we conducted an empirical study. In this study we also compared the Value Map with Business Model Canvas (Osterwalder & Pigneur, 2010), one of the most established methods in business model design. We organized three workshops with 14 senior managers and executives. In the first workshop, we discussed business modeling and problem structuring and familiarized the participants with business model canvas and its nine building blocks. In the second workshop, we presented the Value Map, its underlying theoretical perspectives along with the example provided in this chapter. The participants modeled their business ideas first with the business model canvas and then the Value Map. At the end of the second workshop the participants filled out a survey questionnaire. In the third workshop, the participants were debriefed on the usefulness, practicality and the potential merits of the Value Map.

The Value Map has been instantiated in an online platform for business model design called www.tradeyourmind.com. Hevner et al (2004:2) refer to instantiations as implemented and prototype systems. We provide some information on the www.tradeyourmind.com platform in an appendix to this chapter.

3. Literature Review and Conceptualizations

In this section, we review the literature on the theoretical frameworks that examine value creation and capture. A literature review can be conducted for a variety of purposes see (Hart, 1999: 27). In this chapter, the literature review will help us discover the important concepts relevant to value creation and capture and explore the relationships among these concepts in order to gain a new perspective into the structure and the dynamics of value creation and capture. Thus, the literature review helps us understand the "what" (i.e., the concepts), the "how", (i.e., their relationships) and the "why" (i.e., the rationale behind the selection of the concepts and the perceived relationships among them). According to Whetten (1989), the “what”, “why” and the “how” are the three tenets of a theoretical contribution.

The correct selection of the published materials is a vital element of a literature review. We followed Baker (2000) and developed a number of criteria for selection of the work to be included in the literature review. The articles we included in the literature review addressed value creation and capture simultaneously, and were indexed by Institute for Scientific Information (ISI). These two criteria led us to a total of around 30 articles. We then derived the key concepts discussed in each article. The concepts were then analyzed and divided into three categories: customer value, customer value creation process, and service provider value capture. Next, for each category, we developed a number of functions that embody algebraic expressions explaining the relationships between the concepts. We also explained the rationale underlying the relationships among the concepts. Having identified the concepts and their relationships, we graphically represented them in form of a conceptual model made up of boxes (i.e., the concepts) and arrows (i.e., their relationships). According to Whetten (1989: 491), “such visual representations often clarify the author's thinking and increase the reader's comprehension”. In the next sections we present the three categories of the concepts (i.e., customer value, customer value creation process, and service provider value capture), explain their relationships and the rationale underlying their relationships.

3.1 Customer Value

To understand the value creation and capture, we first conceptualize value from the customer side, since the customer is the eventual locus and the determining party of the value that is created (Grönroos & Ravald, 2011). We start our analysis by discussing net perceived customer value (NPCV) of a service offering, its constituent elements (i.e. perceived benefits and costs) and the NPCV of the service offering of the service provider relative to the competition.

3.1.1 Net Perceived Customer Value (NPCV)

Customer value has been examined through several perspectives (e.g. Pynnönen et al., 2011). In this study, we focus on the net perceived customer value (NPCV), which is a central concept in value analysis in business models. We invoke the definition of NPCV as the overall benefits minus the costs of receiving the service (following Kotler, 2000; Day, 1990). Thus,

Net perceived customer value = (Perceived service benefits) – (Perceived service costs) (1)

A similar concept is the consumer surplus, often expressed as “value for money” (we use NPCV and consumer surplus interchangeably here). Bowman and Ambrosini (2000) define consumer surplus as the difference between the monetary amount the consumer is willing to pay and the actual price paid. It is important to recognize that consumer surplus or net perceived value is assessed ex-ante, i.e., prior to the transaction. This is precisely the reason benefits and costs are assessed as “perceived”; this is in contrast to complementary concepts such as customer satisfaction, which are ex-post. For instance, if a service offering consists of entertainment services, the customer perceives a certain value for being entertained, whereas costs of receiving the service are linked to, for instance, time spent to going to the venue, as well as the monetary costs involved.

Thus, in any situation where a transaction actually occurs, the NPCV is expected to be positive. That is, the customer is willing to pay an amount in excess of the costs (including monetary and non-monetary costs), and therefore to make the purchase, pocketing the "surplus". The larger this surplus is the more eager the consumer will be to make the purchase. The converse is also true, the smaller this surplus becomes, the less eager the consumer is willing to engage in the transaction. The borderline situation is that of the monopoly supplier/service provider, where the firm is able to charge exactly the maximum amount the consumer is willing to pay, thus netting zero surplus for the consumer. Taking these issues into account, net perceived value can only increase through one of the following situations: (1) an increase in perceived benefits while maintaining perceived costs unchanged, (2) a decrease in perceived costs while maintaining perceived benefits unchanged, or (3) a simultaneous increase in perceived benefits with a decrease in perceived costs.

3.1.2 Customers' Perceived Benefits of the Service Offering

The customer's perceptions of the benefits are related to the use value of the service for the customer (e.g. Grönroos & Ravald, 2011). Use value covers the specific characteristics of the product or service perceived by the customer as potentially serving their needs. Bowman and Ambrosini (2000) emphasize the subjective nature of use value - it maps uniquely to each customer. Use value itself can be further categorized into two sub-components, namely functional and emotional benefits.

Functional benefits represent the tangible benefits of the product or service that fulfill the primary needs of the customer. Grönroos (2000) refers to functional benefits as the "core value" of the service. Furthermore, customers make their subjective assessment of the appropriateness of the functional benefit of the service. In the majority of cases, where the product and context are well understood and established, the process is straightforward. However, in cases of innovation and disruptive products, or when changes take place in social and cultural context, buyers might not be able to properly make their assessment, resulting in a net negative impact on functional benefits.

Emotional benefits are made up of the intangible extras that the firm is able to offer, which go above and beyond meeting primary needs; the analogous terminology of Grönroos (2000) is "added value". Kotler (2000) highlights various specific strands of these types of benefits, such as personal interaction value and image value. Based on the discussion in this section we can conclude that:

Perceived benefits of the service offering = Perceived functional benefits + Perceived emotional benefits (2)

3.1.3 Customers' Perceived Costs of the Service Offering

In addition to various types of benefits, there are always costs incurred to the customers receiving a service. The extant literature details the many types of such costs. However, such costs are often not included in existing service value models. The most obvious is the actual monetary cost (Kotler, 2000), or exchange value, based on Bowman and Ambrosini (2000). Not all costs can be expressed in monetary terms. Kotler (2000) identifies three non-monetary costs: time, energy, and psychic costs. To understand the overall costs that incur to the customers, non-monetary costs should be taken into account, along with the monetary costs. Time cost is made up by the sum of durations the consumer has to spend in acquiring and getting acquainted with the product or service. Energy cost is the net of energy that needs to be used by the customer. Finally, psychic costs form an opposite pair to psychic utility - the cognitive stress experienced by the customer in purchasing and using the product.

Perceived costs of the service offering = (Perceived non-monetary costs) + (Perceived monetary costs) (3)

3.1.4 Competing Value Networks and the Relative NPCV of the Service Offering

Customers compare the net value they could derive from offerings of a service provider and its value network with the net value of the alternatives available in the market before making a purchase decision. Thus, to better understand customer behavior, the NPCV created by competing value networks' offerings should also be taken into account (Bowman & Ambrosini, 2000). To this end, we introduce the "relative net perceived customer value" concept, which is the net perceived value created by a service provider's offering in relation to the competing offerings. The higher the relative net perceived value is, the higher the competitiveness of the service provider and its value network is in the eyes of the customers therefore,

Relative NPCV of the service offering = (NPCV of the service provider's value network offering) – (NPCV of the competing value network's service offering) (4)

In Figure 2 we graphically represent the relationships captured in functions 1-4.

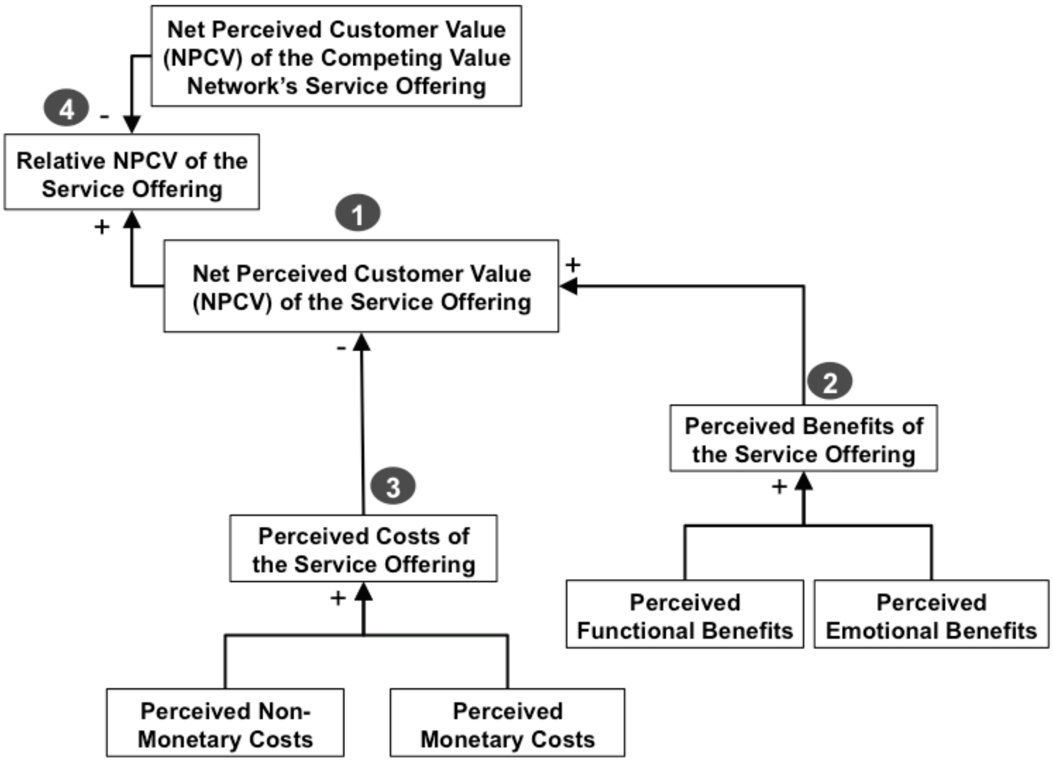


Figure 2. Graphical Representation of Customer Value Concepts

3.2. Customer Value Creation Process

Creating value for the customers is the fundamental reason any company exists in the first place and thrives in competition (Bowman & Ambrosini, 2000). Customer value creation is especially pronounced in service systems (Chesbrough & Spohrer, 2006).

3.2.1 Service Components

Customer value creation can be referred to as a process, where the service provider delivers the customer a service offering that creates value i.e., the use value (see e.g. Grönroos & Ravald, 2011) when the customer uses the service. In general, a firm always faces the strategic challenge of managing the fit between what it actually can do and what it should do to create customer value (Norman & Ramirez, 1993). Firms are heterogeneous from each other in the resources and capabilities they possess (Teece, 2009). Only in rare cases, is a firm able to provide all the resources and capabilities required for creating the service offering by itself. Hence, firms utilize value networks, where resources and capabilities of various suppliers and stakeholders are integrated in order to efficiently and effectively organize the activities required to create and deliver the offering to the customer (Kothandaraman & Wilson, 2001; Möller & Svahn, 2006).

In practice, not all the resources and capabilities emerge in a service provider's offering, and therefore only certain resources and capabilities can be linked to or mapped onto the service offering (Bowman & Ambrosini, 2000). We refer to the manifestations of such resources and capabilities as *service components*. Thus, service components are a subset of the resources and capabilities of the service provider and its value network.

Service components ⊂ Resources and capabilities (of the service provider and its value network) (5)

3.2.1 Service Features

Service components describe only the contents of the service and are more related to the practical concerns of the service provider to organize the resources and capabilities based on the customer's requirements. Thereby, service components are expressed in service provider's words and vocabulary. However, service components create some emergent properties for the service, which are noticed by the customer. We refer to these emergent properties of the service as *service features*. Service features are created by the service provider through the configuration of the service components that are designed and embedded in the service offering. Furthermore, service features impact the perceived customer value through various value attributes (Pynnönen et al., 2011), therefore

Service components (of service provider and its value network) ⇒ Service features ⇒ Service value attributes (of service customer) (6)

Value attributes are the phrases the customers use to express the perceived benefits and costs of the service. Kotler (2000) pinpoints that value attributes are expressed in customer terms, further reinforcing their subjective nature. For instance, in the case of an e-commerce company such as Amazon.com, "credit card processing" is a service component that creates the service feature "online payment". The customer's perception of the benefit they receive from this service feature is expressed in the value attribute "ease of payment". This value attribute increases NPCV by reducing the energy and time costs of the service customer who wishes to obtain the service. More instances are shown in Section 3. By identifying the link between a specific resource and a specific offering, the value can be optimized both for the service provider and the customer (Bowman & Ambrosini, 2000; Clulow et al., 2007).

Figure 3 is a graphical representations of the relations between the concepts in functions 5 and 6.

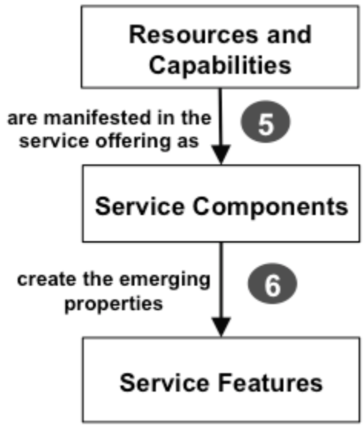


Figure 3. Graphical Representation of Customer Value Creation Process

3.3. Service Provider Value Capture

Value capture (also termed as value appropriation or retention, in some sources) by the service provider is an issue of much interest in management research and even more so in organizational studies. Value capture is related to the actualized profit-making of a certain party (for an in-depth discussion, see Bowman and Ambrosini, 2000, where they address the importance of analytical distinction between value creation and capture). Lepak et al. (2007) asserts that the process of value creation is often confused or confounded with the process of value capture or value retention and that the two should be understood as distinct processes.

Although there is certainly a strong correlation between value creation and capture, it is essential to recognize that the former neither automatically nor fully translates into the latter. Bowman and Ambrosini (2000) argue that, although value is created for the customer by organizational members (i.e., the value network), value capture has a different set of determinants, including "perceived power relationships between economic actors" (in other words, the bargaining power between the firm and other entities, which is explored at depth below). Lepak et al. (2007) and Ritala and Hurmelinna-Laukkanen (2009) follow a similar line of argumentation, suggesting that only through the use of specific mechanisms is the creator of value able to capture it, and that value creation and capture sometimes have completely different determinants and time frames.

3.3.1 Net Captured Value (NCV)

In our model, the value captured by the service provider is determined by the various monetary and non-monetary benefits the service provider can extract from the customers. In assessing the benefits realized by the provider, as stated in Section 3.1.4, the offerings of competing value networks should also be taken into account. Benefits gained by the service provider are directly proportional to the customer's net perceived value of the service offering relative to the competing offerings.

Customers perception of relative NPCV of the service offering ∝ *Service providers benefits* (7)

The customer's relative perception of value determines the actions he undertakes, which result in generating more or less tangible (e.g. annual subscription fee) and intangible (e.g. referrals, word-of-mouth, loyalty) contributions for the service provider as a compensation for the net perceived value of the service offering. The net captured value (NCV) of the service provider is defined as value captured by the service provider minus the costs of service components. Note that this view is symmetrical to the customer side where the NPCV is also dependent on benefits and costs. However, the perspective is different in that the service provider is the producer of value (which incurs costs), and is receiving various types of compensation for doing that.

Net captured value (NCV) of the service provider = (Value captured by the service provider) – (Cost of the service components) (8)

3.3.2 Benefits for the Service Provider

Service provider's benefits range from direct monetary (i.e. revenue streams) to non-monetary benefits (e.g. customer loyalty, learning). While monetary benefits for the service provider are quite straightforward to interpret (e.g. bulk price, subscription fees etc.), the non-monetary benefits are more varied and ambiguous. Based on Allee (2008), non-monetary benefits can sometimes be translated to monetary ones by an intermediate conversion. For instance, customer loyalty involves major (non-monetary) benefits for the service provider, which also contributes to the monetary benefits in both short and long term. In fact, customer loyalty manifests itself in the form of repeat purchases and is thus strongly linked with superior profits.

In addition, organizations learn by doing and thus constantly evolve (e.g. Nelson & Winter, 1982). Therefore, one type of non-monetary benefit is also linked to the organizational learning in the form of trial-and-error, customer feedback, that can lead to improved service offerings. This type of non-monetary value is of a higher level of abstraction, but it translates into improved service offerings and value creation over time.

To sum up, the benefits a service provider can capture fall into two categories: monetary and non-monetary. These benefits increase (i.e., are directly proportional to) the value captured by the service provider.

(Non-)monetary benefits for the service provider ∝ *Value captured by the service provider* (9)

3.3.3 Costs of the Service Components

In addition to the monetary and non-monetary benefits for the service provider, the costs of providing the service components affects value capture. We divide these costs into two main categories: the organizing costs of the service provider, and the external opportunity costs of the suppliers in the value network. Combined, these costs decrease the value captured by the service provider.

First, the organizing costs refer to the internal costs of the service provider. These costs are comprised of the production costs, related to the production of firm's offerings, and the management costs, related to the administration, control, monitoring, and incentives in organizing firm's operations (e.g. Masten et al., 1991; Blomqvist et al., 2002).

In addition to the organizing costs, the value network includes costs that are dependent on the suppliers of various independent or jointly provided service components. Following Brandenburger and Stuart (1996), we refer to the costs of the service components provided by the suppliers/partners in the service provider value network as opportunity costs. Opportunity costs are defined as the financial compensation provided to the suppliers in exchange for the service components they provide to the offering. The opportunity costs take into account the highest alternative compensation that suppliers could receive from utilizing their resources in another context (ibid.). Thus, the economic rationale of the suppliers' involvement in the business model is tied to the opportunity costs of the suppliers in providing certain service components. Opportunity costs are a widely-recognized economic concept that is a measurement of the best alternative passed up on. In effect, opportunity costs determine the eventual cost burden that needs to be taken into account when analyzing the costs related to maintaining the external network of suppliers and partners. Thus,

Costs of the service components = (Organizing costs i.e., internal costs of the service provider) + (Opportunity costs i.e., external costs of the suppliers in service provider value network) (10)

3.3.4 Net Captured Value and Future Value Creation

The cyclical feedback that net captured value offers to future value creation activity remains a relatively unexplored domain in the literature which should be taken into account when building a practice-oriented model of value creation and capture. As the most evident issue, the actual monetary value and related resources (i.e. the revenue streams to service provider) directly help to maintain service providing activities in that they provide funding for the on-going operations. Sanchez and Heene (1997, 2003) use the term "competence leveraging" to refer to the use of an organization's existing resources to create product offers and carry out other activities that do not require qualitative changes in the resources the organization uses or in the way the organization coordinates its resources.

In addition, and more important in longer term, is the development of value creation activities that take place over time. Lepak et al. (2007) touch on this point in their conclusion, suggesting that, "a key question is whether actors learn from past value creation efforts in terms of the amount of value they capture and use this knowledge for decisions regarding future value creation activities." In other words, organizational learning accumulated over time can guide a firm to better structure its value creation efforts. Sanchez and Heene (1997, 2003) refer to such activities as "competence building". They define competence building as "any process through which an organization creates or accesses qualitatively new kinds of resources and capabilities and/or develops new ways of coordinating and deploying new or existing resources and capabilities".

Competence leveraging and competence building are central to the sustainable creation and capture of value in business models. Hence, we suggest that over time, there is a feedback loop from value capture to maintaining (i.e. leveraging competences) and/or developing (i.e. building new competences) service components. In terms of the development of service components, the feedback loop is a result of organizational learning, leading to improved capabilities and resources related to service production. This can either increase the customers' value, reduce costs on the service provider's side, or both. In general, these improvements can be linked to Porter's (1980) generic strategies of cost leadership and differentiation. Figure 4 graphically represents the concepts and their relationships in functions 7-10.

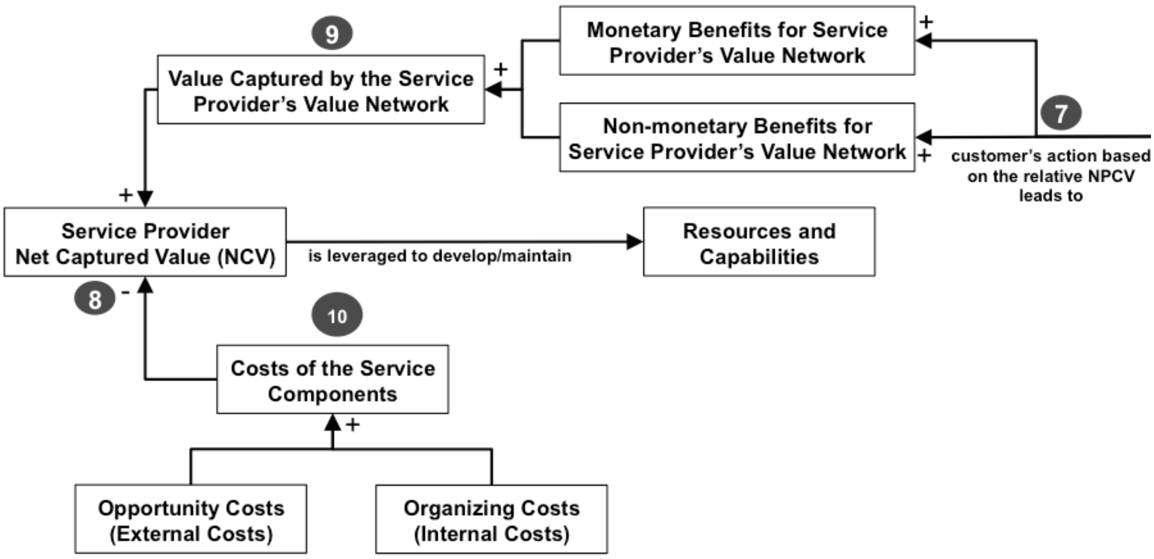


Figure 4. Graphical Representation of Service Provider Value Capture Conceptualizations

In Table 1 we summarize the 10 functions capturing the relationships between the customer value, customer value creation process, and service provider value capture concepts. Figure 5 is a graphical representation of the relationship between the concepts in the10 functions.

In the remaining sections of the chapter, we draw on the concepts and their relationships to build the Value Map that enables us to concretely analyze value creation and capture in service-oriented business models. In this task, we use the business model of Amazon.com in Amazon Marketplace as a working example.

Table 1 – The Algebraic functions capturing the relationships between the customer value, customer value creation process, and service provider value capture concepts.

Customer Value Conceptualizations	1	Net perceived customer value (NPCV) = (perceived service benefits) – (perceived service costs) (Kotler, 2000; Day, 1990; Huber, 2001)
	2	Perceived benefits of the service offering = (perceived functional benefits) + (perceived emotional benefits) (Kotler, 2000; Grönroos, 2000)
	3	Perceived costs of the service offering = (Perceived non-monetary costs) + (Perceived monetary costs) (Kotler, 2000; Bowman & Ambrosini, 2000)
	4	Relative NPCV of the service offering = (NPCV of the service provider's value network offering) – (NPCV of the competing value network's service offering) (Bowman & Ambrosini, 2000)
Customer Value Creation Process	5	Service components $\subset$ Resources and capabilities (of the service provider and its value network) (Kothandaraman & Wilson, 2001; Moller & Svahn, 2006; Bowman & Ambrosini, 2000)
	6	Service components (of service provider and its value network) $\Rightarrow$ Service features $\Rightarrow$ Service value attributes (of service customer) (Pynnonen et al., 2011)
Service Provider Value Capture Conceptualizations	7	Customers perception of relative NPV of the service offering $\propto$ Service providers benefits (Bowman & Ambrosini, 2000)
	8	Net captured value (NCV) of the service provider = (Value captured by the service provider) – (Cost of the service components) (Bowman & Ambrosini, 2000)
	9	(Non-)monetary benefits for the service provider $\propto$ Value captured by the service provider (Nelson & Winter, 1982; Allee,2008; Ulaga, 2003)
	10	Costs of the service components = (Organizing costs i.e. internal costs of the service provider) + (Opportunity costs i.e. external costs of the suppliers in service provider value network) (Masten et al., 1991; Blomqvist et al., 2002)

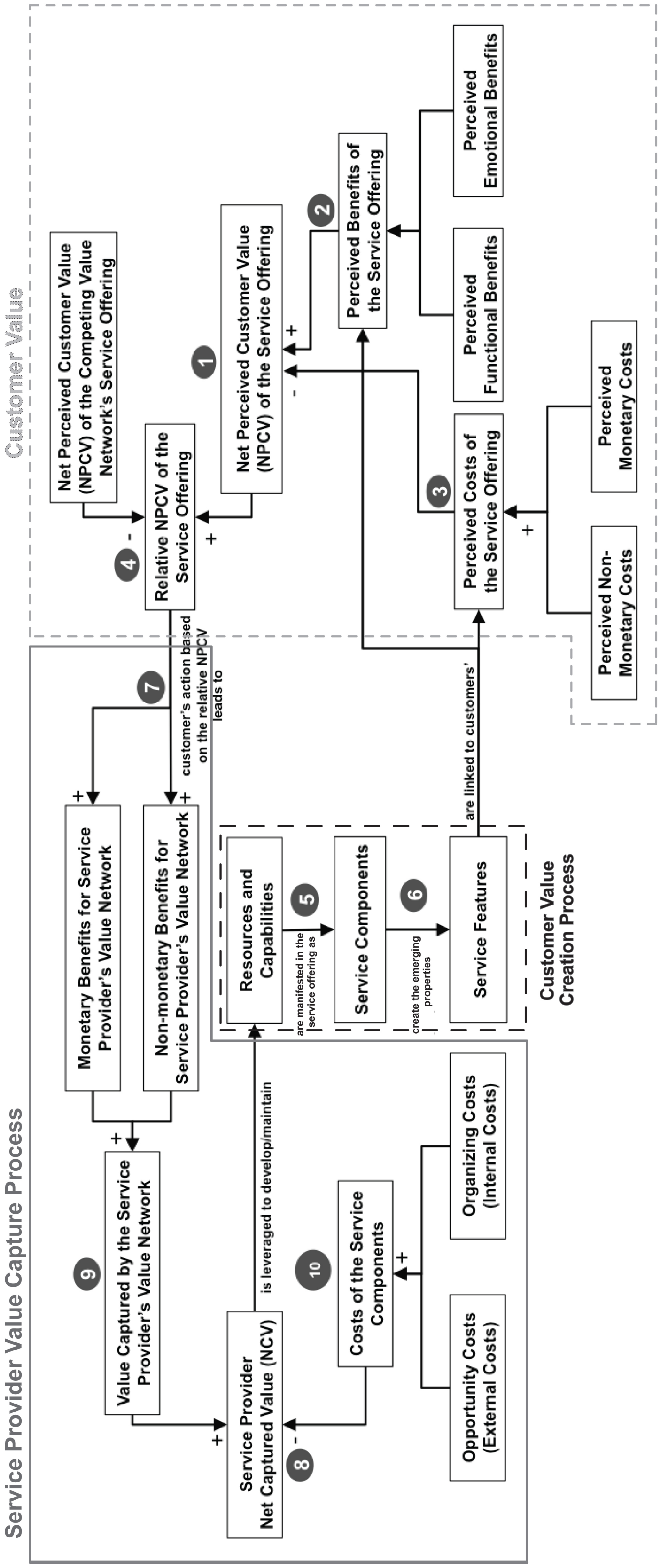


Figure 5. Graphical Representation of Value Creation and Capture Concepts and their Relationships

4. Modeling Value Creation and Capture in Amazon.com's Business Model

In July 1995 Amazon.com opened for business as an online bookseller and by September 1995, the company was selling $20,000 per week. After nearly three years as an online bookseller, the company began aggressively diversifying its offerings to include other product categories beyond books, initially adding music, videos, toys, and electronics (Afuah & Tucci, 2002). Such diversifications were followed by the launch of several other stores such as home improvement software. In parallel with these product diversifications, in October 1998, Amazon.com expanded geographically by launching its first international sites Amazon.co.uk and Amazon.de through the acquisition of UK-based online bookstore Bookpages and German-owned Telebook (Applegate, 2002). The rationale behind such diversifications was Amazon.com's strategy of "get big fast" to turn Amazon into the biggest mass merchandiser or e-mall in the online world (Spector, 2002).

Following its evolution from an online bookseller or to an e-tailer by diversifying its product offering through new store openings, Amazon.com extended its business model to become a third-party market place by launching Amazon Marketplace in November 2000. The marketplace idea was then implemented in Amazon.com's international websites, UK and Germany in 2002, and France, Canada and Japan in 2003 (Kalpanik & Zheng, 2011; Brandt, 2011).

In the case study analyzed in this chapter, we focus on the evolution of Amazon.com's business model from an online bookseller to a third-party marketplace in the online bookselling segment. From a service perspective, we model the value creation and capture through Amazon.com's transition from selling new books to establishing partnerships with other booksellers to sell used and new books. To this end, we apply the Value Map to model value creation and capture in Amazon.com business model circa 1997. The insights provided by the model shed light on the financial performance of Amazon in late 90's. By modeling the Amazon Marketplace customer value in 2001, we capture the impact of the marketplace service features on the value attributes and the NPCV. We link these changes to the impact of Marketplace on Amazon.com's value capture and financial performance.

In order to explain the relation between the Value Map and the theoretical discussions in the previous section and to gain a better understanding of the modeling constructs and notations, we present the Value Map in three parts corresponding to the three sets of the conceptualizations in Section 3 (i.e. customer value; customer value creation; and service provider value capture).

4.1 Modeling Customer Value in Amazon.com's Business Model

The first part of the Value Map deals with the service value attributes, as perceived by Amazon.com's customers circa 1997. In Figure 3, we list a number of value attributes, which reflect customers' perceptions of the benefits and costs of Amazon.com's online book selling service. In Section 3.1.1, we discussed how a customer assesses a service based on his perception of value. The next step is to understand the relative importance of value attributes in terms of their impact on the NPCV. As illustrated in Figure 6, we use minuses and pluses to represent the nature (i.e. negative or positive) and the intensity (medium or strong) of the impact.

The information on customers' perceptions and their relative importance can be gathered through direct interaction with customers or customer surveys. Revealed preference methodologies (Carson et al., 1996) are also used to understand customers' needs and preferences based on their behavior. In this chapter, the information provided on the value attributes and their relative importance, as perceived by Amazon.com's customers was gathered through the secondary sources outlined in Section 2.

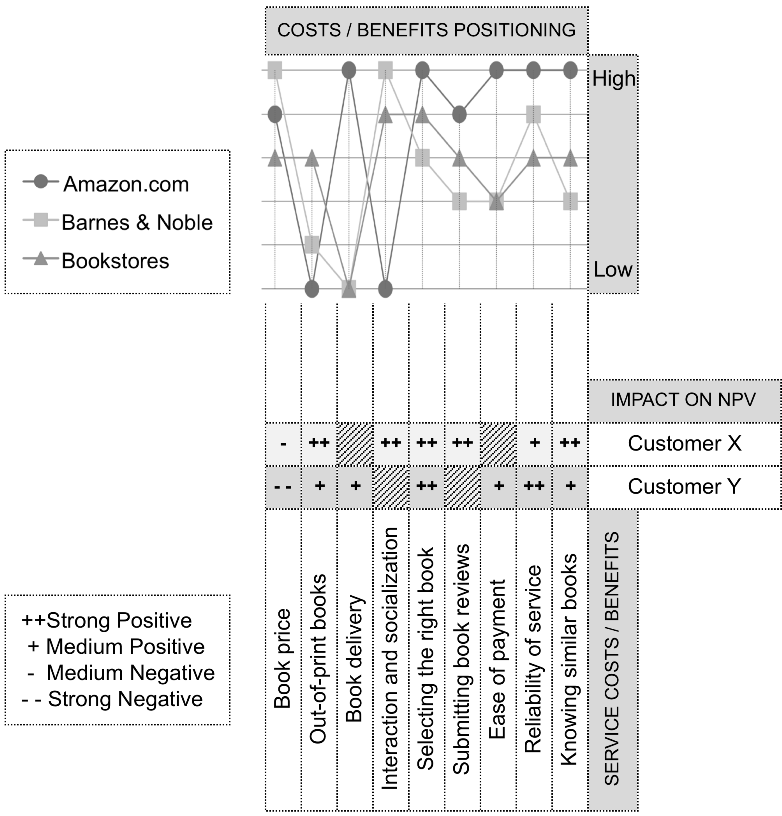


Figure 6. Modeling customer value

As illustrated in Figure 6, different customers perceive different value attributes of the service offered by the service provider. Similarly, a value attribute has different impacts on the NPCV for different customers. For instance, as shown in Figure 6, the value attributes "Ease of payment" and "Book delivery" do not have any impact on Customer X's perception of Amazon.com's service offering. By the same token, "Submitting reviews" and "Interaction and socialization" do not influence Customer Y's perception of service value. Moreover, "Book price" and the "Reliability of service" are more important for Customer Y, whereas, Customer X cares more about value attributes such as (availability of) "Out-of-print books" and "Knowing about similar books". The customers can represent different segments of a market that seek to fulfill different needs and preferences when it comes to a service offering.

Finally, as already discussed in Section 3.3.1, it is important to identify the strategic positioning of the service provider by understanding where the provider stands relative to the competing value networks in terms of the value attributes. This assists the service provider in identifying service improvement opportunities, as well as, in analyzing whether delivering the perceived value attributes results in a competitive advantage. In our example, we compare Amazon.com, Barnes & Noble and the Bookstores with respect to the value attributes listed in the model. By Bookstores we refer to small and independent bookstores that were not a part of the book superstores or chains such as Barnes and Noble or Borders. As illustrated, Bookstores were doing better in the price and availability of out-of-print books. Bookstores' superiority in these two value dimensions was mainly due to selling used books and their efficient cost structures (Spector, 2002; Kalpanik & Zheng, 2011; Brandt, 2011).

4.2 Modeling Customer Value Creation in Amazon.com's Business Model

In the previous section, we focused on the analysis of value attributes and their impact on NPCV, as well as on the strategic positioning of the service relative to the competition. In this section, we model the design of the value creation process.

SERVICE PROVIDER VALUE NETWORK / SERVICE COMPONENTS	Credit card processing	in-print book inventory	Electronic Funds Transfer	Book publishing	Distribution centers	Book review submission sys.	Book recommendation sys.	Customer relationship mgt.
Amazon.com					x	x	x	x
Amazon.com's Bank			x					
Credit Card Company	x							
Customer's Bank			x					
Book Distributor Co.		x						
Book Publisher Co.				x				

SERVICE FEATURES	Credit card processing	in-print book inventory	Electronic Funds Transfer	Book publishing	Distribution centers	Book review submission sys.	Book recommendation sys.	Customer relationship mgt.	Book price	Out-of-print books	Book delivery	Interaction and socialization	Selecting the right book	Submitting book reviews	Ease of payment	Reliability of service	Knowing similar books
Book shipment		x		x	x						x	x					
Online payments	x		x												x		
Customer book reviews						x							x	x			
Availability of in-print books		x		x					x	x							
Customer oriented services								x								x	
Recommended books							x										x

SERVICE COSTS / BENEFITS

Figure 7. Modeling customer value creation

Figure 7 illustrates the value creation process in the Amazon.com's business model, wherein we model the service features, created by the service components that are provided by the service provider and its value network, and their corresponding value attributes. In the model, we put an X to map the service components to service features and service features to the value attributes. More concretely, we can see that, for instance, Amazon.com provides the service component "Book recommendation system" creating the service feature "Recommended books" that is linked to the value attribute "Knowing similar books". Similarly, the Distributor Co. holds an "In-print book inventory" creating the feature "Availability of in-print books" that pertains to the value attribute “Book delivery”. Note that, a service feature can be linked to more than one value attribute. For instance, as illustrated the service feature “Book shipment” is linked to value attributes “Book delivery” and “Interaction and socialization”. The nature of the impact (i.e. whether positive or negative) is implied. “Book shipment” positively contributes to “Book delivery” and is negatively linked to “Interaction and socialization” because the customer does not need to leave his house to buy a book and consequently does not have an opportunity to meet and socialize with other book buyers or the bookseller.

4.3 Modeling Service Provider Value Capture in Amazon.com’s Business Model

As discussed in section 3.3.2 the monetary and non-monetary benefits created by the customers determine the value captured by the service provider. As already discussed, such benefits are thereby directly proportional to the net value service supplier captures. The costs of the service components (i.e. organizing cost of service provider and the opportunity cost of the suppliers in the value network) reduce the net captured value by the service supplier.

To model the service provider’s net captured value (NCV), we begin our analysis from the customer side. We discussed, in Section 3.3.1, that the customers of the service offering take actions based on their perceptions of the net perceived value of the service provider relative to the competing offerings. Figure 8 illustrates the overall Value Map, including the service provider’s value capture. As illustrated, Customer X and Customer Y buy books on Amazon.com. This action generates the monetary benefit of “Book sales” which leads to “Sales revenues” as the value captured by Amazon.com. As illustrated, revenues have a strong positive impact on Amazon.com’s net captured value. Similarly, Customer X “Writes reviews” and generates the non-monetary benefit of “Book reviews”, which results in an “Increase in the service value” of Amazon.com and thereby a higher NPCV that could lead to more sales and revenues. Therefore, over time, a non-monetary benefit can lead to the generation of monetary benefit. As shown in the model, “Increase in the service value” has a medium positive impact on the net value captured by Amazon.com. Finally, Customer Y “Recommends Amazon.com to friends”. The non-monetary benefit of “Word of mouth” results in “Growth in potential customers” and a strong positive impact on Amazon.com net captured value over time. The gray background denotes that this impact will not occur immediately.

To model the cost of service components, we represent the “opportunity cost” and “organizing cost” concepts as elaborated in Section 3.3.3, by “cost of sales” and “operating expenses” constructs. We define these two indicators based on the definitions in the Amazon.com’s annual reports 1997 – 2010 (Amazon, 2011b).

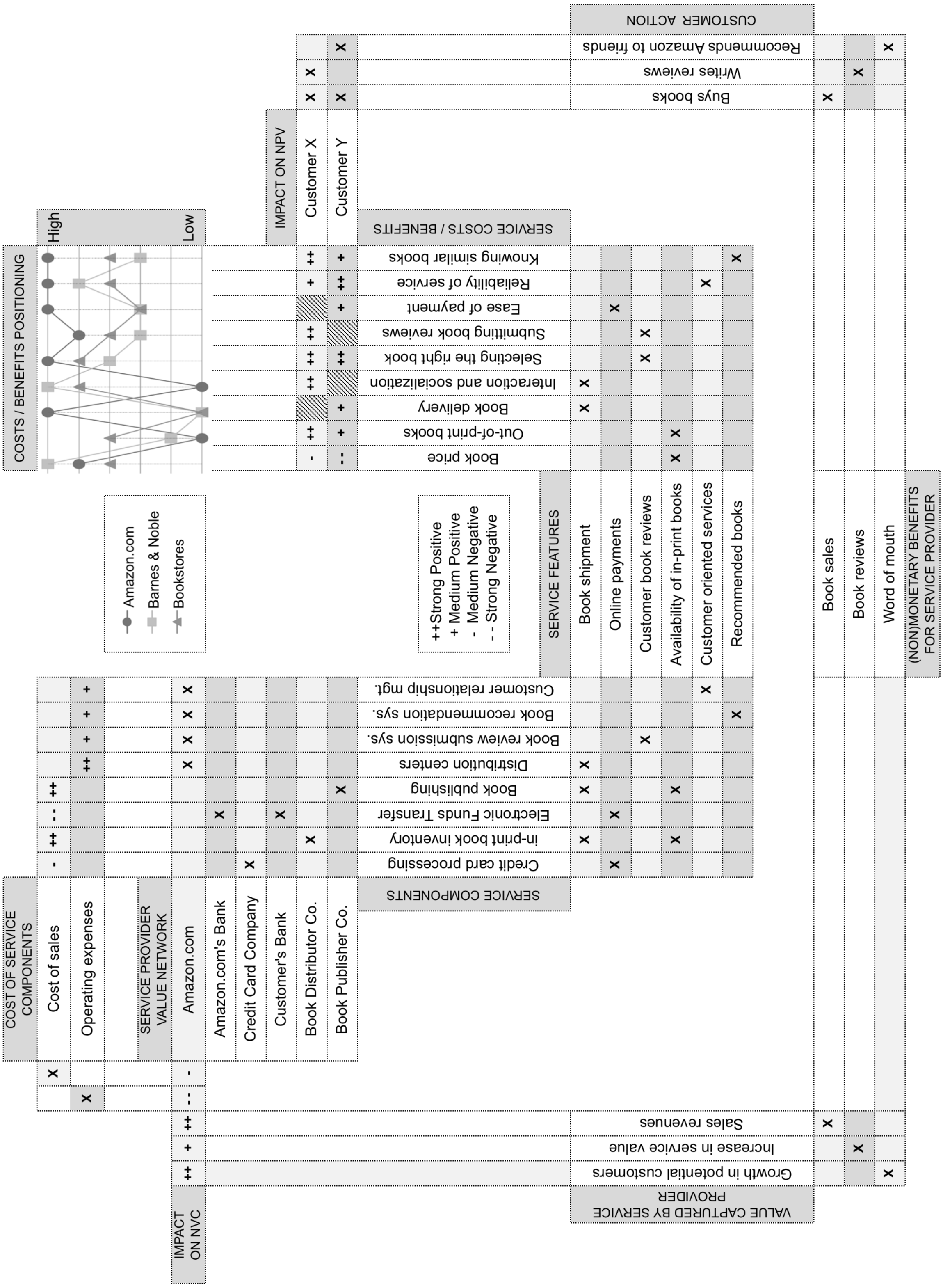


Figure 8. The overall Value Map including service provider's value capture

As our study focuses on the book segment of Amazon.com's business, we modified these definitions to match the scope of our analysis.

- *Cost of sales* consists of the purchase price of the books sold by Amazon.com, inbound and outbound shipping charges to Amazon.com, packaging supplies, etc.
- *Operating expenses* comprise marketing and sales expenses (i.e. advertising, promotional and public relations expenditures including the related expenses for personnel engaged in marketing, selling and fulfillment activities, product development expenses, and general and administrative expenses (i.e. payroll and related expenses).

As illustrated in Figure 8, we link the service components to the cost of sales and the operating expenses. More specifically, to represent the organizing and opportunity costs, the service components provided by Amazon.com are linked to the "Operating expenses" and the service components provided by the suppliers in Amazon.com value network are connected to the "Cost of sales".

In 1997, books could be acquired from publishers or from a network of distributors. Both the publishers and the distributors had very high opportunity costs. Months before publishing a book, the publishers had to determine the number of copies they intended to print. Publishers could not have managed to come up with an estimate before negotiating a deal with the booksellers that grants the booksellers the permission to return the unsold books. In 1994 for instance, 35% of the 460 million books shipped by the publishers were returned to them. The distributors, on the other hand, carried around 500,000 titles in their inventories to ensure they met the demand. Moreover, Amazon.com was suffering from its high organizing costs that were mainly related to managing its huge distribution centers. In November of 1997 Amazon.com opened up its second distribution center. The 200,000-square-foot state-of-the-art Delaware distribution center, the length of three football fields, together with the expansion of its Seattle distribution center, drastically increased the operating expenses (Spector, 2002).

In the late 1990s, Amazon.com's net captured value had decreased, mainly due to the high opportunity costs of publishers and distributors, high operating expenses of its operations, and the reduction of its NPCV (see Figure 8). The reduction in its net captured value had placed Amazon.com on the brink of bankruptcy. As a matter of fact, by the summer of 2000, Amazon's stock price had dropped by more than two-thirds and by the end of 2000, was down more than 80% from the beginning of 2000. Wall Street speculated that Amazon would file for bankruptcy or that another company would buy it. Analysts assert that if Amazon had not been able to borrow $680 million in February of 2000, it would have run out of cash and gone bankrupt (Applegate, 2002; 2008). Therefore, a redesign of Amazon.com's business model in terms of how value is created and captured needed to be done in order to make the business viable. In the following we discuss and model this issue.

4.4 Value Redesign in Amazon.com's Business Model circa 2001

In November 2000, Amazon.com introduced its new service offering, Amazon Marketplace. In the online book value segment, Marketplace allows bookstores to sell new and used (including out-of-print books) on the same page that Amazon.com sells its new books. This side-by-side placement dramatically expanded the book selection available to the book buyers by enabling them to choose between new and used books from multiple booksellers including Amazon.com, at one single store (Spector, 2002).

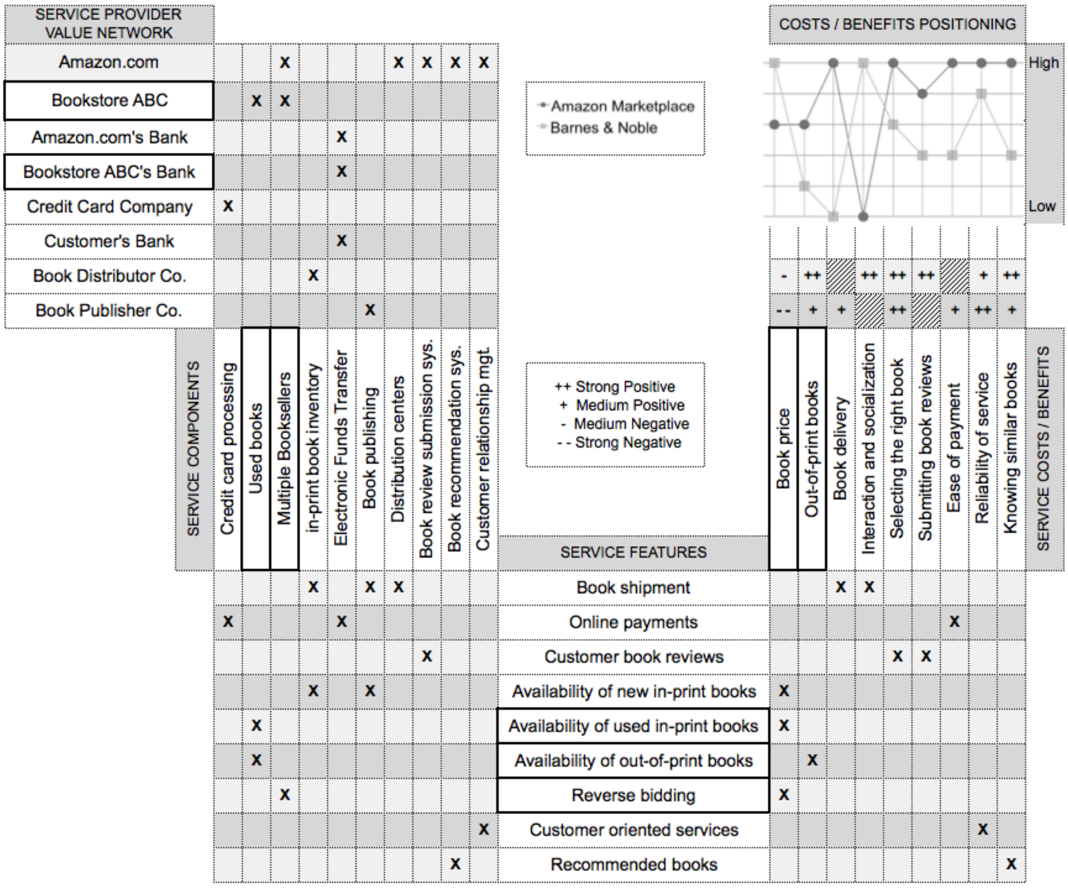
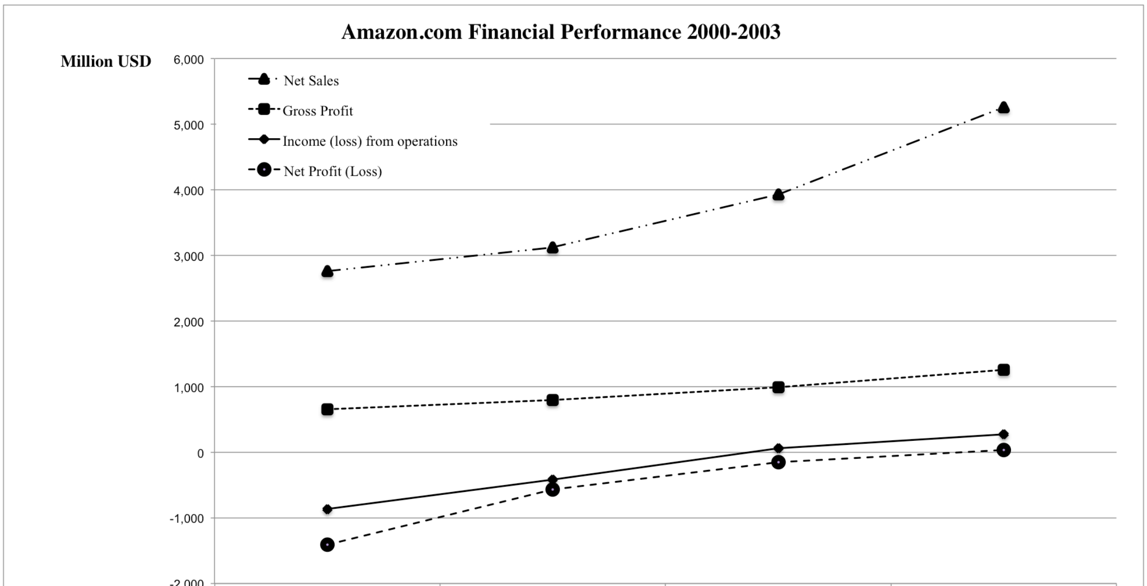


Figure 9. Increase in NPCV through reducing book prices and higher availability of out-of-print books and the reverse bidding by multiple booksellers

Amazon.com and the bookstores had to think of ways to decrease their organizing costs so that they could offer books at the lowest price possible. This resulted in a reverse bidding process for winning customer orders that reduced the book prices for the book buyer. In addition, the presence of the multiple bookstores in Amazon Marketplace led to the increase in the number of the titles available. Most of the bookstores also offered used books at much lower prices compared to new books. Sometimes these used books were in fact out-of-print. Sales of used books on Amazon Marketplace, once more increased the variety of the titles and resulted in the availability of books with low prices.

As illustrated in Figure 9, Amazon Marketplace increased NPCV by reducing the book prices and increasing the availability of books. In Figure 9, we have specified the changes to Amazon.com value network, the service components and features to shed light on the increase in the NPCV.



	2000	2001	2002	2003
Net Sales	2,762	3,122	3,933	5,264
Gross Profit	656	799	993	1,257
Income (loss) from operations	-864	-412	64	271
Net Profit (Loss)	-1,411	-567	-149	35

Figure 10. Amazon.com's Financial Performance 2000-2003 (Source: Amazon.com annual reports 2000-2003)

By launching the Marketplace services, Amazon.com put itself in a head-on price competition with the bookstores to win over customer orders. Amazon Marketplace provides sellers with the e-commerce services and tools and thereby enabling them to present their products alongside those of Amazon.com's on the same product detail page on Amazon.com's website, pursuing what Bezos phrased as "single store strategy". To realize this single-store strategy, by adapting a coopetitive strategy (simultaneously competitive and cooperative) (Brandenburger & Nalebuff, 1996). Amazon.com provided third-part sellers with automated tools to migrate their catalogs of millions of used and out-of-print books onto the new single product pages inside the Amazon books tab consequently, reducing the bookstores' costs of doing business with Amazon.com. In addition, as the bookstores were allowed to merchandise their products on Amazon.com's high-traffic web pages, they achieved a volume of orders higher than before. Higher sales volume reduced the opportunity cost of Bookstores.

Amazon Marketplace generated significant business and considerably increased net sales and gross profit. In fact, Marketplace helped Amazon.com to offset operating expenses and sales costs and achieve profitability in 2003, for the first time after its establishment. The Marketplace was the major factor behind Amazon.com's profitability. Amazon reported that third-party transactions accounted for 20% of its North American sales in the second quarter of 2002 (Applegate, 2008).

Figure 10 illustrates the financial performance of Amazon.com between 2000 and 2003 capturing the impact of the Amazon Marketplace in Amazon.com's business model.

5. Empirical Study

In this section, we elaborate on the empirical study that we conducted to assess the usefulness of The Value Map. In this study, we also compared the Value Map with Business Model Canvas (Osterwalder & Pigneur, 2010). Business Model Canvas is a strategic management tool, that assists in the development of new, and improvement of existing business models. The canvas represents value creation and capture in business models by nine building blocks: key partners, key activities, key resources, value propositions, customer relationships, channels, and customer segments. Business Model Canvas is one of the most established methods in the academia and industry for business model design, development and improvement.

We organized three workshops attended by 14 participants from Iran. The participants belonged to various industry sectors, such as automotive parts manufacturing, power generation, pharmaceutical and investment. They all held executive and senior management positions in their companies and had a minimum of 8 years of experience.

The first workshop lasted for 6 hours. In the first part of this workshop, we discussed business modeling and problem structuring in organizational decision processes. We also explained the theoretical concepts such as value creation and capture in business models. Then, we familiarized the participants with business model canvas and its nine building blocks. Next, we provided an example of a business model represented by the business model canvas. It should be noted that 5 participants were already familiar with the Business Model Canvas and/or applied it in representing a business model.

In the second workshop that also lasted for 6 hours, we presented the Value Map, its underlying theoretical perspectives along with the example provided in this chapter. The participants were then divided in four groups. Each group decided on a business idea. In the groups where the members were from the same industry background a real business idea was chosen. The groups represented their business ideas first with the business model canvas and then the Value Map. We acted as facilitators during the sessions and answered to the participants' questions. When the models were completed and presented by the groups. During the presentation of the models, we provided feedback on the models to each group.

The third workshop was held a week after the second workshop lasted for three hours. We had asked the participants to reflect upon the usefulness, practicality and the potential merits of the Value Map and its positioning with respect to the Business Model Canvas. In the workshop, which lasted nearly 3 hours, we debriefed the participants. Some of them had tried to apply the Value Map in their organizations and shared their experiences with us. Some pictures from the workshops and the models developed by the participants are shown in Figure 11.

Figure 11. Photos from the modelling sessions and the models developed by the participants

At the end of the second workshop, a survey questionnaire was distributed among the participants. As shown in Figure 12, the participants had to specify whether they strongly disagree, disagree, are undecided about, agree or strongly agree with the nine statements. The first statement was on the importance of value creation and capture in the business model of an organization. Statements 2-5 were derived from the proposed future work by Osterwalder (2004:141): “I propose that future work on business models includes testing the following hypotheses developed on the basis of the interviews with business practitioners:

- A business model ontology based visualization tool can help business practitioners more quickly understand a business model and the relationships behind its elements.
- A business model ontology based tool creates a common langue to address business model issues and in this regard improves communication between business practitioners.
- Discussing business model issues with a business model ontology based tool (to understand business models) has an impact on discussion quality."

In statements 6-9, we compare the Value Map and the business model canvas.

SURVEY OF VALUE MAP, A PROBLEM STRUCTURING METHOD FOR VISUALIZING THE BUSINESS MODEL OF AN ORGANIZATION

Name and Surname		Respondent's Signature
Organization		
Type of Business		
Organizational Position		
Years of Experience		

1	Strongly disagree	2	Disagree	3	Undecided	4	Agree	5	Strongly Agree

		1	2	3	4	5
1	Value creation and capture are central to an organization's business model.					
2	The Value Map helps business practitioners to understand and analyze customer value; customer value creation, and the value capture processes in an organization's business model.					
3	The Value Map creates a common language for business practitioners that enables them to jointly represent, discuss the as-is situation and envision the to-be situation of the customer value creation and capture processes in the organization's business model.					
4	The Value Map facilitates and improves the communication among the business practitioners within the organization. This improvement in communication positively impacts the quality of the discussions regarding the business model of the organization.					
5	The Value Map is a useful visualization tool that contributes to managerial decision making processes of business practitioners about the value creation and capture in an organization's business model.					
6	Business Model Canvas helps identify the building blocks of an organization's business model.					
7	The two additional building blocks in the Value Map (i.e., the competing offers and, the service/product features) are useful and/or necessary for representing an organization's business model.					
8	The Value Map models the inter-relations, inter-connections, linkages and the dynamics between the building blocks of a business model.					
9	The Value Map complements and augments the Business Model Canvas by aiding the business practitioners in representing the necessary building blocks of business model of an organization and their inter-relations and interconnectedness.					

Questionnaire distributed among the participants in the business modeling workshop in the Ministry of Industry, Mine and Trade Page 1 of 1
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Figure 12. The questionnaire

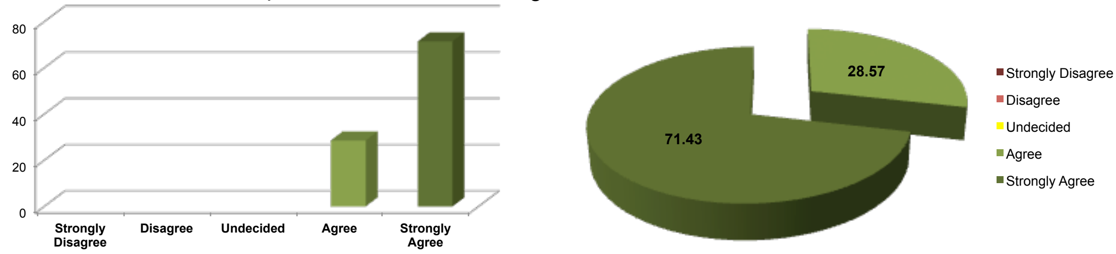
Table 2 summarizes the frequency of the responses for the nine statements in the questionnaire.

Table 2. Results of the survey - frequency of responses for statements in percentage

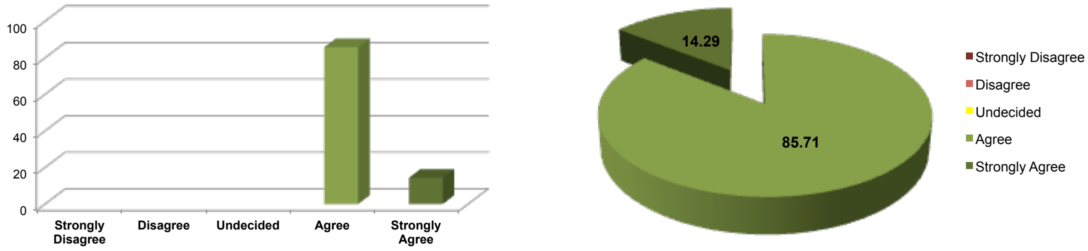
	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Statement 1	0.0%	0.0%	0.0%	28.6%	71.4%
Statement 2	0.0%	0.0%	0.0%	85.7%	14.3%
Statement 3	0.0%	7.1%	0.0%	57.1%	35.7%
Statement 4	0.0%	14.3%	0.0%	71.4%	14.3%
Statement 5	0.0%	14.3%	7.1%	64.3%	14.3%
Statement 6	0.0%	7.1%	0.0%	57.1%	35.8%
Statement 7	0.0%	0.0%	0.0%	28.6%	71.4%
Statement 8	0.0%	7.1%	0.0%	50.0%	42.9%
Statement 9	0.0%	0.0%	0.0%	50.0%	50.0%

The results show that around 90% of respondents either agree or strongly agree with the statements. There is no proposition that is strongly rejected. In Figure 13, we present the frequency of the responses to Statements 1-5 in bar and pie charts. As mentioned earlier, these statements evaluate the applicability of the Value Map.

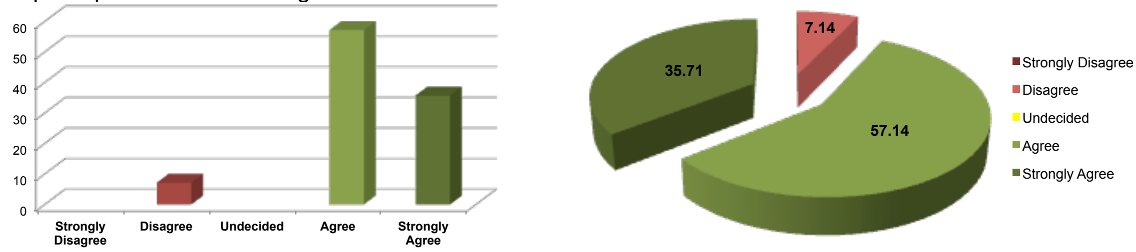
1. Value creation and capture are central to an organization's business model.



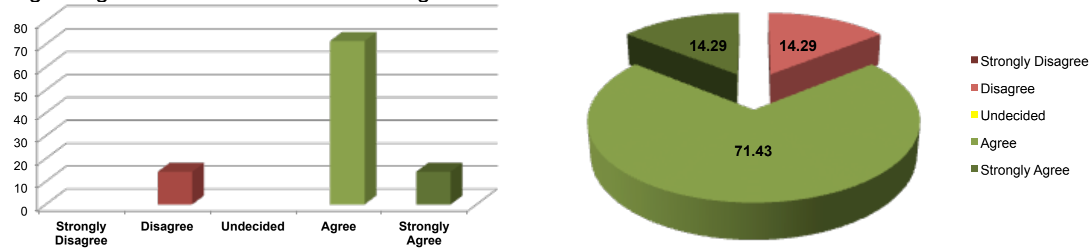
2. The Value Map helps business practitioners to understand and analyze customer value; customer value creation, and the value capture processes in an organization's business model.



3. The Value Map creates a common language for business practitioners that enables them to jointly represent, discuss the as-is situation and envision the to-be situation of the customer value creation and capture processes in the organization's business model.



4. The Value Map facilitates and improves the communication among the business practitioners within the organization. This improvement in communication positively impacts the quality of the discussions regarding the business model of the organization.



5. The Value Map is a useful visualization tool that contributes to managerial decision making processes of business practitioners about the value creation and capture in an organization's business model.

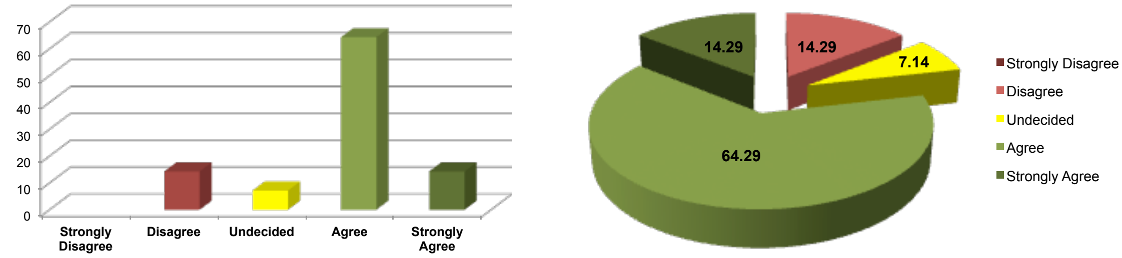


Figure 13. Results of the survey for statements 1-5

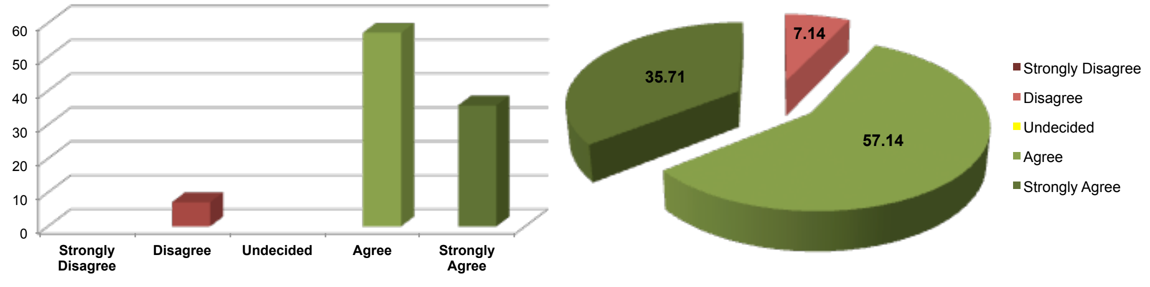
As illustrated in Figure 13, all participants either agree or strongly agree on the importance of value creation and capture in the business model of an organization. This sheds light on the practical relevance of the topic of the research for the industry practitioners who participated in the survey.

Based on the responses to Statements 2 and 3, almost all of the participants found the Value Map a tool that can help them in understanding and analysis of value creation and capture by creating a common language that enables them to jointly represent, discuss the as-is situation and envision the to-be situation of the customer value creation and capture processes in the organization's business model. Over 85% of the participants agreed that the common language created by the Value Map improves the communication among the business practitioners within the organization and thereby positively impacts the quality of the discussions by surfacing the practitioners' implicit assumptions regarding the business model of the organization. Finally, the majority of the participants came to the conclusion that the Value Map is a useful visualization tool that contributes to managerial decision making processes of business practitioners about the value creation and capture in an organization's business model.

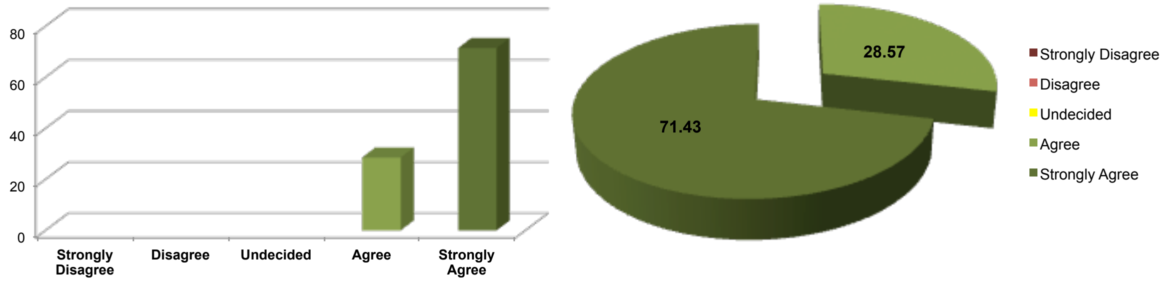
In Figure 14, we show the results of the comparison between Business Model Canvas and the Value Map. The participants found the Business Model Canvas a useful method for identifying the building blocks of a business model. As stated earlier Business Model Canvas represents the business model by nine building blocks: key partners, key activities, key resources, value propositions, customer relationships, channels, and customer segments.

In the Value Map, we represent two building blocks additional to the ones conceptualized by the Business Model Canvas, namely: competing offerings and product/service offer features. The participants either strongly agree or agree that these two additional building blocks are useful and/or necessary for representing an organization's business model. The participants also concluded that Value Map models the interconnections between the building blocks of a business model, whereas the Business Model Canvas just aims at identifying these building blocks. Finally based on the responses to Statement 9 we can state that participants thought that the Value Map can complement and augment the Business Model Canvas by representing the necessary building blocks of business model of an organization and their inter-relations.

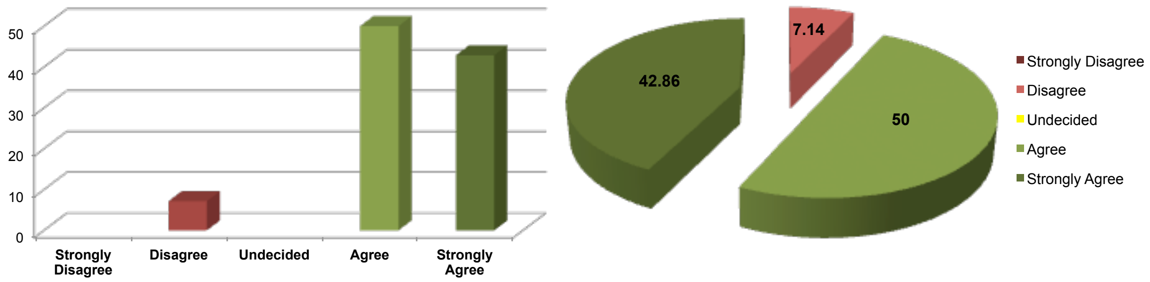
6. Business Model Canvas helps identify the building blocks of an organization's business model.



7. The two additional building blocks in the Value Map (i.e., the competing offers and, the service/product features) are useful and/or necessary for representing an organization's business model.



8. The Value Map models the inter-relations, inter-connections, linkages and the dynamics between the building blocks of a business model.



9. The Value Map complements and augments the Business Model Canvas by aiding the business practitioners in representing the necessary building blocks of business model of an organization and their inter-relations and interconnectedness.

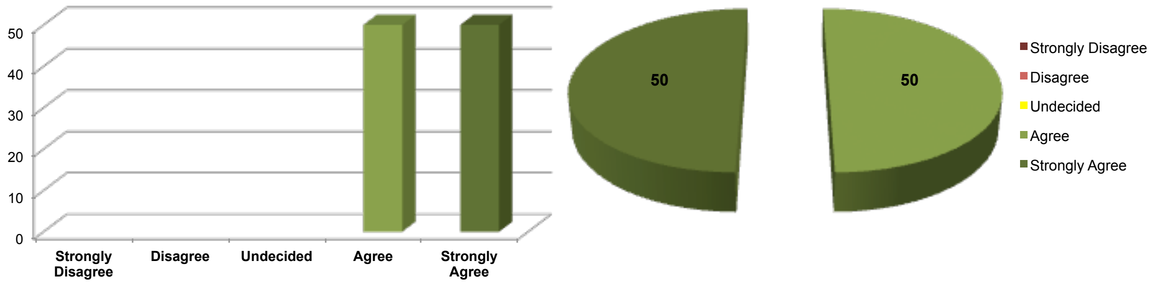


Figure 14. Results of the survey for statements 6-9.

Table 3 illustrates a summary of the statistics of the survey. As shown, the average (mean) of the responses to the statements is 4.27 which means the participants either agree or strongly agreed with all the statements. The standard deviation for all the statements is 0.67, which is relatively small with negative skewness values.

Table 3. Summary of the statistics of the survey

	Mean	Median	STD	Skewness
Statement 1	4.71	5.00	0.469	-1.067
Statement 2	4.14	4.00	0.363	2.295
Statement 3	4.21	4.00	0.802	-1.482
Statement 4	3.86	4.00	0.864	-1.361
Statement 5	3.79	4.00	0.893	-1.035
Statement 6	4.21	4.00	0.802	-1.482
Statement 7	4.71	5.00	0.469	-1.067
Statement 8	4.29	4.00	0.825	-1.583
Statement 9	4.50	4.50	0.519	0

Table 4 summarizes some of the opinions of the participants on the potential merits and the improvement opportunities identified with the application of the Value Map. We write the exact statements of the participants as elicited and recorded in the third workshop.

Table 4. The summary of the opinions of the workshop participants on the merits and the improvement opportunities of the Value Map

Merits	Improvement opportunities
Useful in competitor analysis , understanding the needs of customers	Seems too complicated and scientific.
Helps in viewing the value from the customer's perspective, design the product features based on the value they create for the customers and configure the product components based on the cost and benefits associated with them.	High-level of detail that can be boring for the upper level management
Can be applied in and is useful for cross-functional teams	Understanding how to read the map can take some time and requires some facilitation
Provides a comprehensive 3-dimensional (provider, product/service/, customer) view of value creation and capture	It should be presented section by section to help the audience gain a better understanding of the overall method
Useful for organizational diagnosis and product/service improvement	A quantification of the qualitative concepts to accompany the Value Map is required

To sum up, the participants found the Value Map a useful visualization tool that can contribute to the decision processes that require competitor analysis, understanding customer needs and preferences and the features of the product or service that needs to be designed or improved to meet and fulfill the customer needs. Some of the participants stated that the Value Map can be of great value for cross functional teams and when applied for organizational diagnosis. The discussions with the participants also revealed a number of improvement opportunities in terms of adding a quantitative model, simplifying the graphical representation, and the parsimoniousness of the conceptualizations.

The participants also commented on the relationship between the Value Map and the Business Model Canvas. They were unanimous that the representations created by Business Model Canvas can be used as an input to the Value Map. In other words, the Value Map makes explicit the relationships between the building blocks of a business model represented in the Business Model Canvas.

6. Conclusions

In this chapter we introduced the Value Map as a problem structuring method (PSM) that aids in conceptualization and representation of value creation and capture in service-oriented business models. The Value Map is grounded in the theoretical insights from economics, management science and (services) marketing literature, drawing principally upon work from the past two decades on value creation and capture, including theories, frameworks, constructs, and other models.

We illustrated the usability and applicability of our framework by modeling value creation and capture in Amazon Marketplace, one of the Amazon.com's business models, circa 1997 to explain the reasoning behind the changes that occurred in Amazon.com's business model circa 2001.

To evaluate the usefulness of the Value Map we conducted an empirical study in which we also compared the Value Map with Business Model Canvas which is widely recognized as a tool for business model design and innovation. The study was conducted in form of three workshops with 14 senior managers and executives from a range of industries in Iran. In the first workshop we presented the theoretical and conceptual discussions underlying problem structuring and business modeling. Next, we familiarized the participants with Business Model Canvas and presented an example illustrating its application in business modeling. In the second workshop, we introduced the value map and showed the application example presented in this chapter. At the end of the second workshop the participants filled out a survey questionnaire. The questions were divided into three categories: the importance of value creation and capture in business models, the potential merits of modeling value creation and capture with the Value Map and comparison of the Value Map with the Business Model Canvas.

The results reflected that the participants believed that Value Map helps business practitioners to understand and analyze customer value, customer value creation, and the value capture processes. Based on the results, this is achieved by creating a common language that enables the representation and the discussion of the as-is and to-be situation of value creation and capture in an organization's business model. The results in general suggest that Value Map is a useful visualization tool that contributes to managerial decision making processes of business practitioners in the choice situations that entail value creation and capture in an organization's business model. We learned that the Value Map complements and augments the Business Model Canvas by aiding the business practitioners in representing the necessary building blocks of business model of an organization and their inter-relations and interconnectedness.

A week after the second workshop, we held the third workshop with the participants to debrief them on the application, the potential merits and the improvement opportunities with respect to the Value Map. Based on the discussions we drew the conclusion that the Strategy Canvas can be used as an input to the Value Map in designing the value creation and capture processes in a business model. These discussions also revealed a number of improvement opportunities such as quantification of the qualitative concepts, improving the graphical representation of the Value Map. Some of the improvement opportunities mentioned by the participants are already taken into account in the instantiation of the Value Map in the www.tradeyourmind.com online platform. For instance, the inclusion of the quantitative models that can generate numerical analyses of various value creation and capture strategies is part of the platform. The step-by-step model generation wizard embedded in the www.tradeyourmind.com platform also facilitates the development and the presentation of the Value Map. We will try to address the remaining points in our future work.

This research suffers from a number of limitations. We used secondary data synthesized in a single case study to illustrate the applicability of the Value Map. Despite the fact that Amazon.com is well-studied company and there are plenty of secondary sources available that enable data triangulation, we believe the usage of primary data for business modeling in the Value Map can contribute to the practical relevance of the representations. Thus, in our future work we will develop our models based on primary data from prospective business cases. This will definitely result in a better evaluation of the applicability of the Value Map.

The second limitation of this research concerns the empirical study we conducted to evaluate the usefulness of the Value Map. The fact that all the participants in the survey were from Iran and the relatively small sample size limit the generalizability of the findings of our research. To tackle this limitation, the same study should be conducted among executives and managers from different countries. To ensure an accurate evaluation, the participants should have knowledge about the research context, the Value Map and Business Model Canvas, the alternative methodology with which we compared the Value Map. Thus, we believe the study should be conducted in form of workshops in which the participants are familiarized with the methodologies and attempt to apply them to develop a business model. In the empirical study we conducted, we included participants that belonged to different industries. Therefore, the sample size although relatively small, featured representatives from different industries. This heterogeneity of the participants can positively contribute to generalizability of the study results.

Lastly, the articles based on which the conceptualizations underlying the Value Map were developed are not exhaustive. Despite the fact that we synthesized over 30 well-cited articles on value creation and capture that were to the best of our knowledge seminal to the field, some relevant work may still have not been included in the review of the literature. Inclusion of such articles can bring in new modeling constructs in the Value Map or fine-tune and improve the existing constructs. Refining our conceptualizations based on the existing work that has not been included in the study will also be a part of our future work.

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Appendix – www.tradeyourmind.com an Instantiation of the Value Map

In this appendix we present an instantiation of the Value Map in an online business modeling platform called Tradeyourmind.com. The Tradeyourmind.com platform provides entrepreneurs with a set of tools for defining, analyzing, evaluating and presenting their business models. In other words, Tradeyourmind.com enables the entrepreneurs who do not have the training and background knowledge in business to turn their business ideas into business models. As of March 2013, over 100 projects have been defined on the Tradeyourmind.com. The main customers of the platform are the entrepreneurs and the incubators that support start-up companies. Figure 1 depicts the tradeyourmind.com home page.

Figure 1. Tradeyourmid.com home page

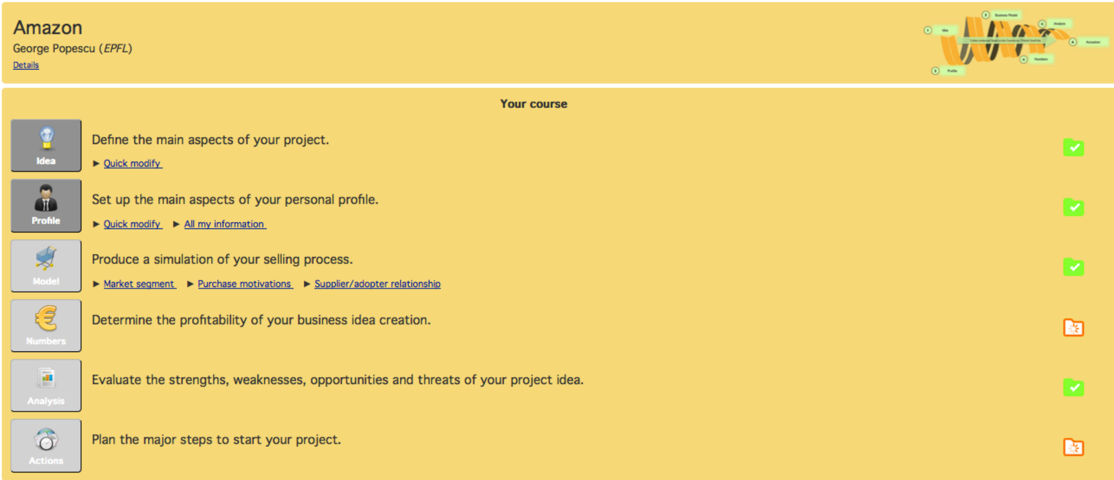

Figure 2. Main menu of the tradeyourmind.com platform

Figure 2 illustrates the main menu of the tradeyourmind.com platform where the personal profile of the entrepreneur is set up and his idea is defined. In the "Produce a simulation of your selling process" tab the entrepreneur can have access to three different types of analyses of his business idea: Market segment, Purchase motivations and Supplier/adopter relationship. The supplier adopter relationship analysis in the tradeyourmind.com platform is an instantiation of the Value Map. An eight-step wizard guides the entrepreneur in developing the Value Map. This step-by-step wizard facilitates the understanding of the building blocks of the Value Map and their inter-relations.

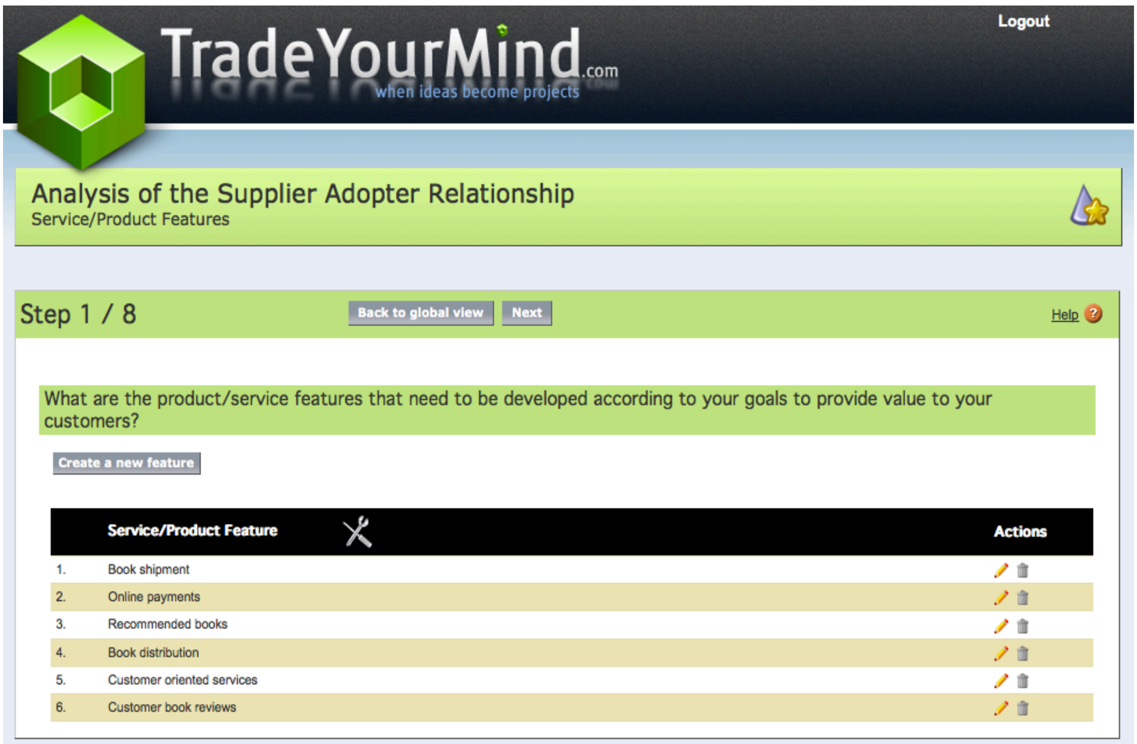

Figure 3. Step1 - Defining the service/product features

As illustrated in Figure 3, in the first step, the features of the product or service need to be defined. As discussed earlier, features are the emergent properties of the product/service. We have used the information form the Amazon.com's case in the chapter to generate the Value Map in the Tradeyourmind.com platform. As illustrated, "book shipment", "online payments", etc. are the features of the book selling service in Amazon.com.

Figure 4. Step 2 – Competitive positioning of the service/product

Figure 4 shows the second step in the analysis of the supplier adopter relationship (i.e., the Value Map) in the tradeyourmind.com platform. In this step, the positioning of the product/service relative to the competing offering is analyzed. As illustrated, we compare the features of Amazon.com's service, defined in Step 1, with those of Barns and Noble. Once the corresponding values are entered the comparison chart is automatically generated. This step helps the entrepreneur analyze the relative net perceived customer value (NPCV) of the service/product it offers.

Figure 5. Step 3 – Mapping service/product features to customer benefits

In the third step as shown in Figure 5, we map the service/product features to the benefits they create for the customer. This clarifies the relationship between the features the supplier provides and the benefits that customers perceive from these features. The customer perceptions of service/product benefits are modeled in a different section of the tradeyourmind.com platform, called the "Purchase motivation analysis". Therefore, in this step we simply map the features defined in Step 1 to the value attributes or the benefits as perceived by the customers. For instance, "online payment" is a service feature by Amazon.com that creates the benefit "ease of payment" for the book reader.

Figure 6. Step 4 – Defining the service/product components

In the fourth step as shown in Figure 6, we define the service/product components that are required for creation, delivery, promotion, supply and sales of the service/product features. As stated in the chapter, these components are in essence a subset of the resources and the capabilities of the service provider and its value network. In short, the components present the necessary building blocks of the service/product offered by the provider. In the case of Amazon.com, examples of components include, “credit card processing”, “customer relationship management system”, etc.

Figure 7. Step 5 – Mapping the service/product components to the service/product features

In Step 5, as presented in Figure 7, we map the service/product components to the service/product components. For instance, "electronic funds transfer" and "credit card processing" are the two components that create the "online payment" feature. This is in effect a part of the value creation process as discussed in the chapter. Understanding the relationship between the service/product components contributes to alignment between the value creation processes of the service provider and the service/product benefits to be realized for the customers.

Figure 8. Step 6 – Defining the list of the companies in the value network

Figure 8 shows the sixth step in generating the Value Map. In this step, the value network configuration is specified. As shown in Figure 9, in Step 7 the service/product components are mapped to the companies that compose the value network.

Figure 9. Step 7 – Mapping the service/product components to the companies in the value network

Figure 10. Step 8 – Completion of the process

Finally, as shown in Figure 10, in the last step when the process is completed the entrepreneur can access different sections of the platform that enable him to view or modify various aspects of his business model. By choosing the tab “analysis of the supplier adopter relationship” he can view the Value Map generated by the wizard.

Figure 11 shows the Value Map generated at the end of the eight-step wizard. We can see the companies that compose the value network (referred to as the supplier and the supplier’s partners), the service/product components they provide, the mapping between these components with the service/product features and the value attributes or the benefits by the customers. Clicking on the “competitive differentiation” reveals the positioning of the service/product features relative to the competing offers. Thus, customer value and the customer value creation processes are included in the model. The provider’s value capture is however not represented graphically as part of the “supplier adopter relationship” in the tradeyourmin.com platform.

For analyzing the value capture, the entrepreneur should choose the “determine the profitability of your business idea creation” tab in the main menu of the tradeyourmind.com platform as illustrated in Figure 2. From there he can then calculate the profit potential of the business idea. It should be noted that in this instantiation only monetary value for the service/product provider is taken into account and non-monetary value such as “positive word of mouth”, “customer loyalty”, etc. are not included in the analysis.

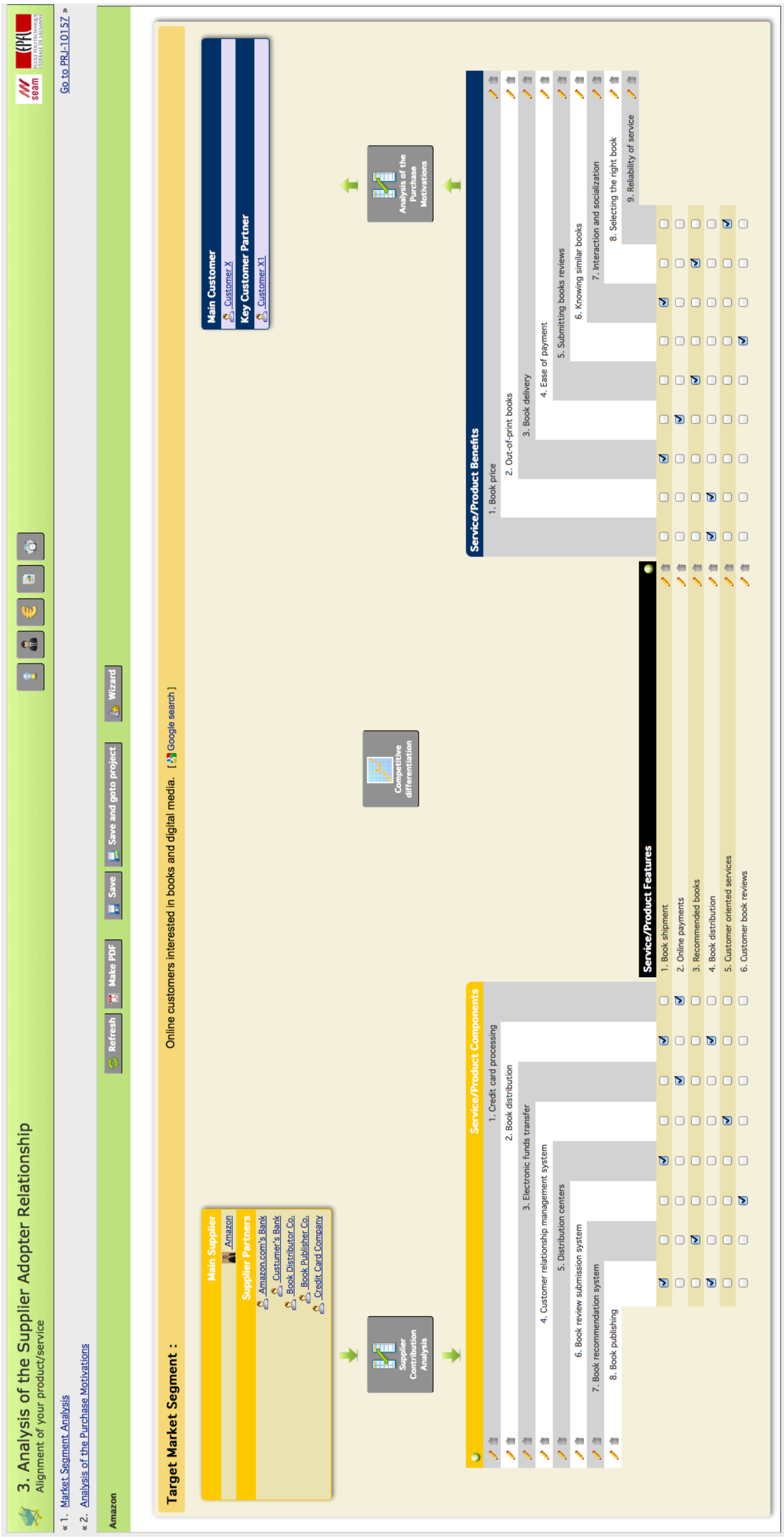
3. Analysis of the Supplier Adopter Relationship
Alignment of your product/service
Target Market Segment :
Online customers interested in books and digital media.
Main Supplier
Amazon
Supplier Partners
Service/Product Components
Service/Product Features
Service/Product Benefits
Main Customer
Key Customer Partner

Figure 11.

Costs

Direct Costs

	Service/Product Component	Type	Quantity	Unit	Unit Price	Total
1.	Credit card processing	Service	1'000'000	Unit	0.50	CHF 500,000.00
2.	Book distribution	Distribution	1'000'000	Unit	6.00	CHF 6,000,000.00
3.	Electronic funds transfer	Service	1'000'000	Flat	0.10	CHF 100,000.00
4.	Customer relationship management system	Service	1	Flat	2'000'000.00	CHF 2,000,000.00
5.	Distribution centers	Distribution	5	Flat	1'000'000.00	CHF 5,000,000.00
6.	Book review submission system	Service	1	Unit	100'000.00	CHF 100,000.00
7.	Book recommendation system	Service	1	Flat	500'000.00	CHF 500,000.00
8.	Book publishing	Production	1'000	Unit	12.00	CHF 12,000.00
Total direct costs						**CHF 14,212,000.00**

Figure 12. Service/product provider value capture - direct costs

To calculate the monetary value captured by the service/product provider, as illustrated in Figures 12 and 13, the direct and indirect costs of the service/product offer are calculated. The direct costs pertain to the costs of the service/product components. The indirect costs are those that cannot be directly linked to a service/product component.

Indirect Costs

	Title		Total per Year
1.	Marketing	CHF	1'000'000.00
2.	Salary – General and Administrative	CHF	3'000'000.00
3.	Technology and content	CHF	1'200'000.00
4.	External Advisors	CHF	0.00
5.	Other	CHF	0.00
6.	Meals and Accomodations	CHF	0.00
7.	Travel and Transport	CHF	0.00
8.	Salaries	CHF	0.00
9.	Telecom	CHF	0.00
Total indirect costs			**CHF 5,200,000.00**

Figure 13. Service/product provider value capture - indirect costs

The revenue (i.e., monetary value captured by the service/product provider) is determined by the features or the service/product. As illustrated in Figure 14, Amazon.com charges the customers for the shipment and the online payments in addition to the price of the book. As shown in Figure 15, the profit (i.e., net captured value) made by the service/product provider is calculated by subtracting the direct and indirect costs from the revenues generated by the service/product.

Revenues

Revenues

	Service/Product Feature	Type	Quantity	Unit	Unit Price	Total
1.	Book shipment	Add	1'000'000	Rate	5.00	CHF 50,000.00
2.	Online payments	Add	1'000'000	Unit	1.00	CHF 1,000,000.00
3.	Recommended books	Free	0	Flat	0.00	CHF 0.00
4.	Book distribution	Sale	1'000'000	Flat	20.00	CHF 20,000,000.00
5.	Customer oriented services	Free	0	Flat	0.00	CHF 0.00
6.	Customer book reviews	Included	1	Flat	0.00	CHF 0.00
Total Revenues						**CHF 21,050,000.00**

Figure 14. Service/product provider value capture - Revenues

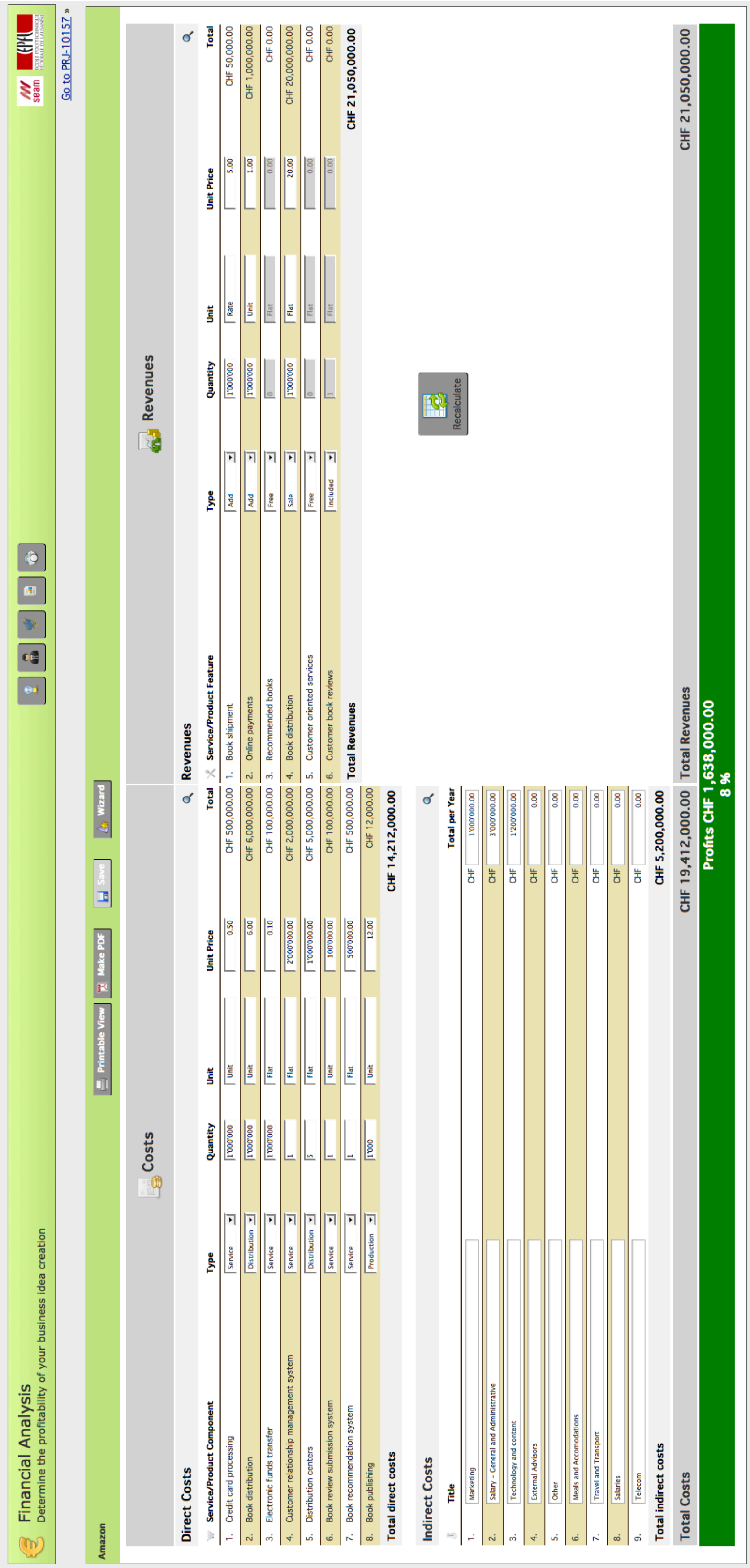

Figure 15. Service/product provider value capture - Profit

Chapter 3: The Viable Service System Model: Modeling and Analyzing Viability in Service Systems

Abstract: *Broadly speaking, a service system is a configuration of companies and individuals that provide value to all of its actors. Recent research has explored the principles of service system viability based on Stafford Beer's viable systems approach. In this research, we introduce the Viable Service System Model as a problem structuring method (PSM) based on Beer's Viable System Model (VSM) for concretely modeling the viability of service systems. The Viable Service System Model is an extension to the System Diagram in the Systemic Enterprise Architecture Method (SEAM). It contributes to the diagnosis of viability in service systems by providing analytical assistance to address the question, "How can a service system remain viable?" It can aid managers in gaining a better understanding of the organizational design, as well as of the control structures that need to be put in place in a service system to ensure it meets the criterion of viability. We illustrate the applicability of the Viable Service System Model by means of an instrumental case study of a utility company service. The case study data was gathered during a consulting project we undertook for this utility company. A simplified version of the Viable Service System Model was applied in two consulting projects. We include the reflection and feedbacks from the organizational participants in the modeling sessions on the usefulness and the applicability of the Viable Service System Model.*

1.Introduction

The concept of a *service system* is central to service science and service-dominant (SD) logic (Vargo & Lusch, 2004; 2008; Lusch & Vargo, 2006). A service system is defined as “a configuration of people, technologies, organization and shared information, able to create value to providers, users and other interested entities, through service” (Maglio & Spohrer, 2008). A service system delivers this value for as long as it remains in existence. Service science researchers have recently shown an increasing interest in studying the viability of service systems. See for example (Barile et al., 2010; Saviano et al., 2010).

Following systems inquiry, this body of research uses systems theory and cybernetics to understand the factors that can contribute to the viability of a service system, see for example (Barile et al., 2010; Saviano et al., 2010). However, systems inquiry encompasses more than just systems theory and cybernetics.

Banathy and Jenlink (2004) proposed to conceptualize systems inquiry into three sub-parts: systems philosophy, systems theory and systems methodology. Systems philosophy embodies the fundamental assumptions about the domain of inquiry. Systems philosophy defines the worldview of the systems thinker. The systems theory and systems methodology used by the systems thinker depend on his systems philosophy. Banathy and Jenlink (2004) identified three aspects of systems philosophy: epistemology, ontology and axiology. Epistemology is concerned with the origins of the systems thinker worldview, or how we know what we know. Ontology is the worldview itself, the systems thinker’s view of reality. Axiology defines the ethics of the systems thinker in terms of what is right or wrong, elegant or not. Of the three components of systems philosophy, ontology is the only one that is often made explicit. Epistemology and axiology remain implicit in most systems thinking discourse [for exceptions to this rule, see (Weinberg, 1975; Vickers, 1968, 1987). But implicit or not, epistemology and axiology determine systems theory and methodology.

Systems theory provides the set of principles that can be invoked to build an understanding of some aspect of reality as perceived by the observer. Systems theory refers to the science of systems that resulted from General Systems Theory (Bertalanffy, 1976). General Systems Theory provides “models, principles and laws that can be generalized across various systems, their components and the relationship among them”. General Systems Theory is, in effect, a theory of universal principles that are common and apply to systems in general. Finally, systems methodology aims at the instrumentalization of systems theory and its application to a functional context (Banathy & Jenlink, 2004). It involves developing models and methods to make adequate predictions or retrodictions about some aspect of reality and to learn how to control a phenomenon of interest in a desirable way (Klir, 2001).

Based on Banathy’s Systems inquiry, our research has the following particularities: (a) it is based on an explicit systems philosophy, and most specifically an epistemology in which we explicitly define what we view as viability; (b) it involves a systems methodological approach for either analyzing the viability of a service system or for designing a viable service system, achieved by means of applying systems modeling.

Our epistemology is often called interpretive (Checkland & Scholes, 1999). It defines a worldview where knowledge is created as a relation between an observer and the observed. The systems modeling reported in this chapter follows our epistemological worldview.

In systems modeling, we construct systems that are models of some aspects of reality as perceived by the modeler (Klir, 2001). The first step of systems modeling process is for the modeler to observe some aspect of reality referred to as the "universe of discourse" (UoD). Employing a set of conceptualizations, the modeler then distinguishes a set of entities that compose the universe of discourse and the relationships between them. In effect, the conceptualizations employed in a model form a lens through which the modeler observes phenomena of interest in a UoD (Tarski & Corcoran, 1983).

Next, the modeler develops a model in the representation domain. The model is composed of modeling constructs that represent the observed entities in the UoD. The conceptualization explains the kinds of modeling constructs in the representation domain and allows for a mapping between the modeling constructs in the representation domain and the entities observed in the universe of discourse. A conceptualization thereby gives the modeling constructs a real-world interpretation.

In the modeling process conducted in this research, a Swiss utility company called SIG[1] (hereinafter referred to as Utility Company) is the service system that constitutes our universe of discourse. Our conceptualizations are derived from Stafford Beer's Viable System Model (VSM) (Beer, 1984, 1995). In the representation domain, we apply the Viable Service System Model as a problem structuring method (PSM) (Mingers & Rosenhead, 2004; Rosenhead, 1996; Rosenhead & Mingers, 2001). The Viable Service System Model embodies our conceptualizations, to represent and analyze viability in SIG as a service system.

The work presented in this chapter is inspired by design science research (Hevner et al., 2004) from a methodological standpoint. To develop the Viable Service System Model we draw on conceptualizations from VSM in our knowledge base. To validate the applicability of the modeling artifact, we apply it to model and analyze viability in the context of a utility company's service system. We have also applied the Viable Service System Model in a number of consulting projects. The feedbacks provided by the participants on the usefulness and the applicability of the representations help us in refining and improving the Viable Service System Model.

This chapter is structured in the following way. In Section 2, we describe the conceptualizations we employed in the systems modeling reported in this research. In Section 3, we model the utility company as a service system by applying the Viable Service System Model. In Section 4, we discuss the related work. In Section 5, we present our conclusions including the feedbacks from the application of the Viable Service System Model and discuss future work. Finally, in an appendix to this paper, we define a number of important terms and concepts, used and referred to throughout the

[1] SIG merely serves as a concrete example of a service system to illustrate the applicability of our The Viable Service System Model. The information presented on SIG in this research is based on the understanding we developed about various aspects of its service offerings and organizational structure, through a consulting project we undertook for SIG.

chapter, that can contribute to a better understanding of the Viable Service System Model and the discussions in the chapter discussions. These concepts are used and referred to throughout the chapter.

2. Conceptualizations

As explained earlier, our conceptualizations are inspired by Stafford Beer's VSM. VSM is applied as a diagnostic tool to assist in the analysis and design of viability in a variety of contexts. For reports on the applications of VSM see (Espejo, 1989). Recently, researchers in the domain of service science have shown increasing interest in conceptualizing and modeling viability in service systems using VSM. A recent issue of the Journal of Service Science features insights and the inferences that can be drawn from VSM to gain a better understanding of viability in service systems and to design viable service systems (VSS). Examples include but are not limited to (Barile et al., 2010; Saviano et al., 2010).

In this section, to gain a better understanding of our conceptualizations, we first give a brief account of VSM, explaining its various parts and underlying concepts. Next, we describe a graphical representation of our conceptualizations. We call this graphical representation a "conceptual model". Figure 1 depicts a simplified representation of VSM.

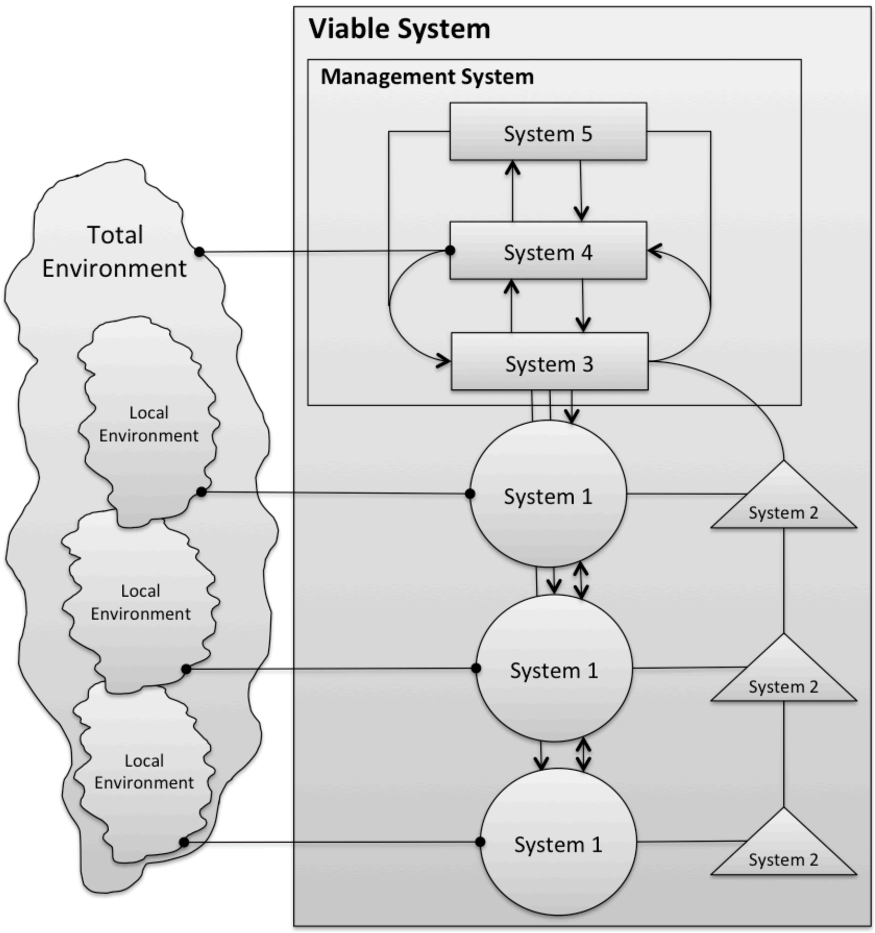

Figure 1. A simplified representation of VSM derived from (Beer, 1984,1995)

1.1 VSM

Stafford Beer decomposes a viable system into a set of five systems: System 1 (the collection of operational systems), System 2 (the co-ordination), System 3 (inside and now), System 4 (outside and future) and System 5 (identity). Beer (1984,1995) refers to systems 3-5 as a meta-system of the management system.

1.1.1. System 1

Stafford Beer refers to the fundamental operations within a viable system as its System 1. Operations create the outputs that justify the existence of the system from an observer's point of view. Hence, the functions of the System 1s (i.e. operational systems) are the reason that the system exists in the first place (Beer 1995). Recursively, an operational system is in turn a viable system. This means, an operational system contains smaller operational systems and is contained in a hierarchy of larger operational systems. Thus, an operational system can be decomposed to its constituent operational systems. In Figure 2, we illustrate a viable system with three operational systems.

A system should interact and communicate with its environment in order to maintain its viability (Ashby, 1956). Channels enable the interaction and communication between the entities within the system and the entities within the environment. In Figure 2, the channels with arrows at both ends denote the interactions between the operational systems.

1.1.2. System 2

System 2 coordinates the various operational systems composing the viable system. It consists of a regulatory center for each System 1, in order to ensure that the overall operations are running smoothly and to deal with and recover from any disruptions and oscillations. In order to achieve regulation, it communicates the desired bounds of certain variables of the operational systems and monitors compliance. Regulation of the interrelated operational systems creates synergy and makes the system more than the sum of its parts.

1.1.3. System 3

This system directs the current and internal operations (i.e." inside and now") and supervises the coordination activities of System 2. System 3 develops a black-box view of the System 1s (i.e. viewing only their inputs and outputs without knowing their internal functions and constituent systems) and looks for ways to optimize the overall efficiency and improve the performance of the operational systems by overviewing their interactions. System 3 exerts control over the System 1s mainly by using the vertical command channels shown on Figure 2.

1.1.4. System 4

This system deals with "outside and future". It guarantees the adaptation of the system as a whole to a changing environment. In doing so, it requires an understanding of the total environment in which the system is embedded: This is beyond the capability of the operational systems, because they concern themselves with their local environment, which is only a sub-set of this total environment. As well as interacting with the environment, System 4 needs to interact with System 3. This is because adaptation cannot be achieved without an understanding of the system, as it currently exists. In Figure 2, the round-tip lines denote the interaction between the System 1s with their local environment and System 4 with the total environment.

1.1.5. System 5

System 5 defines the ethos and the purpose of the system as a whole and monitors and strikes a balance between the activities of Systems 3 and 4. In other words, System 5 maintains the balance between the management of "inside and now" and "outside and future".

1.2 The Conceptual Model, Derived from VSM

Figure 2 shows a graphical model of our conceptualizations. We call this model the conceptual model. Compared to the VSM, in Figure 2, we decompose the management system based on the systemic functions that systems 2, 3, 4 and 5 perform for the system to remain viable. Three key functions are identified: homeostatic, heterostatic and identity.

This function-based re-representation of VSM assists us in translating the entities we observe in the universe of discourse to the constructs we employ in our models in the representation domain. Christopher (2007) gives a brief account of the functions that the management system performs in any viable system. Our conceptual model is partly inspired by his discussions. It should be clarified that a management (sub)system in Figure 1 can perform more than one of the functions specified in the conceptual model at a time. Thereby, the model does not suggest a one-to-one mapping between the management (sub)systems in Figure 2 (i.e., System 3-5) and the systemic functions carried out by the management system as a whole, as illustrated in Figure 3 . We now explain the three key functions.

The homeostatic function focuses on maintaining the status quo and thereby "stability" is an emergent property of the homeostatic function of the management system.

The heterostatic function deals with all sorts of improvements. Thus, "evolution" and "adaptation" are the emergent properties of this function (Christopher, 2007).

Identity is invariance in some certain aspects of the system, in spite of all the changes that the system is going through. Hence, a system's identity is sustained only when a proper balance between stability and change is maintained.

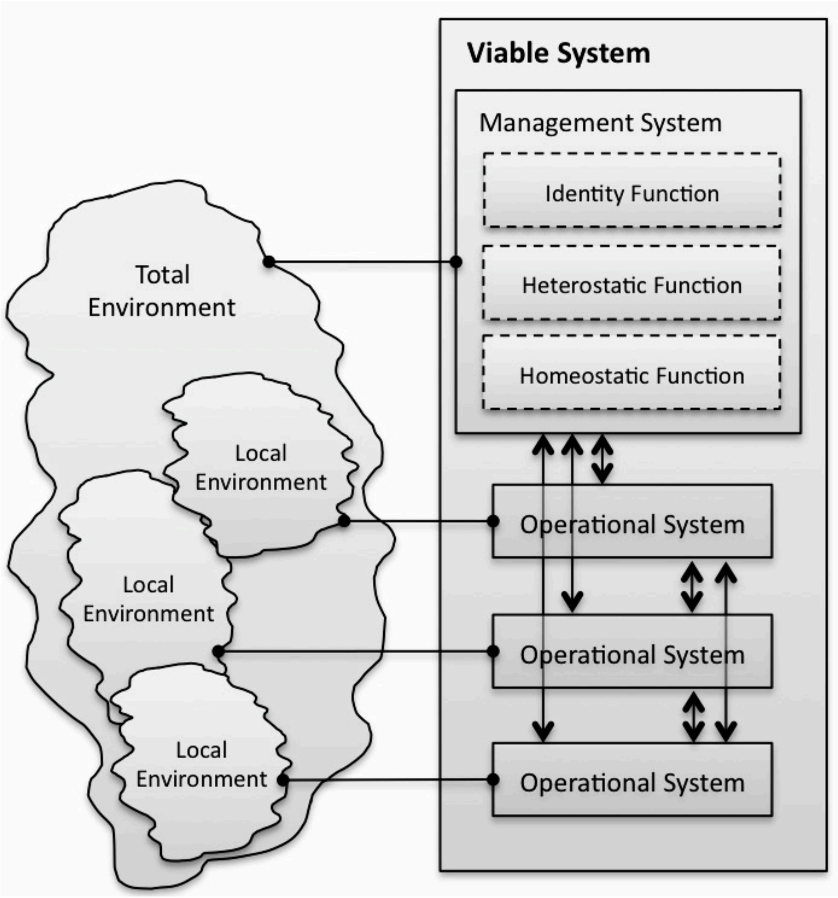

Figure 2. The conceptual Model of a Viable System

1.3 Viability

Beer (1995) defines viability as the ability of a system to maintain a separate or an independent existence. Beer (1995) also adds that viability is a function of the balance maintained between stability versus adaptation. A system achieves viability by maintaining the aspects of its operations that are linked to its identity (i.e. the aspects that enable the observer to identify the system). Hence, when a system loses the aspects that help an observer distinguish it from other entities, it no longer exists for this specific observer. Maintenance of these aspects requires the management system to keep the state of some variables of the operational systems stable and/or precipitate change in the state of some operational systems' variables. This is achieved by performing the three functions outlined in the conceptual model. Recursively, the states that an operational system is to maintain or achieve constitute its identity from the point of view of the management system. Hence, the management system within each operational system is to ensure the achievement or maintenance of those states, for the operational system to remain viable.

3. Modeling and Analysis of Viability in a Service System

In this section, we first briefly explain the modeling notations and semantics embedded in the Viable Service System Model. To this end, we present a generic model embodying the conceptualizations outlined in the previous section. Next, we apply the Viable Service System Model in order to develop models of the Utility Company as a service system. The theoretical insights embodied in our conceptualizations will contribute to our understanding of the mechanisms by means of which the Utility Company maintains its viability. Figure 3 is a generic Viable Service System Model.

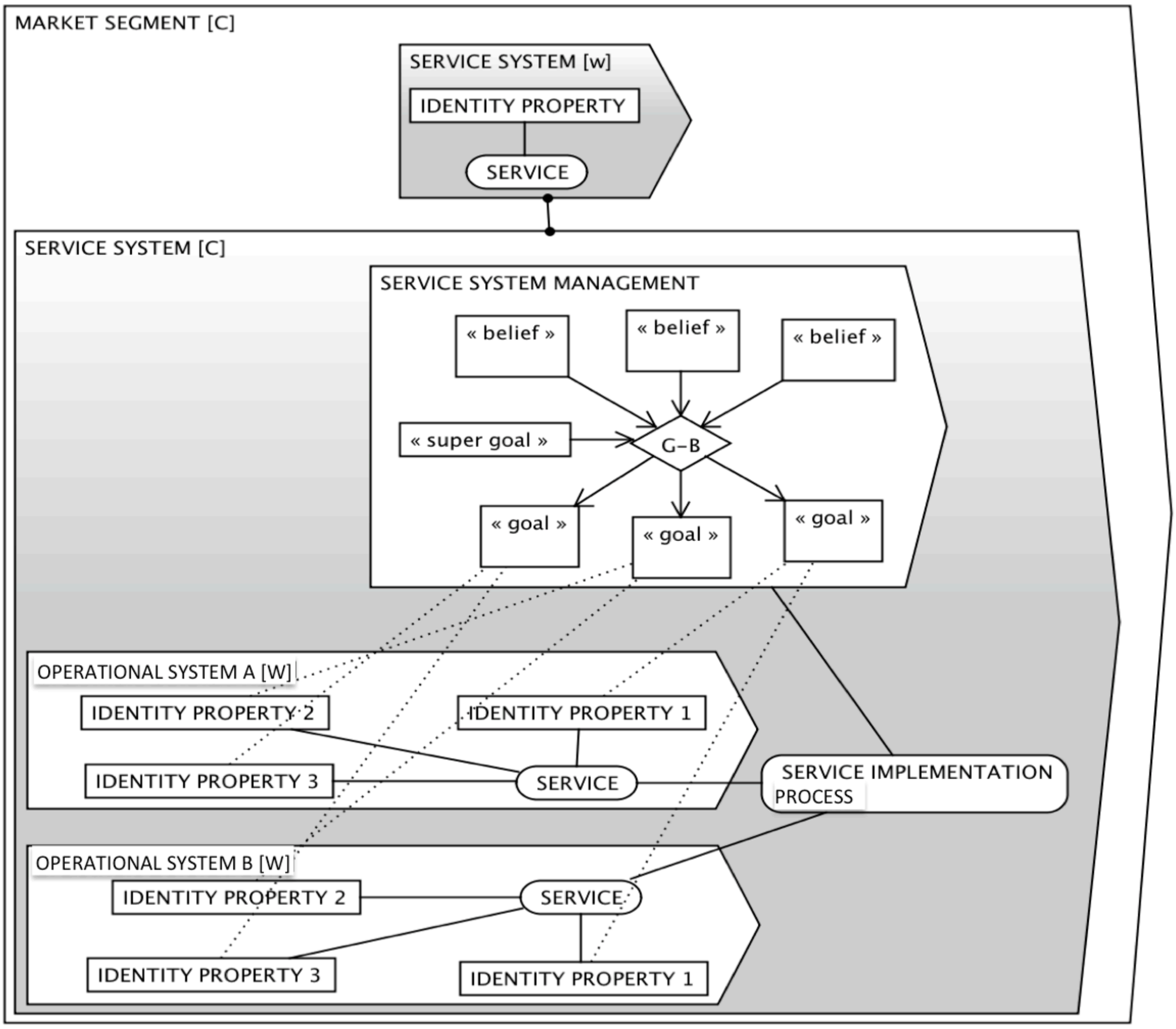

Figure 3. The generic Viable Service System Model

In the Viable Service System Model, a system is denoted by a block arrow and can be represented as a whole (i.e. black box) or as a composite (i.e. white box). Modeling the market segment as a composite, we represent the service system and its total environment. The environment of the service system comprises the service adopters, regulators, etc.

The service system can be decomposed to its constituent operational systems and a management system. Recursively, each operational system is then modeled as a service system and decomposed to its sub-operational systems and its management system.

A service system is characterized by its behavior and properties. In the Viable Service System Model, behaviors and properties are respectively represented by ovals and rectangles. Service systems as wholes and as composites have behaviors and properties. We call the behavior of a service system as a whole “service”. The behavior of a service system as a composite is called “process”. This process captures the implementation of the service. Representing a service system as a composite, we model how its operational systems and management system contribute to the service implementation process. The property of a service system as a whole captures the “identity” of the service system. The identity of a service system is expressed by a prescriptive statement that conveys what the service system is to do in order to maintain its identity and sustain its viability.

As illustrated in Figure 4, we model the way a service system sustains its identity by considering the maintenance of a particular identity property as a super goal and refining it to a set of (sub)goals. This refinement is a cognitive process carried out by the management system with the help of the beliefs it holds. Beliefs, in effect, represent the management system’s interpretations of the state of service system and the systems with which the service system interacts.

Based on the explanations in Section 1.3, goals are grouped into two categories. The first category includes the goals that represent the changes that are to be made to some states of the service system. We refer to these goals as achievement goals. Goals in the second category specify the states of the service system that are to be kept the same and maintained. We call these goals maintenance goals. Achievement and maintenance goals respectively reflect the heterostatic and the homeostatic functions of the management system within a service system. The management system of the service system then, assigns goals to the constituent operational systems. These goals are to be considered by the service systems as the super goals and are thereby refined to a set of achievement and/or maintenance goals.

Going back to our discussion on the link between viability and value in service systems, we assert that the super goals represent the value properties that the service systems tries to achieve to remain viable. Recursively, as these super goals are refined and decomposed to (sub)goals that are in turn super goal. Thus, we can state that for the entities within the service system the value properties are refined and decomposed.

Figure 4, is a model of the Utility Company interacting with *electricity consumer* and *gas consumer* (service adopters) and the *government* in the *energy segment* (i.e. entities in its environment). “Provide gas and electricity service” is the service, the Utility Company as a whole, is offering to the service adopters. Modeling the Utility Company as a composite, we represent the *company management* (the management system in the conceptual model) and *electricity BU* (business unit) and *gas BU* (operational systems in the conceptual model) and their contribution to “provide gas and electricity service”.

In Figure 4, “we are to provide safe and reliable energy services” is the identity property of the Utility Company as a whole, which is then perceived by the *company management* as a super goal. The *company management* believes that “reliability of energy service is achieved by meeting energy demand” and the belief that “energy service is delivered by electricity and gas BUs” is derived from the organization design of the Utility Company (in the SEAM models, such goals are annotated by “org. design”). Based on these beliefs, the goal “BUs are to supply energy service to meet energy demand” is developed by the *company management* as a refinement of the super goal. This goal is then communicated to the BUs by the management system as their identity properties. The *gas BU* interprets this goal as “we are to supply gas service to meet gas demand”. Other parts of the model can be interpreted the same way.

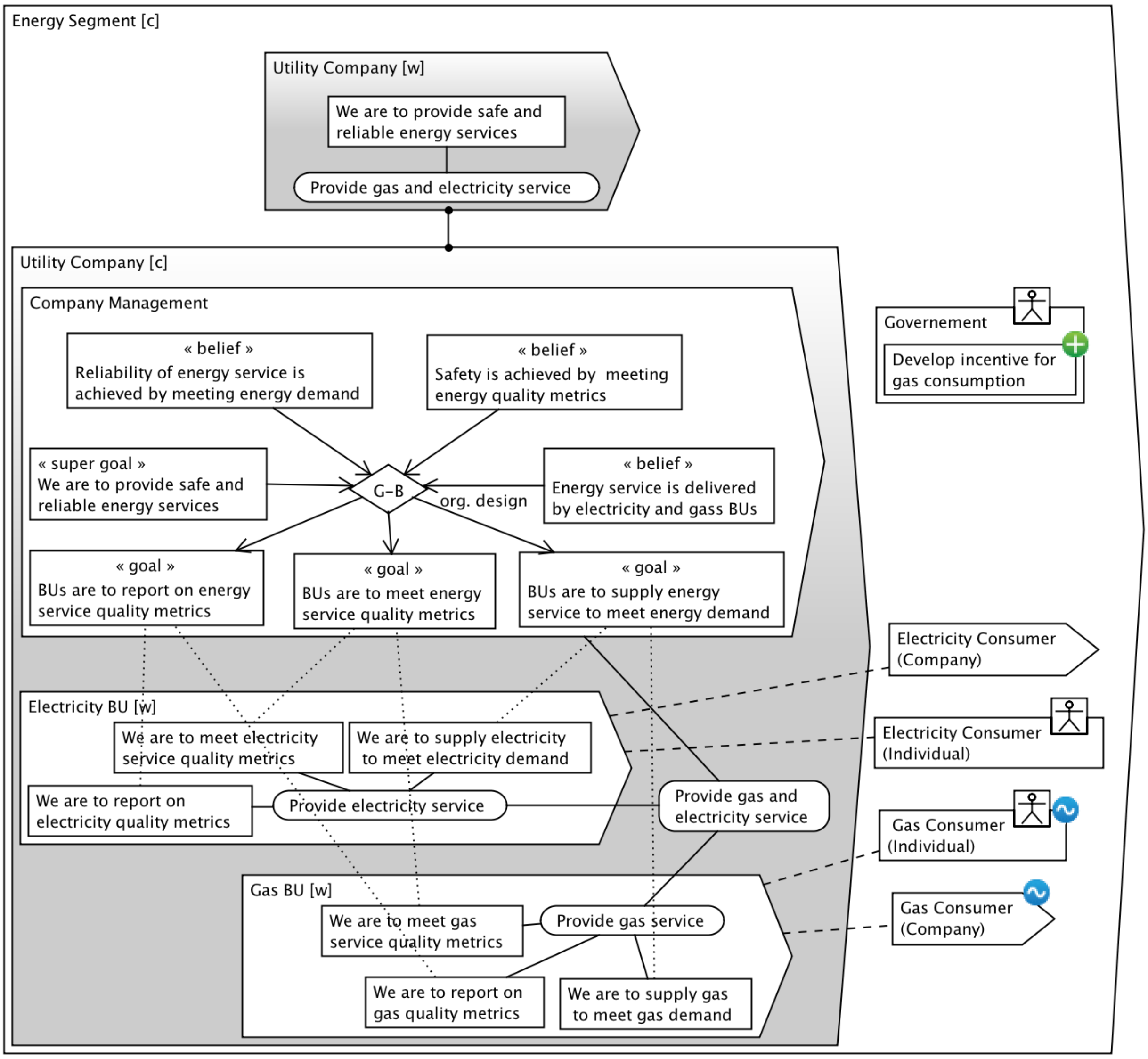

Figure 4. Utility Company in Gas Segment

The pluses in Figure 4 mark the emergence of new entities in the universe of discourse. As it can be seen, the government develops incentives for gas consumption. The new incentives lead to an increase in the number of the *gas consumers* (private and company).

In Figure 5, we represent the *gas BU* as a composite. The composite view of the *gas BU*, provides us with insights into the beliefs and the goals the *gas BU* Management holds. The increase in the number of gas consumers leads to the belief “demand for gas is rising”. The *gas BU* management also believes “gas supply is adjusted by increasing or decreasing the pressure in pipes” and the organization design of the *gas BU* derives the belief “gas supply dept. adjusts the pressure in pipes”. As the identity of the *gas BU* is geared to meeting the demand, the *BU management* formulates the achievement goal “gas supply dept. is to increase the pressure in pipes”.

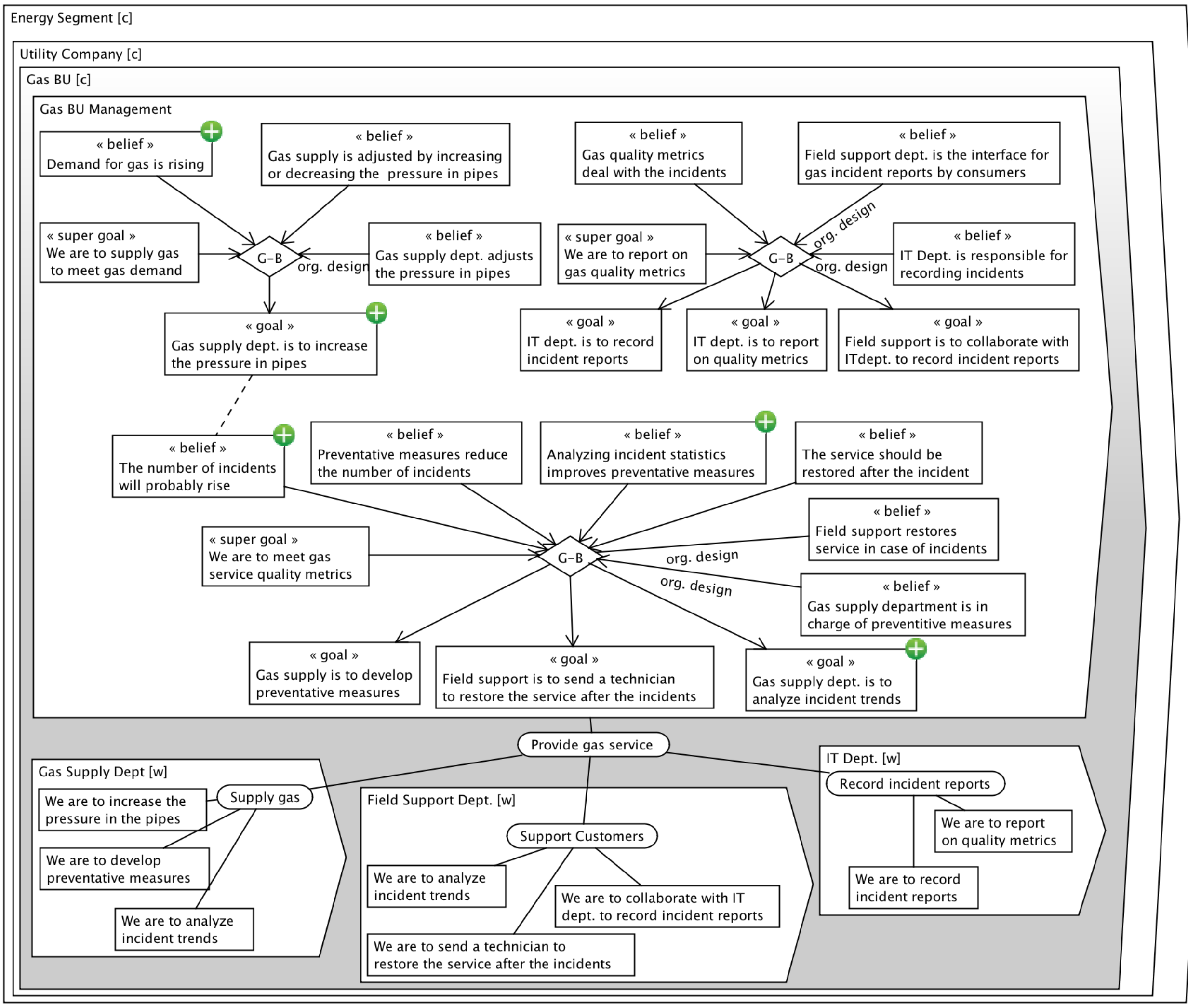

Figure 5. Gas BU in the Utility Company

Whereas, the *gas BU* is to report on and meet the gas service quality service in order to sustain its identity. As illustrated in Figure 5, the *gas BU* believes “gas quality metrics deal with incidents” and “preventative measures reduce the number of incidents”. Increasing the pressure in pipes gives rise to the belief “the number of incidents will probably rise”. The rise in the number of incidents leads to the inability of the *gas BU* to meet the super goal “we are to meet the gas service quality metrics” and consequently threatens the viability of the *gas BU* and the Utility Company.

The belief “ analyzing incident statistics improves preventative measures” reflects how the *gas BU* management plans to counteract the effect of the increase in the pressure in pipes. The analysis of incident statistics results in the development of more effective preventative measures and therefore decreases the incidents. As “gas supply dept. is in charge of preventative measures”, a belief stemming from the design of the organization, the *gas BU* Management formulates the maintenance goal “gas supply dept. is to analyze incident trends”. Other sections of the model can be interpreted similarly. Representing the *gas BU* as a composite, we also model the contribution of its departments to the implementation of the “provide gas energy” service.

In Table 1, we present a mapping between the conceptualizations, modeling constructs in the Viable Service System Model and some entities in the universe of discourse in the modeling process reported in this chapter.

Table 1. Mapping between the conceptualizations, modeling constructs and some of the entities in the UoD.

		Entities in the UoD	
Conceptualizations	**Modeling constructs in the Viable Service System Model**	**Utility Company [c]**	**Gas BU [c]**
Management system	Service system management	Company Management	BU Management
Operational system	Service system	Electricity BU, Gas BU	IT Dept., Field Support Dept., Gas Supply Dept.
Identity	Super goal	We are to provide safe and reliable services	• We are to supply gas service to meet gas demand …
Homeostatic function	Maintenance goal	• BUs are to supply energy service to meet energy demand …	• IT dept. is to report on quality metrics • Gas supply is to analyze incident trends …
Heterostatic function	Achievement goal	----	• Gas supply dept. is to increase the pressure in pipes

4. Related Work

Service science is a fairly new field of research, dating back to 2004 (Barile & Polese, 2010a). Hence, most work in this area is very recent. The concept of service system enables researchers to see a service as a set of interacting providers and consumers who, together, provide value to themselves Hence, when the entity loses the aspects that help an observer distinguish it from other entities, the corresponding system ceases to exist for this specific observer (Barile & Polese, 2010a). Quite quickly, value was linked to the notions of adaptability and survival within an environment (Vargo et al., 2008). Systems thinking was identified as providing some of the necessary foundations for service science (Barile et al., 2010) in general and for service systems in particular. This produced the concept of viable service system (Barile & Polese, 2010b) and resulted in the application of the viable system approach (VSA) to the study of the viability of service systems. VSA is a framework built on Beer's Viable System Model (VSM) (Beer, 1984) and other systems thinking concepts.

Barile and Polese (2010b) compare the fundamental concepts of smart service systems and viable service systems, highlighting the potential mappings between the service science and systems science principles. Godsiff (2009) explains the implications of the law of requisite variety within the service science and reasons about the mechanisms through which a system deals with the variety introduced by its environment.

Barile and Polese (2010a) describe the potential benefits of using network theory and VSA for service science. They also compare the contributions and viewpoints about services, marketing and management of these different frameworks.

There has been earlier research into VSM and services. Most notably, Flood and Zambuni (1990) provide an application of VSM to tourism services.

In the fields of requirements engineering and conceptual modeling, there has been parallel research into services and value modeling. Böttcher and Fähnrich (2010) present a meta-model that comprises the concepts necessary for modeling service systems. The syntax and the implementation of the editor that embodies the conceptualization are then elaborated. The modeling process outlined by Böttcher and Fähnrich (2010) consists of the following steps: analysis, concept extraction, formal specification, and implementation. The first two steps can be mapped onto the modeling process reported in this research. However, we do not discuss the formal specification of our models in terms of their syntax and semantics, as this is a part of research in progress. The meta-model developed by Böttcher and Fähnrich (2010) comprises four inter-related sub-models: resource model, component model, product model, and process model. These sub-models can provide the concepts required for modeling the service systems in general. The methodology presented in this research focuses on structuring the problems concerning the design and analysis of viability in service systems, rather than a generic representation of service systems.

Business process modeling notation (BPMN) (white, 2004) is a technique for formally modeling and describing how business processes are structured and for representing the detail of such processes. In Viable Service System Model, the focus is on building an understanding of the business as a nested hierarchy of systems. The modeler is thus interested in conceptualizing the systems that an enterprise contains and those in which the enterprise is contained. Thus, we emphasize on understanding the systems and on delineating their boundaries, the services provided by the systems as a whole (black-box view of the system) and the processes that implement these services in the system as a composite (white-box view of the system). We specify the behavior of a system by modeling the processes in the systems. We might have a process in the market, one in the company, one in the IT department and one in the IT applications. In BPMN there is usually one process that merges all these levels and abstracts away some. In short, our approach to modeling is system-oriented, whereas BPMN is a process-oriented approach.

e3Service (de Kinderen & Gordijn, 2008) is a method for semi-automatically reasoning about matching service offerings with customer needs. In order to make this semi-automatic reasoning possible, e3Service assumes that the customer and supplier share the same ontology and that the customer specifies her needs in the same vocabulary as the supplier specifies its offering. We expressly avoid making this simplifying assumption. This comes at the cost of enormously complicating automatic or even semi-automatic reasoning, with the benefit of models that more accurately reflect reality.

i* (Yu, 1997) is one of the leading modeling methods used in the requirements engineering research community for reasoning about functional requirements (FR) and non-functional requirements (NFR). i* provides modeling artifacts for reasoning about alternative satisfactions of NFR. i* models describe relationships as actors dependencies. Hence, i* offers support for reasoning about alternatives. i* has been extended with value reasoning in (Gordijn et al., 2006).

The Viable Service System Model presented in this research is an extension to the system diagram (Rychkova et al., 2007; Wegmann et al., 2007a) in the Systemic Enterprise Architecture Method (SEAM). SEAM was designed from the ground up with general systems principles (Wegmann 2003). SEAM serves to analyze and assist in the design of business and engineering strategies. Developed at the Ecole Polytechnique Fédérale de Lausanne (EPFL), SEAM has been used for teaching (Wegmann et al., 2007b) and consulting (Wegmann et al., 2005) since 2001. Using SEAM, we have explored how we can model the value provided by a service with Vickers's appreciative system (Regev et al., 2011). Finally, the research presented in this chapter is an extension of (Golnam et. al, 2011).

5. Conclusions

In the research presented in this chapter, we have applied the Viable Service System Model as a problem structuring method (PSM) to represent and assist in the analysis and design of viability in a service system. The Viable Service System Model embodied concepts from Beer's Viable System Model. With an example adapted from the real industrial case of a gas provision service by a utility company we have shown how it is possible to model aspects such as adaptation to a perceived change in the environment with aspects such as homeostasis and heterostasis. The modeling constructs in the Viable Service System Model enable us to map the theoretical conceptualizations of viability onto the mechanisms through with a service system remains viable.

The Viable Service System Model was also used in two consulting projects. The first project was done for an association of tourist offices in France. The association includes approximately 80 offices that share a common IT infrastructure. This is a challenge as the offices are competing locally to attract visitors. However, as a group, they have a vested interest in making their region more attractive. So, it can be stated that these offices are engaged in a coopetitive (simultaneously cooperative and competitive) situation. The only federating entity is the IT organization. There is no hierarchical relationship of any kind between the offices. The offices are funded by different kinds of local authorities (cities, group of villages, politicians of the region).

One of the challenge for the IT organization is to be able to define an overall business strategy for all the tourist offices. This strategy should help in defining the kind of IT services that need to be developed. The Viable Service System Model was used in this context to support the discussion on why all these competing offices need to have a common management system to define the overall strategy for all offices. This strategy has to be generic enough to avoid the competitive tensions, but at the same time it has to be precise enough to provide a development blueprint for the IT system.

The Viable Service System Model model was also applied to an organization that provides services to the home. This organization has approximately 60 offices grouped in 10 regions. There is a central organization that provides support (HR, Finance, IT). These offices are locally managed and funded. These offices have a smaller organizational structure, and are responsible for install IT equipment in the home. The challenge of the central organization is to federate the activities of these different offices and – in particular – of the smaller IT organizations that provide the IT equipment. The coopetition aspect is weaker than the previous project, as each office as a clearly delimited geographical area to serve. The issue in this project is to decide whether or nor all the smaller organizations should be coordinated by a central organization or if the "home office" provides requisite coordination.

In both cases, a simplified version of the Viable Service System Model was applied to illustrate the key components, in particular the management system, necessary for the survival of the organizations. In both cases, the conceptualizations embodied in the model, made the participants shift from discussing the need to have a clearly defined management authority to the discussion on how should be part of that management committee and what is the responsibility of this committee. It was striking to see how the discussion evolved within the group when the Viable Service System Model was presented. The discussion on the necessity of existence of management system disappeared immediately. Instead, the participants explored the practicalities involved in configuring such a management system.

There was no specific debriefing done on the applicability or the potential merits of the Viable Service System Model. The debrief on the modeling session was that the models were concrete and helped to converge to a positive solution, even if the situation was politically challenging. Many participants were impressed by the fact that, in the workshop, they gave up on their management responsibility to leave this responsibility to a management committee; this was acceptable, as the management system was perceived as necessary for the survival of the overall service system. Therefore, based on the experience of applying the Viable Service System Model, it can be concluded that it is indeed a useful PSM that can help participants reach a consensus in joint workshops by providing a common understanding of the functions and components that are necessary for a system to meet the criterion of viability.

Apart from the contribution to the organizational decision making this research also contributes to service science by adopting an interpretative epistemology where the concepts of viability, identity and indeed service are all dependent on the observer. This opens the door for more research into reconciling the different stakeholders' viewpoints on what they consider as being "the same service."

Our research suffers from a number of limitations. First of all, the Viable Service System Model is developed based on the VSM. Other systemic conceptualizations alternative to the VSM should be taken into account and positioned relative to the VSM. This can definitely contribute to the academic rigor of the Viable Service System Model. Examples of such alternative methods include but are not limited to Robustness analysis (Rosenhead, 1980) Strategic Choice Approach (Friend & Hickling, 1987) Strategic Options development and analysis (Eden et al., 1983; Eden, 1989) Strategic assumption surfacing and testing (SAST) (Mason & Mitroff, 1981). Moreover, the case-based nature of the validation limits the generalizability of the results achieved through the application of the Viable Service System Model.

In our future work, we focus on exploring the synergy between the VSM and the alternative methods listed above. In addition we plan on augmenting the Viable Service System Model with variety concepts and applying it to a prospective case in order to develop prescriptions on a viability compatible design. Planning empirical studies in form of workshops in which a survey instrument can measure the usefulness of the Viable Service System Model also falls into our future work. Semi-structured interviews can also be conducted with the organizational participants in the workshop and gather feedback on the potential merits and the improvement opportunities of the Viable Service System Model.

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Appendix – Definition of the Key Concepts and Terminologies in the Chapter

In this appendix, we define a number of important terms and concepts from systems science that can contribute to a better understanding of the Viable Service System Model and the discussions in the chapter discussions. These concepts are used and referred to throughout the chapter.

1. System
A set of elements standing in interrelations as distinguished by an observer (Weinberg, 1975).

2. Viable System
A system that can maintain an independent existence (Beer, 1979).

3. Observer
The observer is that which invents the system by perceiving a purposive unity (Pask, 1961).

4. State
State is a value defined by an observer that a state can have at a given moment in time (Regev, 2003). A state is a situation that can be recognized if it occurs again (Weinberg, 1975).

5. Variable
A concept defined by an observer as belonging to the system, which can have one state at a given moment in time and another state at a different moment in time (Regev, 2003).

6. Essential variables:
Variables that are linked to the identity of a system (Ashby, 1956).

7. Variety
Variety is the measure of complexity. It is the number of possible states of the variables of a system (Beer, 1981).

8. Stability and Change
A system is stable only when the observer cannot detect differences in the state of some certain variables within the system. Hence, stability and change depend upon the selection of the variables and the ability of the observer to detect differences in their states. Stability can be interpreted as invariance in some certain aspects of the system in spite of all the changes that the system is going through (Regev, 2003; Regev & Wegmann, 2004).

9. Identity
Identity is the set of essential variables by means of which the observer identifies and distinguishes the system from other systems. When all essential variables are stable the system sustains its identity. Identity is the continued existence of a system. To exist is to have identity and a thing that changes its identity passes out of existence (Weinberg, 1975).

10. Regulation
Regulation is maintaining the essential variables within a certain range by blocking the flow of variety and disturbances to essential variables in a system. Regulation can be achieved by establishing feedback loops that report on the state of the essential variables of the system (Ashby, 1956).

11. Feedback
Feedback is a new input to a system based on the difference between the desired and the current state of some system variables in order to bring the system closer to the desired state (Wiener, 1948).

12. Environment
Environment is those variables whose changes affect the system and those variables, which are changed by the system's behavior (Ashby, 1952).

13. Boundary
A boundary separates a system and its environment (Clemson, 1991). Emphasizing on the function of the boundary as a connector rather than a separator of a system from its environment, Weinberg (1975) uses the term interface instead of boundary.

14. Sub-system
A sub-system is a part of the system observed by the observer. It is in effect a system observed by an observer within the observed system (Beer, 1979).

15. Black Box
When an observer can only view the inputs to and the outputs of a system without knowing the internal functions and constituent systems of the system, the system is a black box (Beer, 1979).

16. Recursion
Recursion means to repeat the same structure. A recursive system is a system that contains and is contained in other systems (Beer, 1979).

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Chapter 4: The Customer Value and the Value Network Models: Modeling the Incentives and Design of Coopetitive Value Networks

Abstract: *Coopetition has been defined as an inter-organizational relationship that combines competition and cooperation. It transcends these traditional paradigms in an effort to achieve the advantages of both. As a coopetitive inter-organizational relationship is of a higher complexity than either simple competition or cooperation, it presents both conceptual and practical challenges for business managers and researchers in the marketing and strategy field. In this chapter, we present two problem structuring methods (PSMs): Customer Value Model, and Value Network Model. These PSMs generate graphical representations of the problem structures in coopetitive contexts to provide analytical assistance for the decision makers.*

The Customer Value Model provides a means of analyzing the strategic incentives for organizations to engage in coopetition relationships from the perspective of customer value creation. The Value Network Model helps explore alternative value network designs that address the complexities inherent in coopetition as a multi-faceted relationship. Both models incorporate important conceptualizations from competence-based strategic management (CBSM) theory and are grounded in the coopetition and value network literature.

We illustrate the applicability of the Customer Value Model by applying it to model the strategic incentives of IBM and Apple's coopetition in the development of PowerPC CPU. The Customer Value Model has also been applied in a project to Model the customer value in an online social networking platform called Webdoc. The details of this project are presented in Appendix 1.

To demonstrate the usefulness of the Value Network Model, we built a typology of coopetition in value networks based on the locus of coopetition (i.e. intra-value or inter-network) and the nature of collaboration (i.e. competence leveraging or competence building). The Value Network Model was then applied to represent empirical examples of three coopetitive value networks from Amazon.com business models and the AIM Alliance value network for the categories identified in the typology. The data on the coopetitive value networks of Amazon.com were derived from

an in-depth longitudinal case study we conducted to understand the coopetition-based business models of Amazon.com. This case study is presented as a paper in Appendix 2. Finally, In Appendix 3, we elaborate on the CBSM conceptualization and present a generic enterprise model that incorporates systems principles from Stafford Beer's Viable System Model.

1. Introduction

Coopetition is a multi-faceted inter-organizational relationship that combines collaboration and competition in order to achieve the advantages of both (Lado et al., 1997; Bengtsson & Kock, 2000). The term "coopetition" was first coined by Raymond Noorda in early 90's to characterize Novell's hybrid business strategy, and Brandenburger and Nalebuff further elaborated the coopetition concept in their seminal book (Brandenburger & Nalebuff, 1996). Recently, coopetition is a topic of increasing interest in marketing and strategy research, leading to a growing body of research and theorizing. Coopetition researchers have invoked insights from theoretical frameworks as diverse as the resource based view (e.g. Gnyawali & Park, 2009), transaction cost economics (e.g. McGill, 2007; Park & Russo, 1996), strategic orientations (e.g. Luo et al., 2007), and game theory (e.g. Okura, 2007; Ritala and Hurmelinna-Laukkanen, 2009) in describing and explaining different aspects and strategies related to coopetition.

Even though the aforementioned research efforts have provided significant advantages to theoretical rationale of coopetition, relatively little attention has been paid to developing models, methods, and techniques to provide managers with practical means for analyzing the potential advantages of coopetition and developing value network designs that will be effective in supporting multi-faceted coopetitive relationships. Doing so would require a shift from a positivistic / theory building approach that aims at describing various aspects of coopetitive interaction towards research focused on developing normative recommendations for initiating and sustaining coopetitive strategies and relations. Thus, we suggest that such step is needed in order to forward coopetition research from theory building and testing type of research towards providing concrete management tools to handle such relationships.

To contribute on the aforementioned research gap, this study develops two problem structuring methods (PSMs): The Customer Value Model and The Value Network Model. PSMs are in essence facilitative devices that enable dialog between the decision makers who wish to act upon a choice situation (Mingers & Rosenhead, 2004; Rosenhead, 1996; Rosenhead & Mingers, 2001). The PSMs presented in this chapter can be referred to as a learning device that can help decision makers achieve the following objectives in a strategic choice situation: refine their thoughts when it comes to exploring and understanding the incentives for companies to engage in coopetitive value networks, and explore alternative value network designs that can accommodate the complexities of the simultaneous cooperation and competition.

The Customer Value Model, contributes to our understanding of why companies engage in a coopetitive relationship. It helps in the analyzing the value companies can create for the customers when they join forces with the competition. The Value Network Model, assists in exploring the design of value networks that can accommodate the complexities of coopetition as a multi-faceted inter-organizational relationship.

Both PSMs are grounded in insights from value network approach (e.g. Brandenburger & Nalebuff, 1996; Kothandaraman & Wilson, 2001) and embody conceptualizations from competence-based strategic management (CBSM) theory (e.g. Sanchez & Heene, 1997; Sanchez, 2008).

To illustrate the applicability of the Customer Value Model, we conduct a case study on the role of coopetitive value network in the development of PowerPC architecture between Apple and IBM. The role of the chosen case study is instrumental (Stake, 1995): the main purpose is in illustrating the applicability of the model to explain coopetition rationale and activities in value networks. With the help of the case study, we demonstrate how the Customer Value Model presented in this chapter enables development of insights into the incentives that drive this coopetitive strategy.

With respect to the Value Network Model, we first develop a typology of coopetition in value networks. Four different cases of coopetition are identified. We present empirical examples from ICT sector (Amazon Web Services, Amazon Marketplace, AIM Alliance, and Windows Mobile Community) for the cases identified in the typology. To demonstrate the usefulness of the Value Network Model, we represent coopetition in the four examples by applying the Customer Value Model. The four examples aid in the understanding of the value network structures that can accommodate coopetition as a complex inter-organizational relationship. The data on the examples of coopetition in Amazon.com is derived from a longitudinal case study we conducted to identify and understand the role of coopetition in Amazon.com's business models.

Our discussion is organized in the following way. In Section 2, we discuss the theoretical background of the study: nature of coopetitive relationships, value network approach, as well as the CBSM conceptualizations and related theoretical principles that we employ in developing the two PSMs. In Section 3, we present the Customer Value Model, we then proceed to represent and analyze the incentives of Apple and IBM to engage in coopetition in the development of PowerPC chip. In Section 4, we present the typology of coopetition in value networks. Next, we apply the Value Network Model to represent the different value network designs (derived from the typology) that can accommodate the complexities of coopetition. Section 5 includes our conclusions, and suggestions for future research. There are three Appendices to this paper. Appendix 1, reports on the application of the Customer Value Model in a project we conducted in an online social networking company called Webdoc. In appendix 2, we present an in-depth longitudinal case study of Amazon.com coopetition-based business model. The data for the coopetitive value networks of Amazon.com are derived from this case study. In this case study we also formulate a number of propositions on how coopetition can be advantageous to companies. Appendix 3 includes a more detailed discussion of CBSM conceptualizations. We also present the Enterprise Model that embodies conceptualizations from CBSM as well as theoretical insights from the Viable System Model (VSM) of Stafford Beer (Beer, 1979, 1984). While the Value Network Model provides analytical assistance in undertsnading the structure of coopetitive value networks at a mactro level, the Enterprise Model elaborates on the organizational structure and the fucntions required for an enterprise to remain viable.

2. Theoretical background

In this section, first we briefly discuss coopetition as a distinct type of an inter-organizational relationship. Next, we extend the discussion of coopetition into value network level. Finally, we review the theoretical conceptualizations of competence-based management and discuss how it can help in analyzing coopetition in value networks.

2.1 Coopetition as simultaneity between competitive and collaborative activities

Coopetition has been defined as simultaneous competition and collaboration between certain actors (Bengtsson & Kock, 2000). The simultaneity can either come from competition tension entering a previously collaborative relationship or vice versa (Padula & Dagnino, 2007). Such simultaneity can lead to conflicts and risks (Hamel, 1991; Park & Russo, 1996; Tidström, 2009), or potential benefits in terms of resource sharing, increased innovativeness and new business opportunities (Bengtsson & Kock, 2000; Gnyawali & Park, 2009; Ritala & Hurmelinna-Laukkanen, 2009).

Firms have several options to deal with simultaneous competition and collaboration in business relationships. Dowling et al. (1996) divide these into two polar categories: avoidance and adaptation. Avoidance approach suggests that coopetition should be avoided in the first place, and the interactions between certain actors are solely competitive or collaborative. Adaptation, on the other hand, refers to finding ways to cope with the fact that competition and collaboration are inherent parts of many business relationships. As one solution to this issue, Bengtsson and Kock (2000) suggest that competition and collaboration are situated typically in different phases of the value chain, and are operated by different employees or units inside and organization (see also Walley, 2007). On the other hand, some research has shown that coopetition is a dynamic relationship involving constant evolution in both competition and collaboration (Kock et al., 2010), and that both types of tensions have to be dealt with even by the same persons or units within a company (Ritala et al., 2009). Thus, it can be concluded that coopetitive relationships are very complex, and they embody both competitive and collaborative tensions in various settings. This is likely to put challenges to the design of both organizational and inter-organizational relations pertinent to managing coopetition.

Several recent works on coopetition have started to portray coopetition more and more as a relationship embedded in a larger network of actors. Such approaches include for e.g. structural embeddedness and social networks (Gnyawali & Madhavan, 2001; Gnyawali et al., 2006; Madhavan et al., 2004; Ritala & Hallikas, 2012), mapping of competitive and collaborative linkages (Bengtsson & Kock, 1999; M'Chirgui, 2005), and assessing the level of coopetition in the industry-level (Rusko, 2011). The benefit of these approaches is in understanding coopetition phenomena within the wider business environment in which the focal firm is embedded. Thus, in order to broaden the perspective from examining mere relationships between two firms that compete and collaborate, we suggest that a network approach to coopetition is warranted. In particular, we suggest that coopetition could be viewed through the lenses of value networks. We elaborate on this approach in the following section.

2.2 Value network approach to coopetition

In general, marketing and strategy researchers have examined a broad repertoire of partially overlapping concepts to describe and analyze networks, including strategic networks (Gulati et al., 2000), business nets (Möller & Svahn, 2006; Möller & Rajala, 2007), value creating networks (Kothandaraman & Wilson, 2001), and value networks (Allee, 2000; Andersen & Fjelstad, 2003; Stabell & Fjelstad, 1998). Value networks can be defined as any network or web of relationships that generates tangible and intangible value through complex dynamic exchanges between two or more organizations (Allee, 2000). The main purpose of the value networks is to provide superior customer value by utilizing the resources, capabilities and competences of its constituent entities (Kothandaraman & Wilson, 2001). Indeed, customer value is seen as being delivered by not one firm only, but a system consisting of different actors who contribute to the customer value directly or indirectly (see e.g. Allee, 2000; Kothandaraman & Wilson, 2001; Pynnönen et al., 2011).

In fact, from early on, coopetition has been described as the result of competitive and collaborative relationships within a value network. In their seminal, game-theory based book, Brandenburger and Nalbuff (1996) described the concept of "value net", where a firm is portrayed in the center of network consisting of customers, suppliers, competitors, and complementors. The insight was that any actor can take a role of either competitor or complementor, or that both roles may be acquired simultaneously. This provided the logic for coopetition as a simultaneous occurrence of both competitive forces, and complementing (i.e. collaborative) ones. Several researchers have utilized value net-driven thinking in analyzing and illustrating coopetitive networks (e.g. M'Chirgui, 2005; Rusko, 2011). However, the vast majority of coopetition studies describes and analyses coopetition from the firm or relationship perspective, which dismisses the potential for a more profound value network analysis.

We suggest that viewing coopetition as a part of larger value network is important, since it enables analyzing coopetition in a real-world setting, where relationships and firms are not isolated entities. In the following, we formulate theoretical grounding for the modeling techniques used in the empirical part of this study by combining the principles of competence-based management-theory into value network approach.

2.3 Competence-based management theory and coopetitive value networks

In this study, we invoke conceptualizations from competence-based management (CBSM) theory (see e.g. Sanchez & Heene, 1997; Sanchez & Heene, 2003 Sanchez, 2008) to provide the basis for modeling coopetitive value networks. In CBSM theory an organization is represented as a goal-seeking open system. CBSM theory provides a set of concepts for identifying essential system elements of organizations as goal oriented human systems for sustainable value creation and distribution. An important aspect of CBSM theory is providing precise and consistent definitions of the primitive entities which serve as the building blocks of its conceptual foundation for theory building about markets, firms, and their cooperative, competitive, or coopetitive interactions. In general, CBSM theory includes three categories of concepts[2]: the business concepts, the organization concepts, and core processes. Design of coopetitive value networks is linked to each of these categories.

The business concept fundamentally refers to the creation of customer value, which is also the basic rationale of existence of value networks in the first place (Kothandaraman & Wilson, 2001). Indeed, without customer, there is no "value" as such and this also holds for coopetition. Thus, the analysis of any coopetitive value network should end up with explaining customer value in one way or the other. Organization concepts are linked to how the firm organizes the value creation in terms of resources, capabilities, and competences. Finally, core processes entail the type of activities that are involved in customer value creation. These conceptual categories are linked to value networks and coopetition through the leveraging and development of resources, capabilities and competences within the focal firm, as well as between firms in value network (including coopetition partners).

Studies on the drivers of inter-organizational relationships refer to resource and capability exchange as one of the primary incentives behind establishing and inter-organizational relationships (e.g. Bengtsson & Kock, 2000; Das & Teng, 2000). Through such relationships, firms gain access to both supplementary and complementary resources and capabilities in the attempt to create and realize product offers that increase the delivered customer value. In terms of coopetition, Ritala and Hurmelinna-Laukkanen (2009) express that commonality between the competing firms can lead to the ease and fluency of sharing and transferring the resources and capabilities between actors, which eventually can lead to increased value creation. Thus, understanding both the role of resources, capabilities, and competences, as well as the activities they allow for is important when analyzing coopetition in value networks. More detailed definitions of focal concepts of CBSM that are used in the modeling are defined under methods section.

We utilize the insights developed in this section as a theoretical and conceptual basis for the two PSMs developed in the remainder of this study. In the next section, we present the Customer Value Model and illustrate its application by modeling the incentives for IBM and apple to engage in coopetitive relationship.

3. The Customer Value Model

In this section, we first explain the conceptualizations employed in developing the Customer Value Model. Then, a generic Customer Value Model is represented. We illustrate the applicability and validity of the Customer Value Model by an instrumental case study (Stake, 1995) of the coopetitive value network of Apple, IBM and Motorola (referred to as AIM alliance) that designed and manufactured a new generation of microprocessors with reduced instruction set computer (RISC) architecture. The AIM alliance gave birth to PowerPC (i.e. Performance Optimization With Enhanced RISC –

[2] For a detailed discussion of CBSM conceptualizations refer to Appendix 3.

Performance Computing, sometimes abbreviated as PPC) (see e.g. Duntemann & Pronk, 1994; Vanhaverbeke & Noordehaven, 2001).

In an instrumental case study, the case itself is of secondary interest, serving the purpose of illustrating the applicability and validity of the models that embody the theoretical perspectives (Stake, 1995). In conducting the case study, we assessed, analyzed and synthesized a variety of secondary data sources. This was possible, since the case is very well documented and profoundly researched in several books by Duntemann & Pronk, (1994), Carroll, P. & Reader-Adams, (1994) and Linzmeyer (2004) and articles by e.g. Vanhaverbeke & Noordehaven (2001) and Moore (1993). In addition to these secondary data sources, in-depth semi-structured interviews were conducted with two industry experts in order to confirm certain aspects of the data gathered from the publicly available books and articles.

3.1 Conceptualizations in the Customer Value Model

The Customer Value model, outlines the process of value creation in a value network by specifying a mapping between the following concepts: resources and capabilities provided by the organizations in the value network; the product offer features; and the net delivered customer value (NDCV). We now define the key conceptualizations in the Customer Value Model based on the definitions provided by Sanchez and Heene, (1997, 2003) and Sanchez (2008):

- A *product offer* is the bundle of benefits and costs that an organization presents to targeted market segments when it offers its goods and services.
- A *feature* is an emergent property of a product offer as observed by a customer.
- *Resources* are any assets that a firm can access and use in developing and realizing its product offers. (Assets are defined as anything tangible or intangible that would be useful to a firm in developing and realizing product offers.)
- *Capabilities* are repeatable patterns of action in using the skills and other resources (machines, information, etc.) available to an organization.
- *Net Delivered Customer Value (NDCV)* includes all the benefits and costs a customer expects to experience during the full life cycle of the product, including learning about, purchasing, taking delivery of, using, maintaining, repairing, upgrading, and retiring a product. Customers will prefer a product offer that delivers the highest available (and positive) NDCV (i.e., the greatest excess of perceived value over perceived cost) (Kotler, 1999).

In Table 1 we present the four sources of perceived value and four sources of perceived cost of a product offer recognized by the NDCV framework.

Table 1. Sources of perceived value and cost in the NDCV framework. Source: (Kotler, 1999).

Sources of perceived value	Sources of perceived cost
Product benefit is the perception derived by the customer based on what the product offer enables him/her to do.	*Financial costs* are the monetary costs that a customer experiences during the life cycle of the product.
Service value is the perception of the usefulness of the activities that the organization performs to assist its customer throughout the lifecycle of the product.	*Time costs* are the costs associated with the time the customer has to spend to learn about, purchase, use, maintain, and retire a product.
Image value is the value a customer perceives when he/she imagines how he/she will be "seen" by other people while using the product offer.	*Energy costs* refer to the energy the customer expects to expend in the product life cycle in becoming a customer for and user of a product.
Personal interaction value is the positive feeling a customer may derive from the interaction with the organization's employees.	*Psychic costs* are costs attributed by a customer to the product when the customer worries or has feelings of anxiety about his or her involvement with a product at any stage of the product life cycle.

In the case study, we employ "product benefit" and "image value" as the sources of perceived value and "financial costs" and "psychic costs" as sources of perceived cost. Figure 1, is a generic Customer Value model. As illustrated, four types of relationships and mappings can be identified in the model.

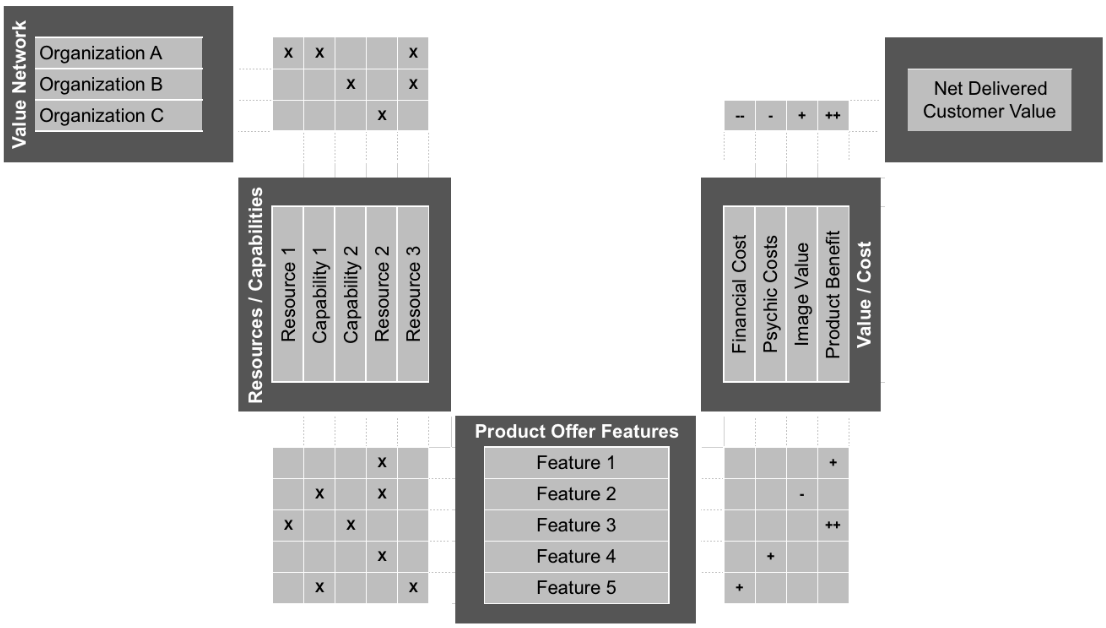

Figure 1. Customer Value Model

Table 2 summarizes these relationships and their corresponding mapping notation in the Customer Value model. As illustrated in Figure 1, Organizations, A, B and C collaborate in their value network by contributing Resources 1-3 and Capabilities 1and 2 to create Product Offer Features 1-5 that impact the value/cost attributes (Financial and Psychic Costs, Image Value and Product Benefit). The impact of these value/cost attributes on the NDCV is also modeled.

Table 2. The relationships and mappings in the Customer Value model

Relationship	Mapping Notation
• Organizations in the value network • Resources and capabilities utilized in developing the product offer	"X" mark
• Resources and capabilities • Features and functions of the product offer	"X" mark
• Product offer functions and features • Customer's perception of value and costs	++ (Strong Positive), + (Positive) - (Negative), -- (Strong Negative)
• Customer's s perception of value and costs • Impact on Net Delivered Customer Value	++ (Strong Positive), + (Positive) - (Negative), -- (Strong Negative)

For instance, "Organization A" and "Organization C" respectively provide "Resource 1" and "Capability 2" that creates "Feature 3". This product offer feature has a strong positive impact on the customers' perception of "Product Benefit" and in this specific market segment product benefit also has a strong positive impact on the NDCV. "Image Value", however, is not as strongly linked to the net delivered customer value.

Sometimes a Resource or a capability is created by more than one organization (see for e.g. Resource 3). Moreover, a resource or a capability can contribute to the creation of more than one product feature (see for e.g. Resource 2).

3.2. Modeling and Analysis of Coopetition between Apple and IBM in the Case of PowerPC

In this section we apply our modeling approach to the case of coopetition between Apple and IBM in the development of PowerPC CPUs. First, Modeling PC industry circa 1990 we represent the Value Network models of Apple and Wintel (i.e. computers with Microsoft Windows operating system and Intel x86 CPU). The Customer Value Models provide useful insights into the strategic incentives (i.e. the "why") behind the coopetitive strategy between Apple and IBM.

In 1990, Macintosh sales were eroding due to the increasing dominance of wintel based PCs. This significant loss of market share was mainly due to the users' perception of Apple machines, in terms of performance and price (Duntemann & Pronk, 1994).

The tightly-coupled architecture of Apple operating system and Motorola CPU while resulting in the high performance of Macintosh machines particularly in the graphics intensive tasks, had made it extremely difficult for Apple to implement changes in its machine. For instance, any upgrade in the CPU (Motorola 680x0 processor) architecture would require a number a changes in the operating system (system 7) and as a consequence the applications by the third party developers needed to be modified or redesigned. This has been captured in Apple Macintosh Customer Value Model (Figure 2), in the following way. Apple (OS)[3] and Motorola collaborate to

[3] In the Customer Value model, to refer to a department of an organization we put the name of the department in parenthesis in front of the organization's name.

maintain “Tightly Coupled Architecture” as a capability that results in: “Low CPU Speed” with strong negative impact, “Low Availability of 3rd Party Software” with negative impact and “High Graphics Performance” with positive impact on customers’ perception of “Product Benefit”. The “Product Benefit”, in turn has a strong impact on the Net Delivered Customer Value. As illustrated, “Image Value” was the most important attribute for Macintosh owners.

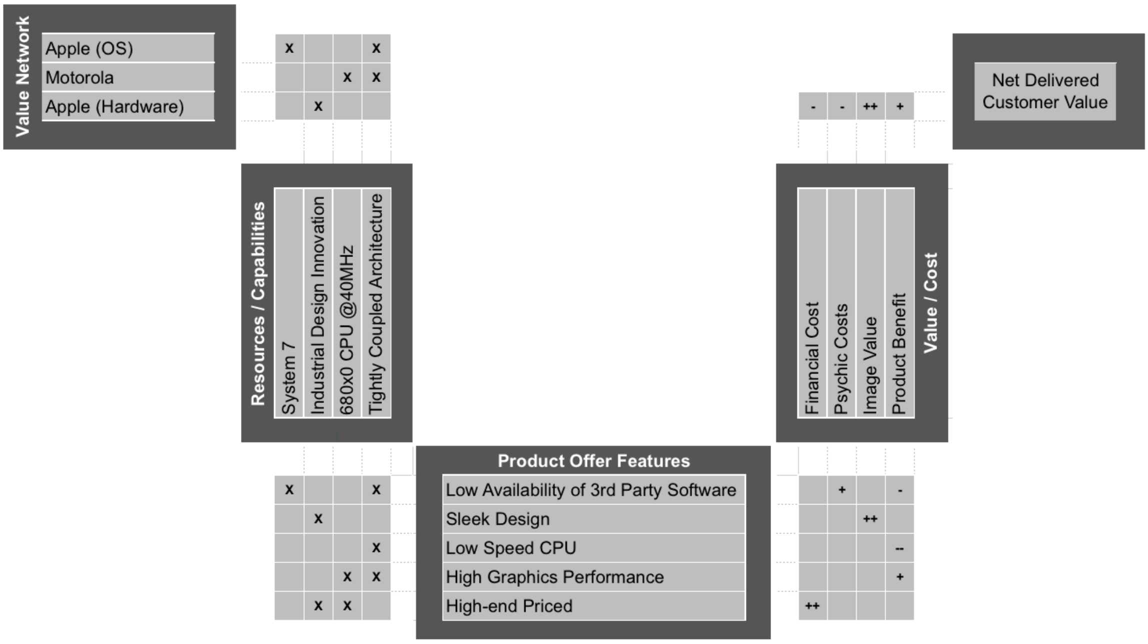

Figure 2. Apple Macintosh Customer Value Model circa1990

Contrary to Apple and Motorola, the collaboration between Intel and Microsoft had led to a loosely coupled architecture between Windows 3 and Intel 486 processor in IBM PCs. Hence, Intel was able to design and use faster chips without requiring Microsoft to redesign the operating system. As a result, the users were able to notice a significant change in the speed and the performance of Wintel based machines whenever they upgraded their machines (e.g. from machines with 386 processors to 486) (Duntemann & Pronk, 1994; Carroll, P. & Reader-Adams, 1994). This interoperability had also led to the high availability of third-party applications for IBM PC.

As illustrated in Figure 3, Intel’s capability of “Cross-OS CPU Design” (i.e. an OS-independent CPU), enabled Intel to upgrade its chip frequently resulting in “486 CPU @66MHz” that created the feature “High Speed CPU” for IBM PC. This feature had a strong positive impact on the perception of IBM PC customers of “Product Benefit”. The same way, Microsoft’s capability to maintain “Software Compatibility with OS” and IBM’s reputation had lead to the “High Availability of 3rd Party Software”, a feature that also had a strong positive impact on the “Product Benefit” perceived by the customers. As it can be inferred from Figure 3, compared to Macintosh owners, IBM PC users cared less about “Image Value” and more about the “Financial Cost”.

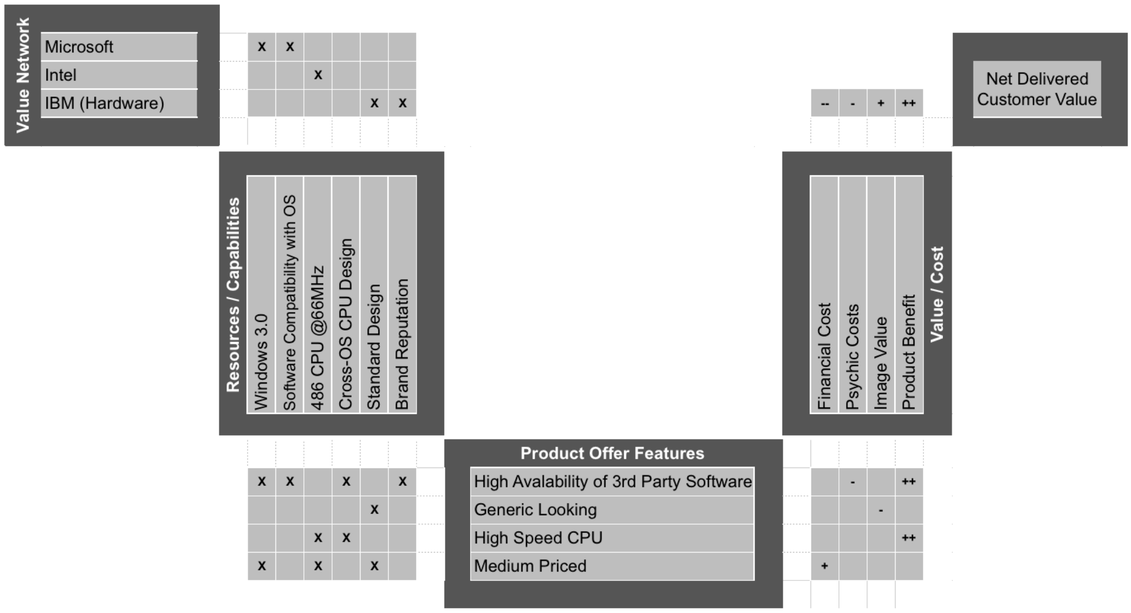

Figure 3. IBM PC Customer Value Model

Microprocessor designers believed that Motorola 680x0 processor was technologically superior to Intel's x86 architecture, and Macintosh machines outperformed Wintel based PCs in particular for running graphic intensive applications. Wintel PC users, however, did not see any reason to switch from their machines with 66MHz Intel processors to Macintosh with a 40 MHz Motorola CPU that cost double the price of their machines. Surprisingly most of the Wintel PC users had not even actually seen a Macintosh to date. So Apple had not managed to win the price/performance fight against Microsoft and Intel.

Having lost a significant share of the PC market, it was evident for Apple that nothing but a radical shift in technology could lead to its survival. This technological change would mean a faster chip with a highly scalable and cross-OS architecture that could support computers of any size without requiring changes in the operating system. In the early 90's this description would be associated with Reduced Instruction Set Computer (RISC) CPU design that required a considerably high technological capability. Furthermore, Apple needed applications tailored to RISC architecture and instruction set. However, considering that Apple's market share percentage was dropping below ten, it was nearly impossible to convince the software developers to develop applications for the future RISC-based Macs. Hence, in order to ensure the success of the new platform Apple needed to find a way to gain the support of software vendors. Finally, in order to change price perception of the users, Apple had to keep the costs of the new RISC-based Mac down. This could only be achieved by reaching high production volume, which was rested heavily upon mass production capabilities and the existence of market demand (Duntemann & Pronk, 1994; Carroll, P. & Reader-Adams, 1994; Linzmeyer 2004; Moore, 1993).

Figure 4 depicts a partial Customer Value model capturing the resources and capabilities required by apple in order to increase the NDCV. The changes to the Customer Value model in Figure 2 are underlined. The major question, however, was to find the companies that could provide the resources required. We now assess Apple's potential partners among the CPU manufacturers circa 1990 based on the resources and capabilities required by Apple.

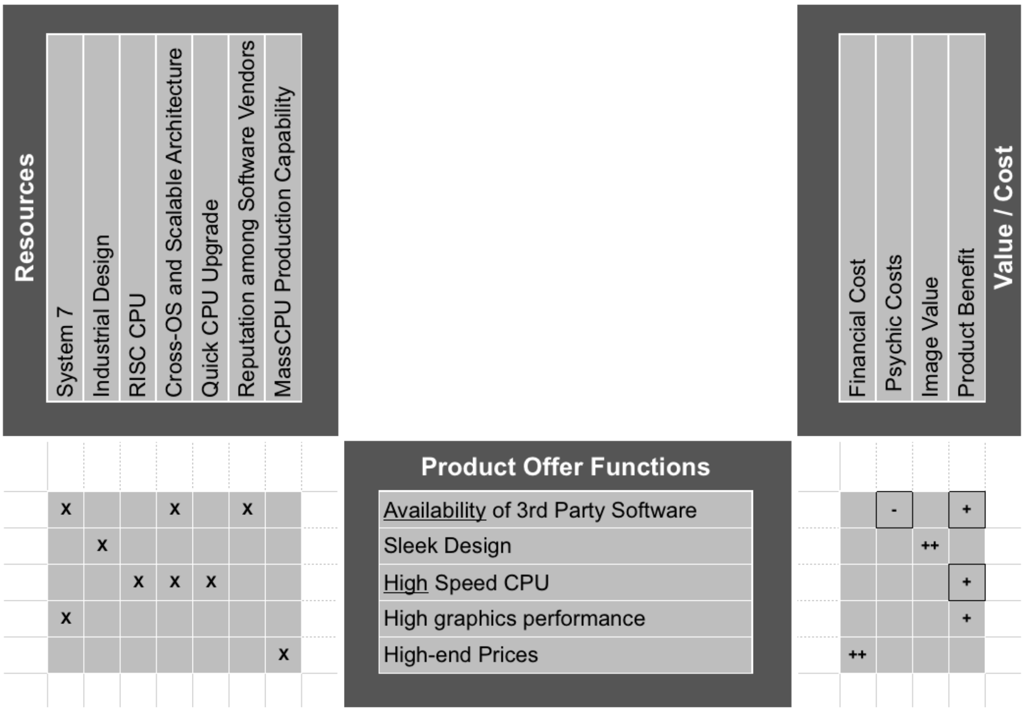

Figure 4. Resources and capabilities required by Apple and their impact on NDCV

In table 3, we compare and assess the extent to which the CPU manufacturers can provide the resources and capabilities required by Apple.

Table 3. Resource provider assessment matrix

		Resource Providers				
		Motorola	AMD	Intel	SUN	IBM
Resources/ Capabilities	Technological capability to develop single chip RISC CPUs	**	-	-	***	**
	Established brand to ensure software developers' support	*	*	***	*	***
	Mass production capabilities	**	***	****	-	*

In 1990, Intel and AMD were manufacturing CISC Architecture CPUs and hence did not have the required technological capability to develop RISC chips. The minus (-) in Table 1 reflects this lack of capability. However, SUN Microsystem, was already manufacturing a RISC instruction set architecture CPU called SPARC for its workstations, which was the closest match to Apple's required technological capability. IBM servers and mainframes were manufactured with RS6000, a multichip RISC CPU. However, it was clear to Apple that IBM had the design capability to create a single chip implementation of the R/S technology. Motorola was half way through the development of the RISC CPUs. From the brand perspective, Intel and IBM had established a prominent brand identity, but companies such as AMD, Motorola and

SUN were not as well-known. Finally, Intel and AMD were leading the market, due to high sales volume of Wintel based PCs which certainly meant that these companies were equipped with mass production capabilities. Whereas, as a result of the low demand (in terms of total units sold annually) for workstations and mainframes, both IBM and SUN did not need to produce high quantities of CPUs. As Motorola was the sole provider of CPUs for Apple machines, it possessed relatively higher volume production capabilities compared to SUN and IBM.

As the comparative assessment of the partnership strategies suggests, the alternative that appears the best for Apple at that time would be to develop a partnership with Motorola and IBM. IBM had built a good image a in the software industry. IBM’s RS/6000 gained quick market acceptance and support throughout the industry, despite the fact that it was brought to the market late. Hence, having IBM on board would enable Apple to ensure support from software vendors for the RISC-based Macs. However, as IBM was manufacturing RS/6000 in small quantities for its mainframes, it lacked the volume production capabilities that Apple was looking for. Hence, involving Motorola who was equipped to manufacture chips in quantities would make sense. Moreover, Apple had made a huge investment in designing system boards for the next generation of Macs, and since the design was based on Motorola’s existing 88100 chip, they did want to ensure that the new chips are 88100 compatible (Vanhaverbeke & Noordehaven, 2001).

But the main question is “Why would IBM collaborate with its head-on rival in the PC market?” IBM had lost more and more proportions of its market share to the Wintel-based PC compatible manufacturers such as Compaq and as the dominance of Wintel platform was getting stronger. As illustrated in Figure 6 Compaq as an IBM PC compatible manufacturer was offering lower product price as compared to the IBM PC, while keeping the rest of product features almost intact. In addition, as the desktop computer was becoming the dominant computation machine in the market the demand for IBM’s mainframes was decreasing. So, IBM had plans to break the monopoly of Microsoft and Intel by forming an alliance with other players in the market to develop a CPU and an operating system that could instantly help IBM gain back legitimacy in the personal computer market (Duntemann & Pronk, 1994; Carroll, P. & Reader-Adams, 1994),

Finally, in July 1991 Apple, IBM and Motorola came to agreement to establish an alliance. The major objectives of the alliance was to prevent Intel and Microsoft from controlling the future of the CPU architecture and OS in desktop computers

The RISC-based Macs received favorable reviews for their speed and excellent compatibility with existing Mac software and hardware and helped Apple capitalize on its newfound price/performance lead to expand its market share.

When apple first announced its intention of designing its next generation of Macintosh machines based on the PowerPC in 1991, no native software existed for this platform. In 1993 less than a year before the launch of the RISC based Macs, fewer than a dozen applications were expected. By January 1994, more than 60 developers had announced they would have PowerPC applications available before the first Power Mac shipped and the number of native applications continued to increase weekly afterwards (Duntemann & Pronk, 1994; Carroll, P. & Reader-Adams, 1994; Linzmeyer, 2004).

While the PowerPC chips continually tried to outpace offerings from rival Intel in personal computer market, it did not become an industry stand. In 2004, Motorola span off its chip manufacturing business as an independent business unit called Freescale Semiconductor. Around the same time, IBM focused on designing chips designs for PowerPC CPUs towards game console manufacturers such as Nintendo's GameCube and Wii, Sony's PlayStation 3 and Microsoft's Xbox 360. In 2005 Apple announced they would no longer use PowerPC processors in their Apple Macintosh computers, favoring Intel produced processors instead.

In this section we showcased the application of the Customer Value Model by applying it to model and analyze the strategic incentives behind the coopetition between Apple and IBM. We have applied the Customer Value Model in a project with a social networking company called Webdoc with to improve the perceived customer value. Details of the project are presented in Appendix 1. In the next section we present the Value Network Model its notational elements and theoretical foundations along with application examples.

4. The Value Network Model

In this section, we aim to provide a theoretically grounded PSM, which is helpful to practitioners and scholars pursuing to analyze the practicalities involved in the design of value networks suitable for addressing the dynamics and complexities of coopetitive relationships. To this end, we first develop a typology of coopetition in value networks. A distinction is made based on two factors. Firstly, whether coopetition takes place inside a particular value network (intra-value network coopetition) or between value networks (i.e. inter-value network coopetition). Secondly, whether the nature of collaboration is competence leveraging or competence building.

We have conducted an in-depth longitudinal case study of two coopetitive business models of Amazon.com: Amazon Marketplace and Amazon Services. We use the data from this case study and the data we gathered on the AIM alliance as well as the coopetition between the application developers in the Microsoft’s windows mobile community to provide model examples for the typology we developed.

The full case study of coopetition-based business models of Amazon.com is presented in Appendix 2.

4.1 The Typology of Coopetition in Value Networks

To analyze and develop a typology of coopetition in the value network level, we focus our analysis on two distinct dimensions: 1) the locus of competition between the network actors, and 2) the nature of collaboration.

In terms of locus of competition, we make a distinction between competition inside the value network and competition outside value network. The former (i.e. intra-value network competition) refers to the situation where competition takes place between actors that operate in the same value network setting – that is – they provide value for same (or almost same) customer base to meet sufficiently similar customer needs. These types of settings happen when coopetition relationship involves simultaneous collaboration and competition within the same domain. On the other hand, the latter setting (i.e. inter-value network competition) refers to the situation where competition happens outside a single value network, and between two value networks. Such separation is suggested and often as a preferred mode of coopetition singe it allows more intuitive possibilities for collaboration and competition (e.g. Bengtsson & Kock, 2000; Walley, 2007). However, we suggest that both types of situations - coopetition inside and outside the focal value network - do take place in practice.

In terms of nature of collaboration, we make a distinction between collaboration for competence leveraging and competence building. It is notable that the competence building and leveraging processes have different objectives and related strategies, and thus their analytical separation is important.

Competence is the ability of an organization to sustain coordinated deployments of its resources and capabilities in ways that help an organization achieve its goals. Competence leveraging refers to the use of an organization's existing competences to create product offers and carry out other activities that do not require qualitative changes in the resources the organization uses or in the way the organization coordinates its resources. Sometimes and organization leverages its competences to provide another organization with the resources and capabilities it requires to sustain its value creation activities (Sanchez & Heene, 1997; 2003). Thus, by competence leveraging we mean collaboration within value network that aims at using the existing resources and capabilities of value network actors in an efficient and effective manner. Competence leveraging collaboration can thus be viewed as a group of coopetition motives related to utilization of complementary and supplementary resources (see e.g. Das & Teng, 2000; Ritala, 2012).

Competence building refers to any process through which an organization creates or accesses qualitatively new kinds of resources and capabilities and/or develops new ways of coordinating and deploying new or existing resources and capabilities (Sanchez & Heene, 1997; 2003). Competence building can be collaborative. This means two organizations collaborate to create new products and services – and eventually new or improved sources of customer value. Various actors within the value network can participate in competence building, including customers, suppliers, and competitors (Möller & Rajala, 2007; Aarikka-Stenroos & Jaakkola, 2012). However, in this study we mostly focus on competence building between competitors.

		Nature of Collaboration	
		Competence Leveraging	**Competence Building**
Locus of Competition	**Outside Value Network**	Amazon Services	AIM (Apple, IBM, Motorola) Alliance
	Inside Value Network	Amazon Marketplace	Amazon Marketplace

Figure 5. A typology of coopetition within and between value networks

Figure 5 summarizes the proposed typology along with an illustrative example of a coopetition in each value network setting. It can be seen that there are four types of coopetition within and between value networks, depending on whether the locus of competition is outside or inside a value network which is analyzed, or whether the nature of collaboration is directed more towards competence leveraging or competence building. It should be noted, however, that these categories are not mutually exclusive, but rather archetypical examples of different coopetition setting.

In a complex business setting, several or all of these coopetition types may take place. In any case, we suggest that this typology helps in understanding where and how coopetition appears in value networks. In the remainder of this study, we discuss each situation separately and develop Value Network Models of the four value network examples.

4.2 The Value Network Model

To gain a better understanding of the design and the structure of the coopetitive value networks, in particular the ones outlined in the typology developed in the previous section, we apply the Value Network Model to represent the organizations and their inter-relations within the value networks. Value Network Model contributes to our understanding of the recurring patterns of coopetition in value networks and sheds light on the optimal design of a coopetitive value network that can accommodate the complexities inherent in coopetition as a multifaceted inter-organizational relationship. In this section, we describe the Value Network Model, specifying the nature of the modeling constructs and representations.

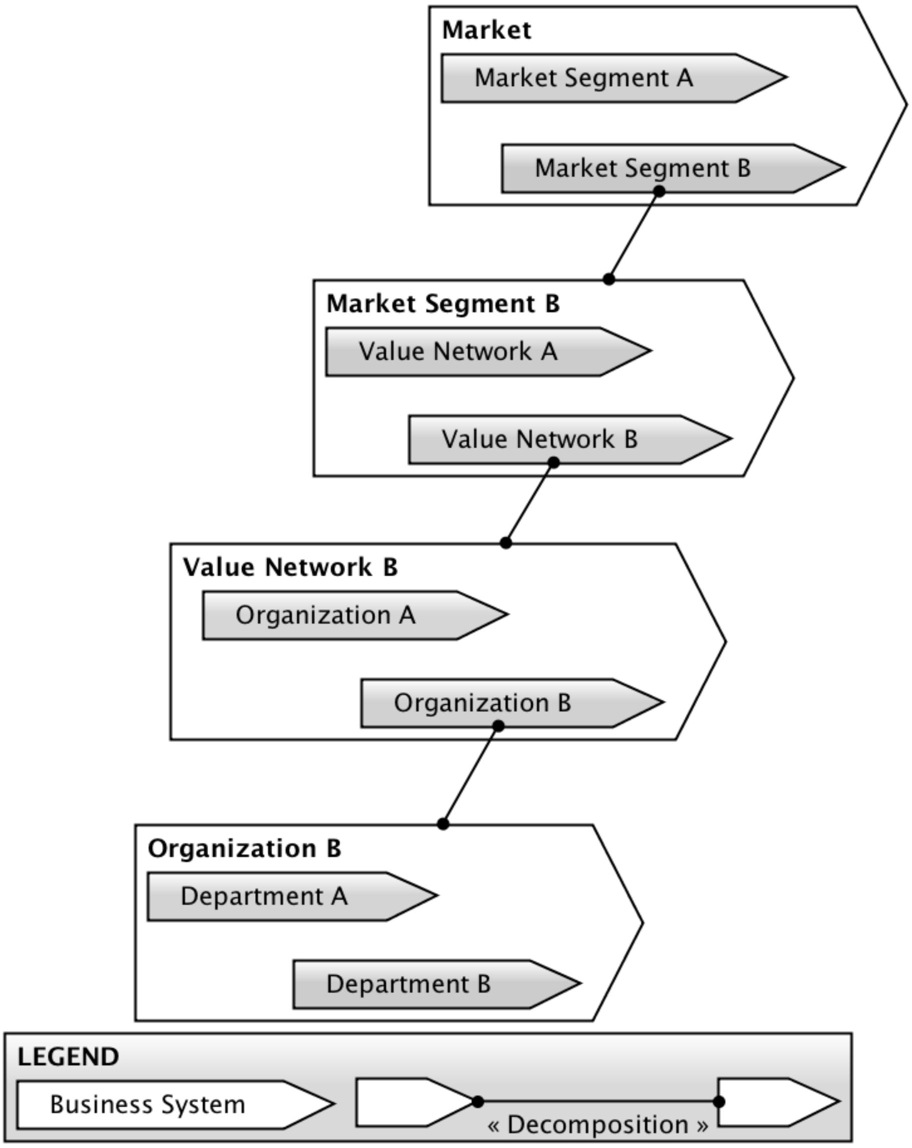

Figure 6. The hierarchy of systems in the Value Network Model

The Value Network Model represents a hierarchy of nested systems i.e., market segments, value networks and organizations. Figure 6 illustrates this hierarchy of systems in the Value Network Model. As shown, we start by modeling a market segment. A market segment can be decomposed to its sub-systems. In the Value Network Model, we decompose a market segment to view the competing value networks as its constituent sub-systems. In Figure 6, the “Market Segment” consists of “Value Network A” and “Value Network B”. As we decompose a system we see the entities within it (such as the value networks within a market segment); we call this representation the white-box view of the system. On the contrary, when the sub-systems that compose a system are not modeled, we view the system as a black-box. In our models, the white-box and black-box views of a system (i.e. value network, organization and department) are color-coded with white and gray respectively.

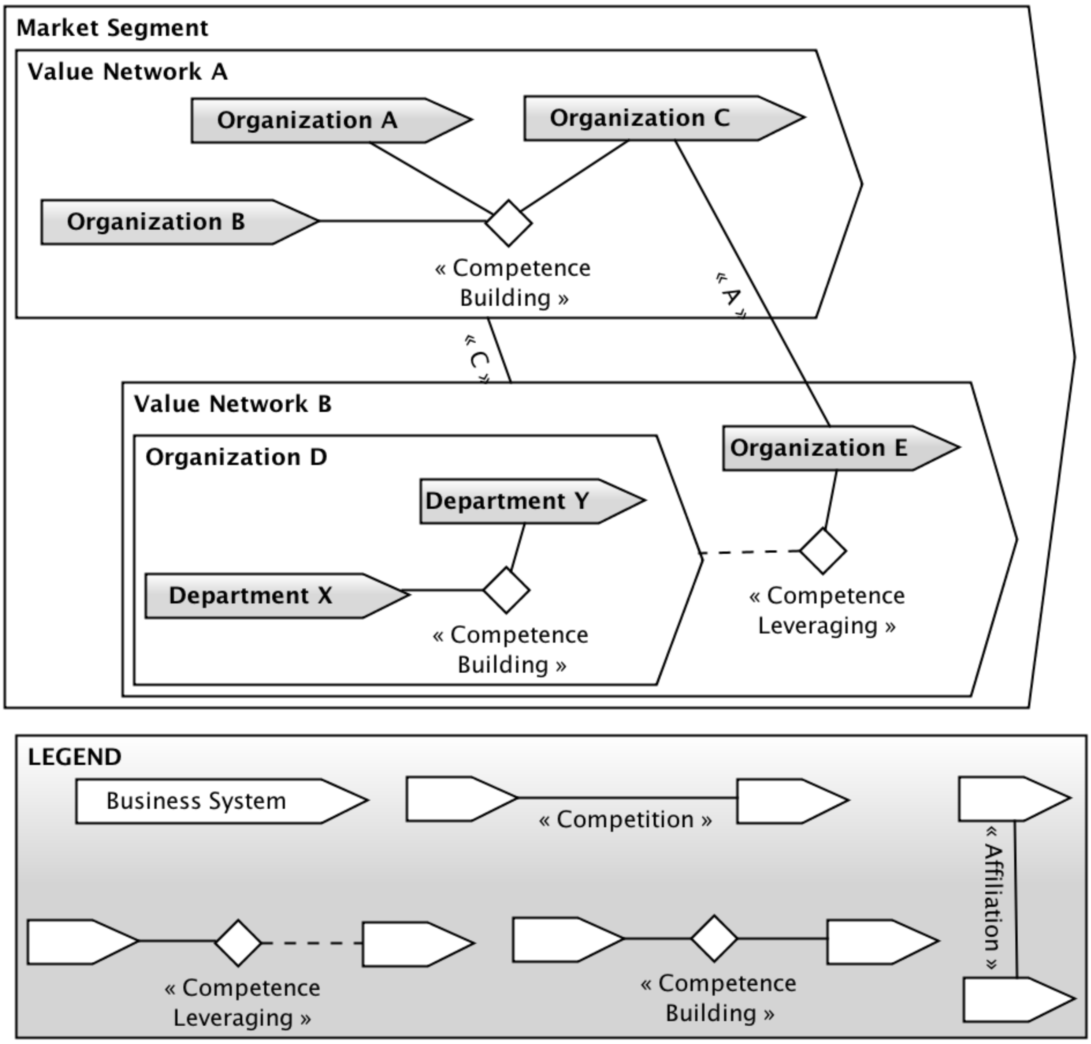

Figure 7. The nature of the relationships in the Value Network Model

In Figure 7, we model two value networks within a market segment capturing the relationships between the entities. We shortly explain the notation used in the study here by using the above example.

- As illustrated, "Value Network A" competes with "Value Network B". In the model, a line annotated with the letter "C" denotes this competition.
- In "Value Network A", "Organization A, B and C" collaborate. A diamond connected to the organizations with solid lines indicates that this collaboration is aimed at *competence building*.
- In "Value Network B", "Organization E" collaborates with "Organization D". We can also see that "Department X and Y" are the constituent elements of "Organization D"[4]. As shown, a solid line connects "Organization E" to the diamond that is connected to "Organization D" by a dashed line. This denotes

[4] In this chapter we adopt a simple representation of an organization as a white-box. We have integrated the CBSM concepts with the Viable System Model (VSM) to represent more details on the entities within an organization when modeled as a white-box. The resulting representation is illustrated and explained in Appendix 3. This representation can provide useful insights into designing the organization structure required for addressing the complexities of coopetition at a more micro level. We refer to this representation as the "Enterprise Model".

that the nature of the collaboration is *competence leveraging*. Meaning that "Organization E" leverages its competence to provide "Organization D" with the resources and capabilities it requires to sustain its value creation activities.

- The line annotated with the letter "A" that connects "Organization E" to "Organization C" denotes that "Organization E" is *affiliated with* "Organization C". This could mean that the two organizations belong to one entity or "Organization E" is a subsidiary of "Organization C".

4.1 Modeling coopetition in Amazon Marketplace value network

We now apply the Value Network Model to represent the example of Amazon Marketplace. In this coopetitive value network the nature of collaboration is competence leveraging and the competition takes place within the value network.

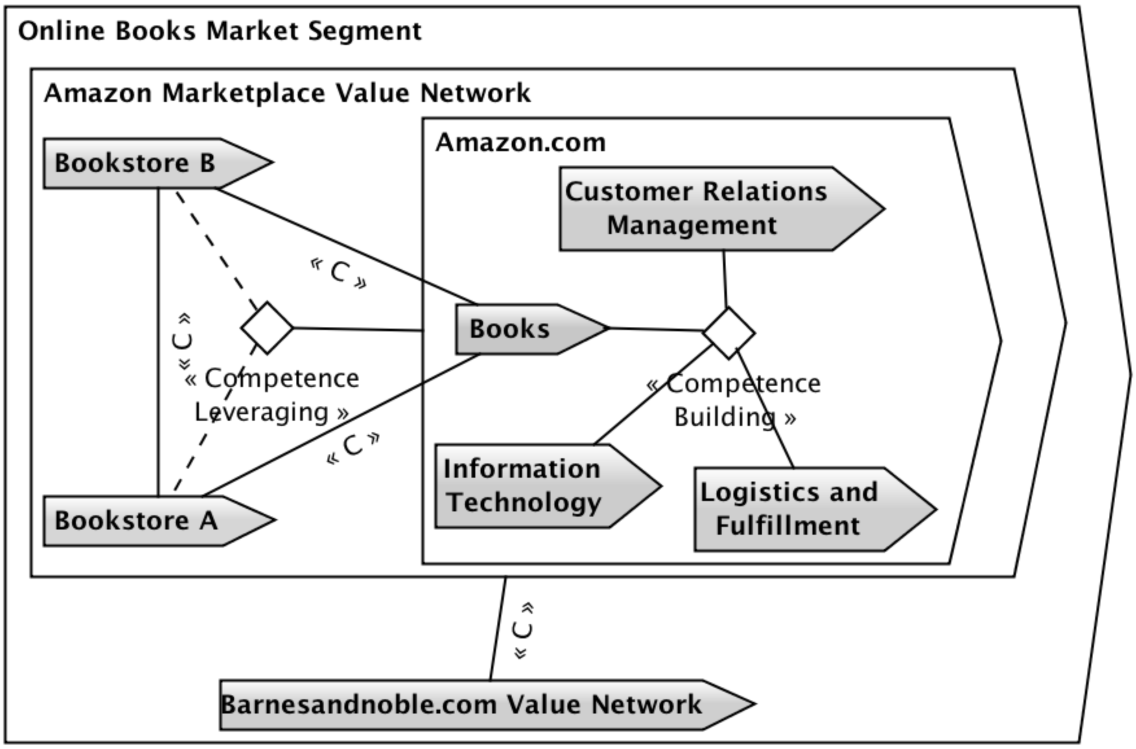

Figure 8. Coopetition within Amazon Marketplace Value Network

As illustrated in Figure 8, "Amazon Marketplace Value Network" and "Barnesandnoble.com Value Network" are in competition in the "Online Books Market Segment". For the sake of simplicity other competing value networks within this segment are not modeled. In addition, as we are interested in modeling coopetition in "Amazon Marketplace Value Network", we do not represent the entities within "Barnesandnoble.com Value Network" and thus this value network is represented as a black-box.

Inside "Amazon Marketplace Value Network", Amazon.com is modeled as white-box. Thus we can see the various departments within Amazon.com such as "Information Technology", "Customer Relations Management" and "Logistics and Fulfillment" and "Books" that collaborate to co-create value. It is also shown that "Amazon.com" collaborates with "Bookstore A" and "Bookstore B" within the Amazon Marketplace. As a result of this collaboration the bookstores are able to place their books next to the ones from Amazon.com's on the same product page. This means the customer can either buy from Amazon.com or from the small independent bookstores that are present on the Marketplace. Thus, Amazon.com's books department is in a head-on competition with the bookstores on Amazon Marketplace to win customer orders. The line annotated with the letter "C" denotes this competition. The dashed line connecting Amazon.com to "Bookstore A" and "Bookstore B" indicates that Amazon.com provides these entities with the supplementary and complementary resources they require to create value for the customers within the segment and thus the nature of the collaboration is competence leveraging. The simultaneous existence of the competition and collaboration linkage implies the coopetitive relationship between these entities.

4.3 Modeling coopetition between Amazon.com and Borders.com value networks

In April 2001, Amazon.com made an agreement with Borders, one of its fiercest brick and mortar competitors, to launch and power Borders' online operations on Borders.com. Based on the agreement, Amazon.com provided Borders with an e-commerce solution of technology services including inventory, fulfillment, site content and customer service in order to help Borders establish online operations. Such services were offered through Amazon.com Services, a subsidiary of Amazon.com. Amazon.com Services offers a variety of e-commerce services that allow retailers to set pricing and other transaction conditions, manage and coordinate the logistical processes for transfer of the physical or digital goods, assure the quality of the goods sold and verify the credibility of buyers and sellers and, as well as settle payments and arrange fund transfer (van Heck & Vervest, 2007).

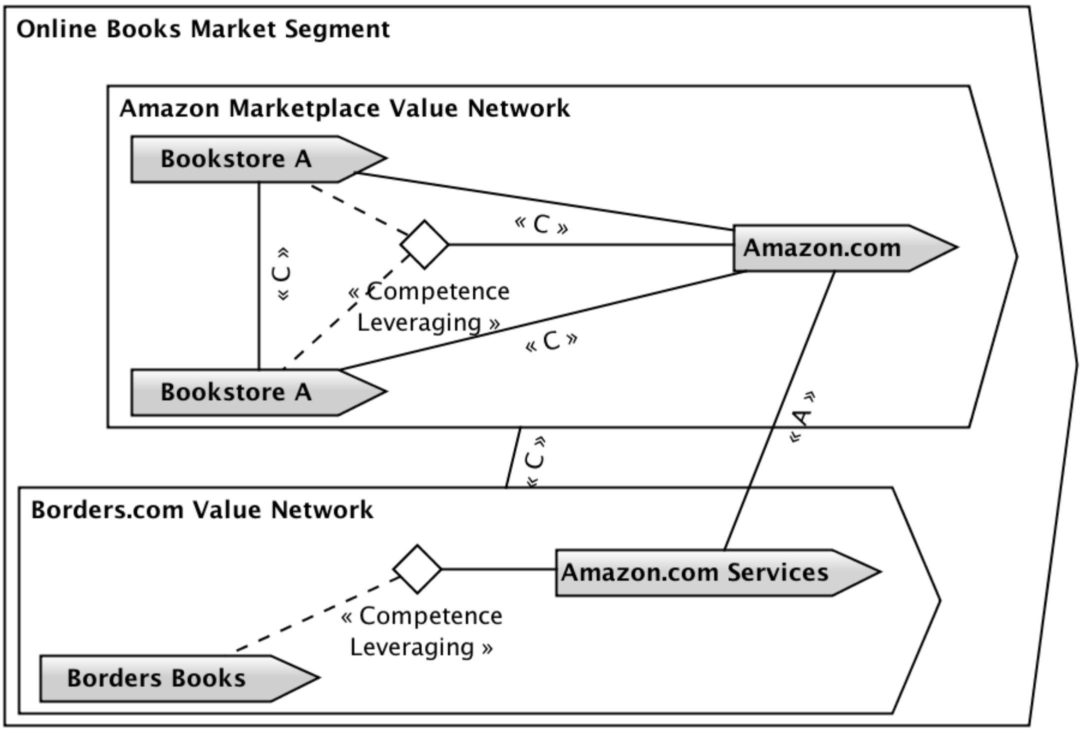

Figure 9. Coopetition between Amazon Marketplace and Borders.com Value Network

In Figure 9, we model the coopetition between Amazon.com and Borders.com. As explained, "Amazon Services" provides "Borders Books" with the resources it requires to launch its online operations in "Borders.com Value Network". Thus, while Amazon.com cooperates with Borders through its subsidiary "Amazon.com Services", "Amazon Marketplace Value Network" and "Borders.com Value Network" compete in the "Online Books Market Segment". It is interesting to observe that in this model Amazon.com is involved in intra-value network coopetition with the bookstores and inter-value network coopetition with Borders.com. In both coopetition initiatives the nature of collaboration is competence leveraging.

4.4 Modeling coopetition between the developers in the Windows Mobile Community

In Figure 10, we represent the Smart Phone Application market segment in which the "Android Value Network", "iTunes Value Network" and the "Windows Phone Value Network" are in direct competition. In these value networks, Google, Apple and Microsoft offer free tools, sample code, community support, and educational resources to help developers develop apps and games for their mobile platforms. This has been widely called as war between mobile "ecosystems" in the popular press.

The nature of the collaborative relationships within these communities (i.e. value networks) is competence building, since the aim is to develop new and improved application solutions to meet end customers' needs. Within these communities the developers collaborate by expanding the number of the applications and thus making the platform more competitive relative to the competing platforms (i.e. expanding the relative value of a particular platform against other platforms). At the same time they compete for the customers who want to buy an application from their platform (i.e. competing for the scarce resources and attention of the customers). This logic is in line with the one often suggested by coopetition researchers in that the "business pie" is first increased through collaboration, and the actors compete to divide it up (Brandenburger & Nalebuff, 1996; Ritala & Hurmelinna-Laukkanen, 2009).

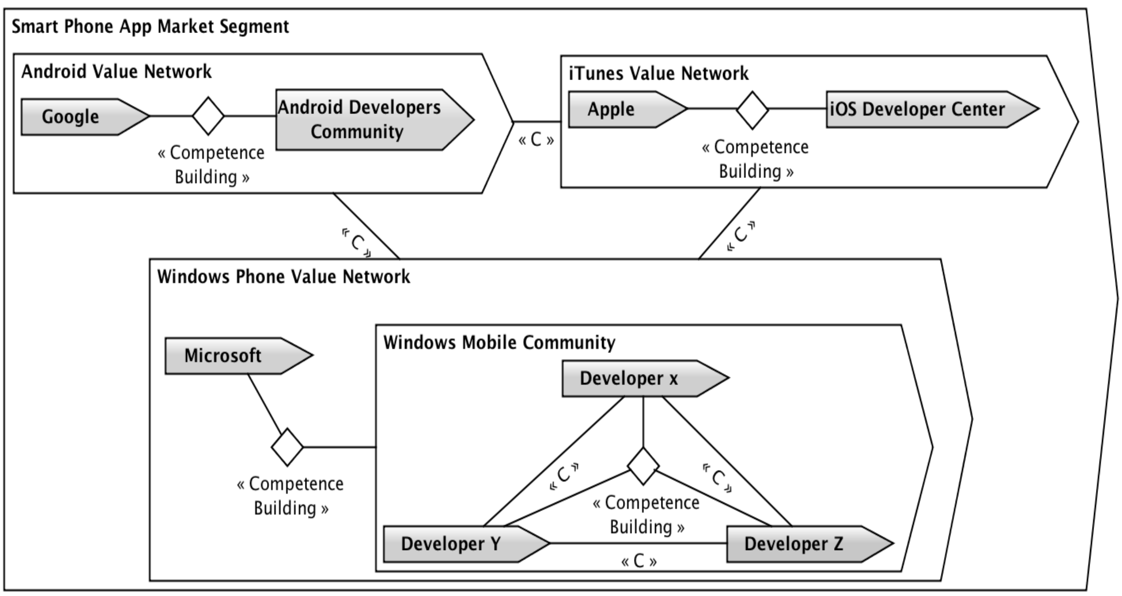

Figure 10. Coopetition among the developers in the Windows Mobile Community

In Figure 10, we have modeled this inter-value network pattern of coopetition in the "Windows Mobile Community". The rest of the application developer communities are modeled as black-boxes.

4.5 Modeling coopetition between Apple and IBM in the AIM Alliance

In this section, by applying the Value Network Model we represent the coopetition between Apple and IBM in the AIM (Apple, IBM and Motorola) alliance that designed and manufactured a new generation of microprocessors with reduced instruction set computer (RISC) architecture. The AIM alliance gave birth to PowerPC (i.e. Performance Optimization With Enhanced RISC – Performance Computing, sometimes abbreviated as PPC) (see e.g. Duntemann & Pronk, 1994; Vanhaverbeke & Noordehaven, 2001). The major objectives of the alliance were to prevent Intel and Microsoft from controlling the future of the CPU architecture and OS in desktop computers.

Apple, IBM and Motorola established the Somerset Design Center in Texas to develop the RISC based CPUs. The facility was jointly owned and managed by IBM and Motorola and employed more than 350 engineers 50% working for IBM and 50% working for Motorola. Apple also kept a number of staff in the facility to ensure software compatibility (Duntemann & Pronk, 1994).

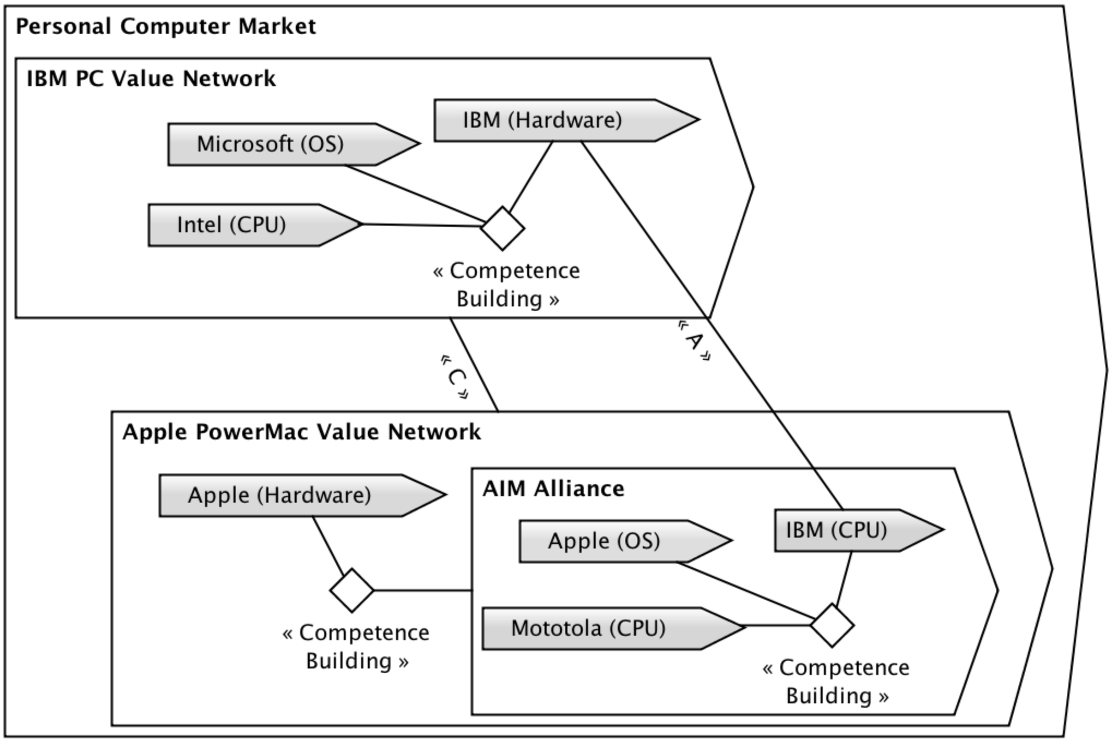

Figure 11. Coopetition between Apple and IBM in AIM Alliance

Figure 11 models the PC market circa 1994, representing the "IBM PC Value Network" and "Apple PowerMac Value Network". In the Apple value network, we represent the AIM alliance as a white box modeling the collaboration between IBM, Apple and Motorola. We have specified the role of the companies in parenthesis. IBM and Motorola were focused on the development of the RISC CPU and Apple was in charge of ensuring the compatibility with the operating system and the third party applications. The line connecting IBM (CPU) to IBM in the AIM Alliance implies that the companies belong to the same financial entity. Hence, while Apple and IBM compete in the PC Market as designers and manufactures of personal computers, Apple as an OS developer (i.e. Apple (OS)), is cooperating with IBM as CPU designer and manufacturer (i.e. IBM (CPU)) in the AIM Alliance.

The PowerPC 601 was the first generation of RISC microprocessors developed by AIM. The design effort started in mid-1991 and the first prototype chips were available in October 1992. The first 601 processors were introduced in first Apple Power Macintoshes, later known as Power Mac, on March 14, 1994 (Duntemann & Pronk, 1994; Carroll & Reader-Adams, 1994).

4.6. Synthesis and theoretical implications

In the models that represent coopetition inside the value network (both for competence leveraging and competence building collaboration) it can be observed that the value network within which coopetition exists is always competing with another value network in the market segment. This implies that intra-value network coopetition helps organizations expand their market share and gain competitiveness against the competing value networks. This is in line with coopetition research suggesting that firms collaborate with their competitors to be able to compete even more fiercely against the rest (Lado et al., 1997), as well as support favorable technological trajectories and other business-related interests in the network-against-network competition (Gomes-Casseres, 1994; Choi et al., 2010; Ritala, 2012). Amazon Marketplace example shows how the bookstores included in this value network pursue to increase their competitiveness against other players (here: Barnes and Noble). On the other hand, Windows Mobile Community example is an archetypical example of technology ecosystem battles that are quite frequent in the ICT industry (see also Gueguen, 2009).

The models that represent coopetition taking place outside the value network (both for value competence leveraging and competence building collaboration) share the “Affiliation Linkage” meaning that an entity that is in collaboration with a organization belongs to an organization in a competing value network.

Dowling et al. (1996) suggest that organizations should departmentalize or divisionalize their organizational structure so that different departments deal with different aspects of the multifaceted relationships (also suggested by Bengtsson and Kock, 2000). As illustrated in the case of the AIM alliance and Amazon Services each of the main players (Apple, IBM and Amazon.com) have established separate entities that comprised some divisions from their organizational structure. Thus, it can be concluded that such arrangement is a way to achieve an organizational structure capable of addressing and accommodating the challenges and the complexities inherent in a coopetitive relationships. The results thus complement the suggestions that management of coopetition is facilitated if collaboration and competition can be separated to some extent in the organizational structure (Bengtsson and Kock, 2000; Walley, 2007).

5. Related Work

The extant research in business and management science has developed a number of techniques for modeling the cognitive processes and the causal assumptions of the decision makers to assist in the decision making process. In this section, we survey three of the most established and widely applied methods that generate diagrammatic representations: Strategy Maps (Kaplan & Norton, 2000a, 2000b) – as a part of balanced scorecard method, Cognitive Maps (Eden, 1989, 1994) – as a part of Strategic Options Development and Analysis (SODA) method, and Causal Loop Diagrams (CLD) (Senge, 1994; Sterman, 2000) – as a part of System Dynamics (SD) methodology (Forrester & Wright, 1961).

Strategy Map (Kaplan & Norton, 2000a, 2000b) is the most established method for modeling the assumptions of the decision makers with respect to the strategic goals of the organization. It is developed as a part of the balanced scorecard method to help organizations communicate and thereby implement their strategy. The origins of Strategy Maps can be traced back to concept mapping and mind mapping techniques. Developed in 1972, concept maps were used as graphical tools for representing and organizing knowledge (Novak & Canas, 2008). A Strategy Map visualizes the strategy of an organization in form of cause and effect relationships between the primary goals of the organization based on four perspectives: learning and growth, internal processes, customer and financial. While a Strategy Map takes into account a number of internal elements (e.g. learning and growth, processes), it limits its analysis to only one external relationship (i.e. customer) when it comes to the external factors and relationships with other entities such as suppliers, regulators and competitors are glossed over. The Value Network Model presented in this chapter can be applied to model the environment in which a service system is embedded.

The Strategic Options Development and Analysis (SODA) (Eden, 1989, 1994) is a method that aims at designing problem solving interventions. SODA uses Cognitive Mapping as a modeling device for eliciting and recording the organizational decision makers' views to help depict the structure of a problem and demonstrate why a situation is problematic. The Cognitive Maps are then used to guide decision makers to solutions. Cognitive Maps can be broadly referred to as problem-driven approaches to strategy representation. The idea for the Cognitive Mapping is to develop a definition of the problem an organization aims to tackle without losing sight of the inter-relationships between the problem and other areas in the organizations. Nevertheless, when it comes to representing the incentives behind the strategy of an organization, the Cognitive Map does not provide a theoretically grounded set of constructs that provide analytical assistance by representing those aspect of the strategy that are deemed pertinent to the problem in focus. Being grounded in theoretical conceptualizations from competence-based strategic management, the Customer Value Model addresses this issue.

The causal loop diagram (CLD) (Senge, 1994; Sterman, 2000) is a part of the System Dynamics (SD), a modeling and simulation methodology used for developing an understanding of complex systems. A CLD visualizes the decision maker's perception of the causal inter-relations between the variables in a system to provide insights into the behavior of the system. When representing a causal chain of interconnected entities using a CLD, it is difficult for the decision maker to determine the scope of the model in that there are always some entities that impact the ones originally considered by the modeler. An over-elaborated model does not provide the insights requisite for the analysis and understanding of the strategy. The white-box, black-box representations in the Value Network Model help us draw boundaries around those aspects of the organization we seek to study. We can thereby model the organization as a hierarchy of systems that compose the organization and the nested systems in which the organization is embedded.

The three surveyed methods (i.e. Strategy Maps, Cognitive Maps and Causal Loop Diagrams) generate diagrammatic representations of the organizational participants in the decision making process. In our work we focus on diagrammatic representations. From a cognitive standpoint, diagrams are more easily understood and are more cognitively accessible as compared to other forms representation such as sentential or verbal representations (Larkin & Simon, 1987; Tufte, 1990; Zhang, 1991, 1997; Zhang & Norman, 1994).

6. Conclusions

Coopetition is a complex, multifaceted relationship, which is embedded in a value network comprising multiple actors and linkages between them. Understanding why coopetition is beneficial, as well as how it could be organized in this context are important and practically relevant challenges for marketing and strategy scholars. In this chapter we presented two problem structuring methods (PSMs): the Customer Value Model and the Value Network Model. The PSMs embody conceptualizations from competence-based management (CBSM) theory and were grounded in coopetition and value network literature. We showed how modeling contributes to our understanding of the strategic incentives for the organizations to develop a coopetitive relationship and the network design required for accommodating and addressing the complexities and dynamics of such a multi-faceted relationship. We demonstrated the applicability of the Customer Value Model by modeling coopetitive value network between Apple and IBM that gave birth to PowerPC infrastructure. For illustrating the usefulness of the Value Network Model, first a typology of coopetitive value networks was developed. Two dimensions were considered, the locus of competition (inside or outside the value network) and the nature of collaboration (competence leveraging and competence building). Next, based on the developed typology, four examples of coopetitive value networks were presented and modeled using the Value Network Model.

In addition to developing a modeling technique to analyze the design of coopetition in value networks, this study proposes two main theoretical contributions for coopetition research. First, concerning the organizational structure required to accommodate the complexities of a coopetitive relationships, our findings echo some of the perspectives developed in coopetition literature. According to Dowling et al. (1996), companies have two basic choices for dealing with this multifaceted inter-organizational relationship: avoidance or adaptation. In terms of the latter, Dowling et al. (1996) suggest that organizations should departmentalize or divisionalize their organizational structure so that different departments deal with different aspects of the multifaceted relationships (also suggested by Bengtsson & Kock, 2000). As illustrated in the case of the AIM alliance Apple and IBM established separate entities that comprised some divisions from their organizational structure. Thus, it can be concluded that such arrangement is a way to achieve an organizational structure capable of addressing and accommodating the challenges and the complexities inherent in a coopetitive relationships. The results thus complement the suggestions that management of coopetition is facilitated if collaboration and competition can be separated to some extent in the organizational structure.

Second, the study has utilized value network-level analysis in examining coopetition. Based on the analysis, it can be suggested that it is valuable to look inside the value networks (which elements they are comprised of and what are the linkages between the elements) as well as between them (what are the linkages between value networks). Increased understanding of this issue may help researchers to understand how value is created for the customer, as well as how it is eventually captured by the value network participants.

The PSMs introduced in this chapter can help management practitioners in structuring choice situations involving coopetition, both in terms of the incentives to engage in a coopetitive setting and the design of a value network that can accommodate the complexities inherent in such multi-faceted relations. Group model building sessions and workshops can be held within organizations to elicit the potential incentives for establishing a coopetitive value network and the exploring possible organization design choices to accommodate the complexities and mitigate the risk of simultaneous collaboration and competition.

This study suffers limitations due to its case based nature, which decreases generalizability. On the other hand, the case approach used here was mainly instrumental, since the main focus was to develop a modeling rationale for coopetition in value networks. Thus, further research could address issues to both utilizing the PSMs in other settings, as well as developing the PSM itself. More details of the limitations of the two PSMs are as follows.

The Customer Value Model and its method of validation suffer from a number of limitations. The Customer Value Model focuses mainly on value creation, and does not explicitly analyze value capture or appropriation that eventually takes place through the competitive process between different actors in coopetition relationships. This issue has been explicitly been put forward in the coopetition research (e.g. Walley, 2007; Ritala and Hurmelinna-Laukkanen, 2009), and definitely warrants further attention in future research. In addition, we illustrated the applicability of the Customer Value Model by means of case-based example of a coopetitive relationship between Apple and IBM in the development of the PowerPC CPU. The usefulness of the representations in the Customer Value Model was assessed in a project conducted with a social networking platform called Webdoc. Although the results from the project are promising, we cannot establish a warranted belief about the usefulness of the Customer Value Model. Thus, we need to apply it in a number of other projects and gather more evidence on its applicability and usefulness. In our future work, to make the Customer Value Model more prescriptive, the representations can be quantified using System Dynamics Stock and Flow simulations models so that the impact of various resource configurations on the net delivered customer value could be quantitatively assessed.

Regarding the Value Network Model, the typology and the modeling approach presented here aim to be generic to any coopetition setting, but there are several limitations related to our study that should be acknowledged. First, our approach simplifies coopetition settings into a four-cell typology, and real-life business situations may not clearly fall within one category only, or in extreme case in any of these categories. Thus, the reductionist approach adopted here certainly poses limitations for interpretation and analysis. While this is a limitation, we suggest that this can be taken into account in analyzing and modeling coopetition relationships. In addition, by initially acknowledging the different logics of coopetition separately, it is easier to start analyzing more complex value network settings. In any case, we suggest that research using deliberately more complex approaches is also needed to pinpoint the detailed scenarios, which may take place in networked coopetition settings. In our future work, we will focus on holding workshops in which assess the usefulness and practicality of the Value Network Model in concrete business settings. We could assess other business cases in various industry settings including but not limited to coopetition.

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Appendix 1. Modeling Customer Value in Webdoc

In this appendix we present the results of the project we conducted at Webdoc, a social networking company, in order to improve net perceived customer value.

1. Introduction

Webdoc is an internet startup founded in Lausanne in 2009. It currently has offices in Lausanne (headquarters: management, engineering, design, and product), London (business development), Lima (community engagement and support), and San Francisco (business development). Webdoc provides a social network platform on which users can express themselves in a richer, more interactive way than traditional social networks. Specifically it provides a channel in which existing web content, be it video, audio, images, or text, can be combined with content created using the proprietary rich editor, in a way that requires no technical skills and is easy to share and distribute. These creations are referred to as "webdocs" and can be embedded on any third-party site, including other websites and social networks. Additionally all webdocs created can be showcased in their relevant category of interest on the Webdoc destination site. The creators have the option to make their webdocs completely private (only users granted explicit permission can view) or public but unlisted (meaning the webdoc will not be featured on the Webdoc site). The service is free to all users with no advertising, currently available in 5 languages (English, French, Spanish, Portuguese, and Russian), and accessible through a variety of platforms including desktop web browsers, mobile device browsers, and native mobile applications.

As the company and user base has grown tremendously in the past 12 months, there has been an increasing need for establishing a better understanding of and improving perceived customer value. The analysis, conception, and subsequent improvement of the value perceived by the customers feed into vital functions of the service and company, including product development, overall strategy, valorization of the company for current and future investment rounds, and optimization of the service. These needs are what triggered the work that has led to the culmination of this project. The project is described in three sections: surfacing customer value attributes, modeling and improving net perceived customer value.

2. Surfacing Customer Value Attributes

Surfacing customer value attributes have been the first major pillar of this project and can be further sub-divided into two distinct but strongly interconnected fields: data capture and user intelligence.

2.1. Data Capture

The initial step was to do a comprehensive review of all the data being captured. As an internet service, the channels through which the service provider can understand its users are very different than those of a traditional service. The overwhelming difference is the radically new interaction paradigm through which service providers and service adopters communicate. For traditional service providers a wealth of customer data is gathered without any explicit effort, simply by the customer's physical presence. For example, basic demographic information can be taken for granted. On the other hand, for an internet firm like Webdoc sophisticated measures need to be put in place to understand even the most fundamental characteristics of its users, such as location, language, gender, and age. Without the application of data capture tools it would be very difficult to answer basic questions as to service adoption, such as who is using it, how frequently, with what kind of equipment, and for how much time on each occasion. To bridge the gap of this internet interaction paradigm a number of service providers offer web analytics packages. These are third party, off-the-shelf solutions that can be customized to varying degrees, and are provided for a cost ranging from free to tens of thousands of dollars a month. There also exists the possibility for every internet company to custom-build its own web analytics and data capture solution. The latter was the first solution considered, but was quickly discarded for a number of reasons. By far the most important reason it is not a feasible solution for Webdoc is that the creation of one's own analytics system requires extensive and sustained financial, development, and management resources. This is the same reason why apart from the largest of internet corporations, nearly all internet service providers use a third party solution. Having discarded the completely custom route, there were a number of off-the-shelf solutions to review, including the validity of the one already in place – Google Analytics.

Three different packages were reviewed: Google Analytics (the incumbent) provided by internet giant Google, Chart Beat provided by Stats, and Kiss Metrics (a package previously used) provided by the company of the same name. As far as prices, Google Analytics follows a freemium model, whereby the vast majority of users (including Webdoc) utilize the free version, which has some constraints and limited customer support, and a tiny minority pay for the full version, with no constraints and full customer support. Chart Beat and Kiss metrics are pay-only services, although they both offer 14-day free trials to get a feel of their product and help drive the purchase decision. Price was not the overriding consideration in the review of these packages.

The next factor was implementation effort and continuity of data points. In this regard Google Analytics was the clear winner, as any further implementation only required modification, not changing things from the ground up. Similarly, all the historic data would continue to be valid and usable. This becomes especially important when mapping long term trends which require 3 months or more of data. A third factor was the depth of service components, as mapped in the table provide below. In this aspect the three are nearly level, with Chart Beat and Kiss Metrics ahead in some components, but behind in others. In reality many of the product features that were not built-in to Google Analytics by default could still be developed via custom implementation. This of course requires extra effort, but when weighed against the overall cost of the other two packages, turns out to not be significant.

A final factor was the stability and the size of the service provider. This is important to consider as if the company dissolves the analytics package would no longer be available, and of even greater concern, the data no longer usable. In terms of this Google was again the clear winner, being a well-established technology firm with dozens of

Fortune 500 companies using the same package, reducing virtually to nil any risk of discontinuation of the service. On the other hand, while both promising start-ups in growth phases, the future of Stats and Kiss Metrics is not nearly as certain. The specifics of the enhanced implementation of Google Analytics are covered in the implementation section.

Table 1. Comparison of analytics packages for surfacing customer value attributes

Component	**Google Analytics**	**Chart Beat**	**Kiss Metrics**
Real-time analytics	Limited	Yes	Yes
User session tracking	Custom implemented	Yes	Yes
Social Analytics	Limited	Yes	Yes
Cohort Analysis	Custom implemented	Yes	Yes
Events tracking	Yes	Yes	Yes
Event funnels	Limited	Yes	Yes
API for custom reporting	Yes	Limited	No
Visit tagging	Yes	No	Yes
Custom segments	Yes	No	Yes
Dynamic segments	Yes	Yes	Yes
A/B testing	Custom implemented	Yes	Yes
Mobile application	Yes	No	No
3rd party applications and libraries	Yes	No	Yes
Heat maps	No	No	No
Goals and Objectives	Limited	No	Yes
Legacy metrics	Yes	No	No
Custom dashboards	Limited	No	No
Email reports	Yes	No	No
Report Export in multiple formats	Yes	Yes	No
Data Export	No	Yes	Yes
Custom alerts	Yes	Yes	No
Team size permitted	Unlimited	Limited	Unlimited
Customer support	Limited	Yes	Yes

All the above web analytics packages work using HTTP cookies. Cookies are text files that are stored by the visitors browser upon visit of a site. Cookies are associated with a particular site and are conceived to offer visitors a personalized experience with continuity. In the context of Webdoc, as is true for most modern web sites, cookies are used in two distinct manners. The first is to provide fundamental features of the service, such as authentication and storage of account preferences. For example, a common feature offered in the modern web is to remember login, so users do not have to keep re-entering credentials on websites they frequent. Such a feature would not be possible without authentication cookies. The second use, directly related to this project, is to track and capture data, to better understand customers and be able to scale the service as necessary. Cookies have justly long been the source of privacy concern for end user advocates. As on any occasion companies collect personal data of its customers, it is important to store and use that data is an ethical and responsible manner.

2.1 User Intelligence

User intelligence was an area in which only a limited amount of work had been done previously. The key distinguishing factor between the data gathering described above and the user intelligence described in this section is data gathering is quantitative while user intelligence tends to be qualitative. That is, while data capture drives decision by virtue of total sample size and confidence intervals, user intelligence tools provide a much more nuanced perspective, at the micro level, which sacrifices on breadth of data for depth.

The fundamental motivation of the user intelligence aspect was the need for product development insight. While numeric metrics such as overall visitors, logged in users, views of a particular page, and so on are certainly invaluable, they are more useful in measuring the effectiveness (or ineffectiveness) of a feature post-change than they are in suggesting what changes might be needed in the first place.

2.1.1 ClickTale

ClickTale is a unique service provider that offers various user intelligence tools, including heat maps, user recordings, and mouse flows. Heat maps are screenshots of the website showing the spatial distribution of clicks over the screen space. Heat maps offer important product insight, as they show what links and content garner the highest level of attention from the audience. In effect, heat maps are a cheaper, more scalable alternative to eye tracking tests. User recordings provided by click tale are an attempt to recreate individual user sessions by aggregating mouse movement, keyboard activity, scrolling and navigation, and clicks into a video. That is, rather than actually record the session, it is interpolated by capturing all the key aspects. The advantage of a key event based recording then reproduction over a video is it is a fraction of the size, and thus also highly scalable. While video recordings become unwieldy in the hundreds, this approach can comfortably be scaled to the hundreds of thousands. The major drawback is that implementation is very time consuming – essentially implementation becomes another layer of the code base where every feature requires accompanying code, rather than a completely modular approach offered by user videos.

ClickTale is somewhat of a generalist, in that in addition to the user intelligence tools described above, it also offers a basic web analytics package, of the type described in the preceding section. While its package includes features such as funnels, real time monitoring, and custom alerts, the overall package is still too simple to serve as the primary one. Effectively this means adopting ClickTale would require paying for a host of redundant and thus unused features. Additionally much of the product development being done at ClickTale revolves around bringing up their analytics package to the level of their competitors, rather than continued development of the user intelligence tools.

2.1.2 Usertesting.com

Usertesting.com seeks to provide the same genre of insight as ClickTale, but with a much richer medium of full audio and video. The service offers the possibility to create a test environment where tasks are defined, optional demographic and technical requirements are specified if desired, and a full questionnaire is filled out upon completion of the test by the tester. The key aspect is that while performing the tasks the entire user screen is recorded, along with an audio stream for their live commentary. Implementation of this service was extremely straightforward in that it only required defining the tasks and providing the starting point. The greater challenge was interpretation of the results. This was aided by the array of features the service offers, including the ability to annotate specific points in the video, replay videos at higher than 1.0x speed (up to 2.0x, in increments of 0.1x), sharing of highlights with team members, and the option to contact the same testers for further insight. An additional feature provided by usertesting.com is the option to intercept one's own visitors and request them to participate in a test. The advantage of this of course is it provides more organic results and by definition is testing using one's own target demographic and audience.

Unlike ClickTale usertesting.com specializes in user intelligence. All development efforts are focused on continually improving their core offering. Thus usertesting.com was chosen as the tool most appropriate for Webdoc's needs. There is no monthly or yearly subscription, rather the cost structure is based per test, with marginal discounts offered for pre-purchase in bulk and for using one's own customers rather than their tester pool.

3. Modeling Customer Value Attributes

The key academic component of this project was using the data gathered (through analytics and user intelligence, as described in the previous) to model customer beliefs. The beliefs first lead to adopter goals. These are then used to generate service features that would help adopters meet their goals. The service features then dictate the required service components. Based on the service components, appropriate service providers are brought in.

An important concept used in conjunction with the modeling of service adopters and beliefs is that of market segments. Market segments are a fundamental concept of marketing, as well as economics and management, that identifies groups of customers who share characteristics and thus often behaviors. In his seminal work on marketing Porter (1980) dwells deep into the dynamics of market segments, specifically on how a larger base of customers entices competitors into joining the space. In the modeling of adopters each was attributed to a distinct segment.

In the interim phase four unique personas were created to represent typical Webdoc users at that point in time. The diagrams below show a set of beliefs for each of the four personas. Goal-belief modeling is a technique used to analyze the service system and then identify problems to be solved. It is valuable as it allows priorities to be established and development tasks to be organized accordingly. Most importantly it gives way to the identification of features exchanged between adopter and supplier value networks as shown in the matrixes that follow the goal-belief models.

The first persona was Claudia, a 16-year-old girl from Mexico City. She has both her Facebook and Twitter account linked to her Webdoc account. She is specifically an avid fan of the British boy band One Direction as well as more generally teenage popular culture. She has grown up using the internet and spends most of her day connected, either through her laptop or her mobile smart phone. She is comfortable and in fact eager to share all her online activity. She also aspires to communicate directly to One Direction band members via internet services, having discovered Webdoc initially from a tweet made by the official One Direction account. Claudia was created to be Hispanic to reflect the sizeable percentage of Latin American users at the time.

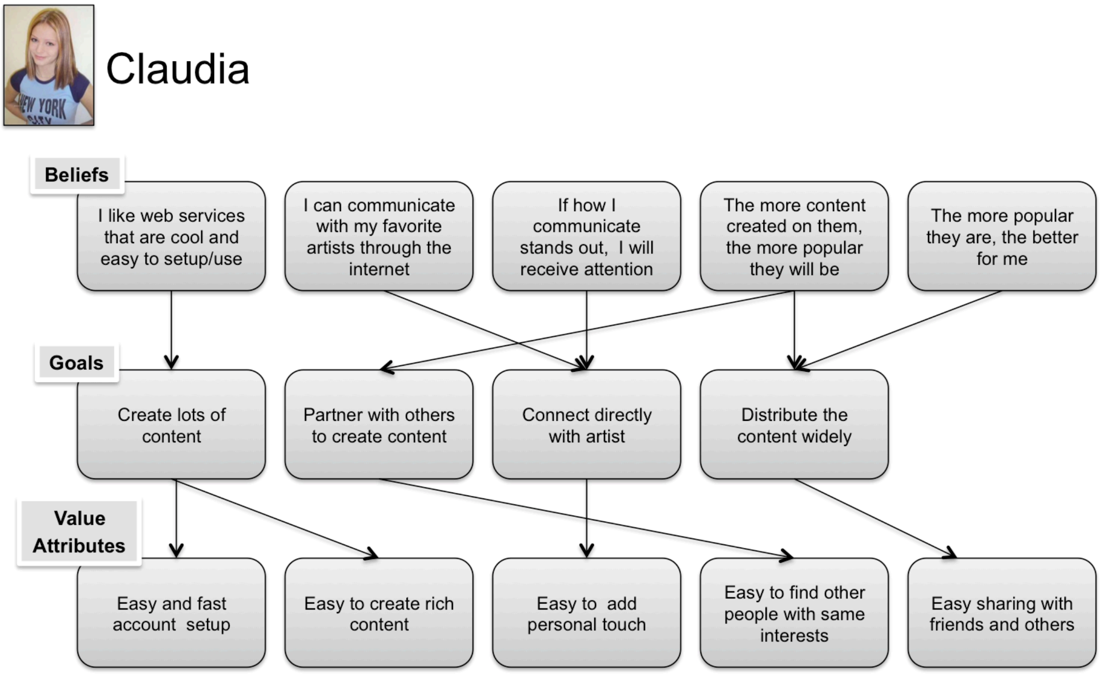

Figure 1. Customer Persona - Claudia

Michael was the second persona, a middle-aged white collar professional based in San Francisco. Michael has a strong nostalgic affection for Nirvana, a band he grew up listening to. Unlike Claudia, he is not as eager to create content, as he has a busy work life. Nonetheless, he uses internet services to stay in touch with his favorite artists and their activities and is interested in browsing content related to them. He has only his Facebook account linked to Webdoc and first found the service through NME magazine, a music site he follows closely.

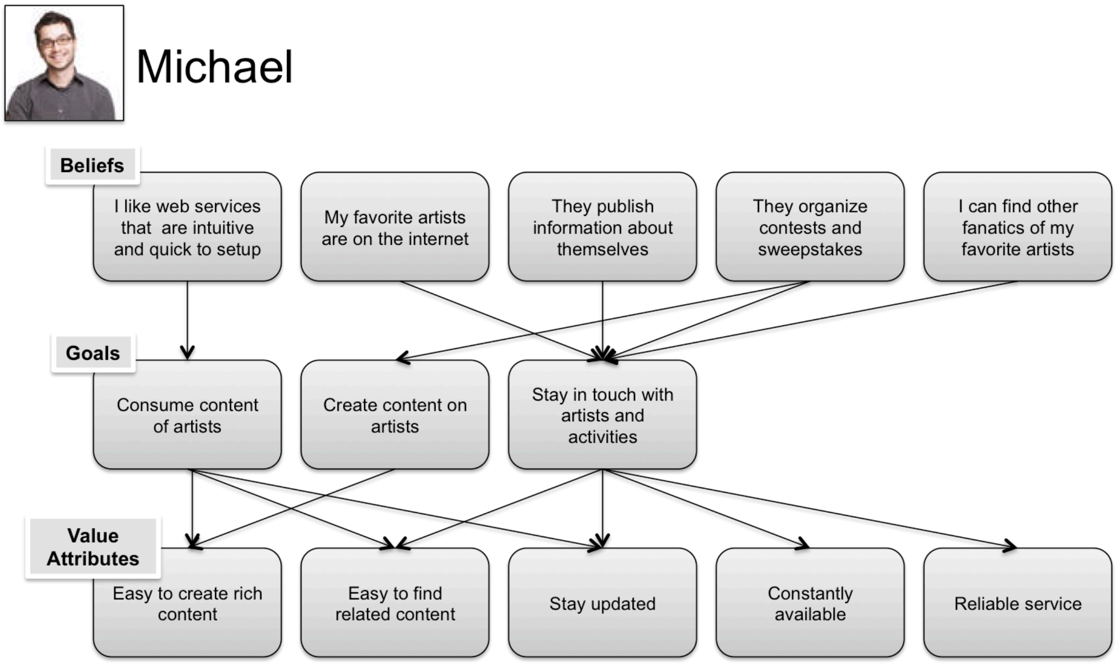

Figure 2. Customer Persona - Michael

Diane was the third persona, a 29-year-old upwardly-mobile working professional based in London. She shares many of the same interests and traits as Claudia – such as an eagerness to create content, an active internet presence, and an interest in pop culture. The important differences are that she is much older and her fundamental interest is fashion trends. Like Claudia, she too has her Twitter and Facebook account linked to Webdoc. Diane was created to represent the mostly UK based fashion users at the time.

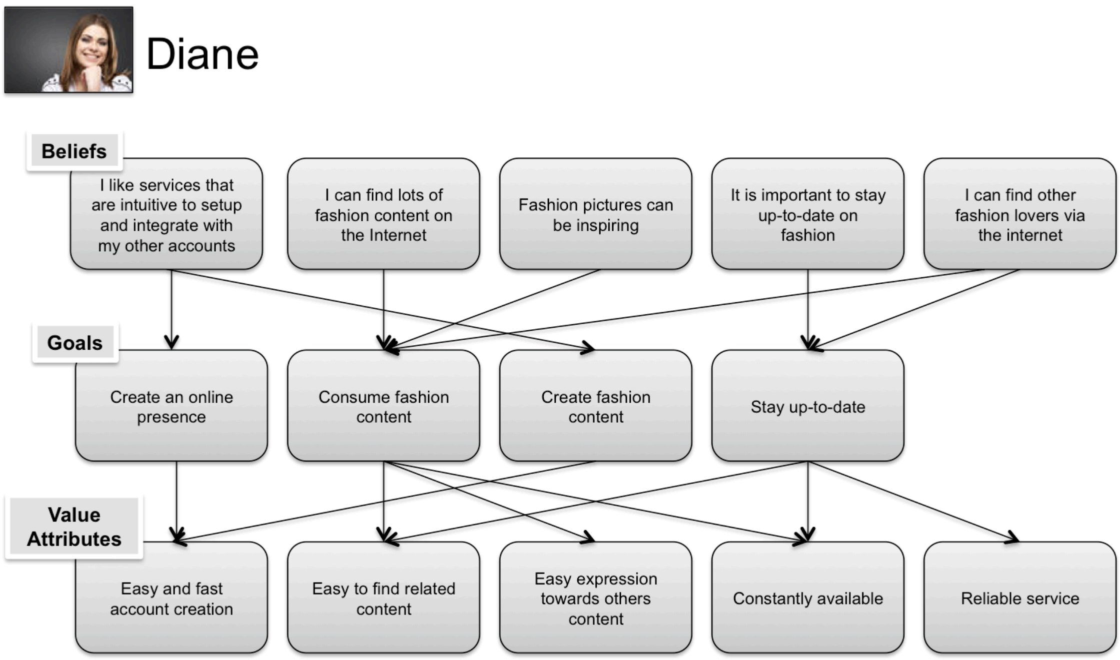

Figure 3. Customer Persona - Diane

Francois was the final persona, a 26-year-old idealistic male from Lyon in France. His interest in using Webdoc is geared to raising awareness for causes such as organic agriculture and endangered species preservation. He was introduced to Webdoc via a link posted on the World Wildlife Federation (WWF) site. He is not as eager a technology user as any of the above personas and has only his Facebook account connected.

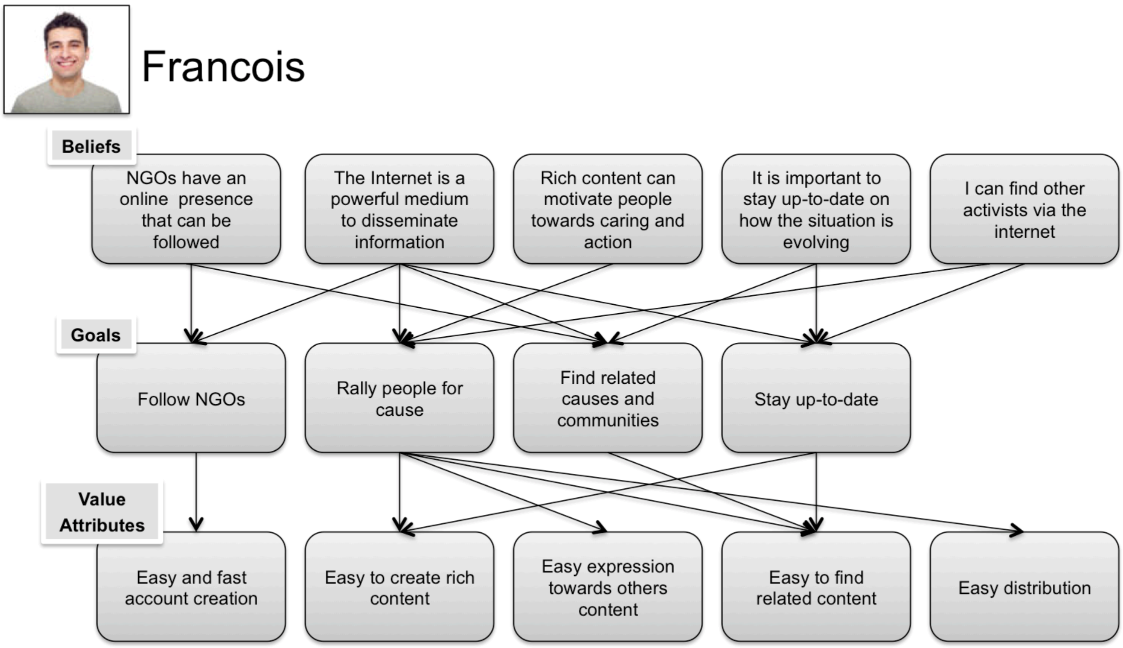

Figure 4. Customer Persona Francois

	Claudia	Michael	Diane	Francois
Easy and fast account creation	+	++	+	++
Monetary cost of use	--	-	--	-
Effort cost of use	-	--	-	--
East to create rich content	++	+	++	++
Easy to add personal touch	++	++	+	+
Easy to find other users	++	+	++	++
Safe and pleasant browsing				+
Fast browsing	++	+	+	+
Easy distributability and sharing	++		+	++
Easy to stay updated	+	++	++	+
Constant availability	+	+	+	+
Reliable service	+	++	++	+
Easy expression towards others content	++	+	++	++

Figure 5. Mapping value attributes to the personas

After surfacing the value attributes, we modeled the impact of value attributes on the net value perceived by each of the customer personas, see Figure 5.

The next step was to define the service features that could create the value attributes for the customers. The mapping between the value attributes and their corresponding service features are presented in Figure 6.

	Easy and fast account creation	Monetary cost of use	Effort cost of use	Easy to create rich content	Easy to add personal touch	Easy to find other users	Safe and pleasant browsing	Fast browsing	Easy distribution and sharing	Easy to stay updated	Constant availability	Reliable service	Easy expression towards others content
Drag and drop creation			X	X	X								
1 click account creation	X		X										
Recommended users						X							
Social network sharing						X			X				
Clean content							X						
Content discovery						X		X					
Multiview browsing								X					
Continual updates to widgets-apps						X				X			
Notifications and updates						X					X		
99.9% reliability						X						X	
Expression towards posted content						X							X
Ubiquitous access									X		X		
Free service		X											

Figure 6. Mapping the service features to the value attributes

Next, the service features were in turn mapped to their corresponding service components. This mapping is shown in Figure 7.

	Drag and drop creation	1-click account creation	Recommended users	Social network sharing	Clean content	Content discovery	Multi-view browsing	Continual updates to widgets-apps	Notifications and updates	99.9% reliability	Expression towards posted content	Ubiquitous access	Free service
HTML 5 architecture	x												
Social network login		x											
Multiplatform													
User recommendation system			x			x							
Social network integration			x	x		x			x				
Inappropriate content flagging					x								
Search and tagging						x			x				
Mosaic view						x	x						
Developer API and SDK								x					
Amazon S3 infrastructure										x			
Likes, follows, comments, replies						x					x		
Mobile website									x			x	
iPhone application												x	

Figure 7. Mapping the service components to the service features

Finally, the providers who contributed to the service were mapped to the components they provided, as shown in Figure 8. These three mappings enabled the analysis of net perceived customer value. In the next section we discuss how the net perceived customer value was improved in light of the service features and components that were linked to the customer value attributes.

	Webdoc	Twitter	Facebook	Soundcloud	Google	Amazon
HTML 5 architecture	X					
Social network login	X	X	X			
Multiplatform	X					
User recommendation system	X	X	X			
Social network integration	X	X	X	X	X	
Inappropriate content flagging	X					
Search and tagging	X					
Mosaic view	X					
Developer API and SDK	X					
Amazon S3 infrastructure	X					X
Likes, follows, comments, replies	X					
Mobile website	X					

Figure 8. Mapping the providers to the service components

3. Improving Net Perceived Customer Value

In this section the costs of the service Webdoc offers as perceived by Webdoc customers are analyzed and the actions taken to improve the net perceived customer value are elaborated.

As the service is offered free of charge, there are no monetary costs associated with the service. Thus, the analysis of non-monetary costs is of prime importance for increasing the net perceived customer value. These costs include but are not limited to time, energy, and psychic. Time cost is the aggregate of the durations the service adopter needs to invest in order to be able to use the service. Energy cost is the sum of the effort that needs to be spent. Psychic cost is the most abstract of all – the cognitive stress undergone by the adopter in using the service.

Reducing these costs is a continual priority for Webdoc. As the monetary cost is as low as it can be, the work focuses on reducing the other three. The challenge lies in their abstract nature and thus this is one of the fundamental ways in which data gathering and user intelligence aids the process. An example of how each of these costs was reduced is now provided.

Time cost is an ongoing aggregation of the time spent by the service adopter to start and continue using the service. As this cost is overwhelmingly dominated by the initial time cost, this became the target of optimization. In other words, once the customer has begun using the service, the additional time cost is minimal. The relevant data that needed to be gathered was how users were initiating their adoption of Webdoc. Adopters have three different channels through which they can register for the service – signing up using the traditional form and providing an email address, username, and password for login; or signing up using the login API exposed by other social networks, namely the two supported by Webdoc, Facebook and Twitter. Seeing that an increasing number of users were taking the latter channel, the sign up process was optimized to push this. A number of concrete changes were implemented, covered in detail in the implementation section. A second set of features introduced to reduce time costs were “categories” and “the welcome workflow”. These features can be grouped together because they both have the objective of reducing the time it takes for a user to discover content they are interested in. The “categories” feature organizes all the posts made on the service by a category (or “categories”, up to four are allowed) chosen by the poster at the time of posting. On the other hand the welcome workflow allows for more passive discovery, by suggesting content producers the user might be interested in following.

Energy costs are often correlated with time costs, but nonetheless there is an important distinction. Particular tasks can be energy intensive while still only taking a short amount of time. An example is accepting the terms and conditions of the service. Although time wise this takes only a few seconds, often the user forgets to check the box and then needs to go back and do so after being prompted. To mitigate this the acceptance of terms and conditions was changed to be phrased in such a way that by continuing the user provides their consent. A second feature to reduce energy costs was the introduction of favorites. Three types of favorites are currently supported: documents (particular content), searches (type of content), and user. Here too although the time to find this content using the normal means is not much, there is energy that needs to be expended. A final feature to reduce energy costs has to do with sharing of content. While manual sharing of content has been optimized down to a single-click after any post, by offering the user auto-sharing, it can be reduced to zero energy cost.

Psychic costs in internet services rise most apparently when the interface is confusing to use, functionality is limited or the full outcome is not clear, simple tasks require many steps, and advanced features are not available. A number of new features in Webdoc address psychic costs directly. The first is password-less signup. Passwords are an excellent example of psychic cost – using them takes neither much time nor energy. Yet keeping track of an ever-growing series of passwords is an enormous deterrent for users in adopting a new service. Thanks to services such as Facebook and Twitter, which are willing to provide a lower level layer, Webdoc can provide users a password-less experience with them still retaining the full security and benefits of a private account. Another prime example of psychic costs is when a user has auto-share enabled and is concerned about what might be shared. A simple yet powerful feature to eradicate this cost is an omnipresent indicator (in the global navigation drop-down menu) that always shows whether auto-sharing is enabled or disabled at the time. Furthermore, with a single click on the indicator, which also serves as a toggle switch, the auto-sharing can be enabled or disabled as and when the user desires. By making the auto-sharing status front and center, rather than hidden in the account settings page, the user has no nagging worry while using the service. A third set of features to reduce psychic cost is the Frequently Asked Questions help section and the Welcome workflow. These can be grouped together as both address the inevitable learning curve that exists when starting to use any new service. While the learning curve can never be nil, by providing features such as these and adopting established conventions and best practices, even brand new users can comfortably use the service from their first time onwards. A final feature to reduce psychic cost are highlights. These are aimed at the more advanced user, who after regular use might find their profile "cluttered" and unorganized. Highlights allow users to group documents into sets that they can title as they want. The full list of features, grouped by cost type, is shown in the table 2.

Table 2. Service features grouped by cost types

Cost type	Cost description	Relevant feature
Time	Filling out sign up form	1-click sign up
Time	Discovering content	Categories, Welcome workflow
Energy	Accepting terms and conditions	Checkbox free accept
Energy	Retrieving previously found content, searches, and users	Favorites
Energy	Sharing content	Auto, 1-click sharing
Psychic	Remembering passwords	Password-less sign up
Psychic	Awkward sharing of activity	Omnipresent social on/off
Psychic	Learning to use the service	FAQ, Welcome workflow
Psychic	Organizing documents	Highlights

The most important manner in which time costs were reduced for the user was by optimizing the signup process. Four specific optimizations that were implemented are detailed here.

3.1 Reducing clicks to signup

Initially the signup window was only shown in a reactive manner. This meant an unregistered visitor needed to consciously search for the sign up button, click it, and then complete the process. Or rather, the much more prevalent scenario was the visitor explicitly taking an action that could only be performed by registered users, and then being shown the sign up window.

To save the visitor time, the sign up buttons were added as a banner at the top of many pages, see Figure 9. This includes the document view, profile pages, and of course landing page. The banner was not blindly appended to all pages because in some case it would be too visually disrupting to the user, such as in the lightbox view. A further benefit of such a banner is providing a direct call to action related to the context of the user's experience – for example on a profile page a visitor is reminded they could follow the user whose profile they are viewing without having to fill out any sign up form. All this effectively reduces the time to sign up because as soon as the visitor lands on the page, within one click, they can register themselves. A final advantage is this serves additionally to drive users to connect using one of the social services, which provides us with the benefit of the social graph that those APIs provide us.

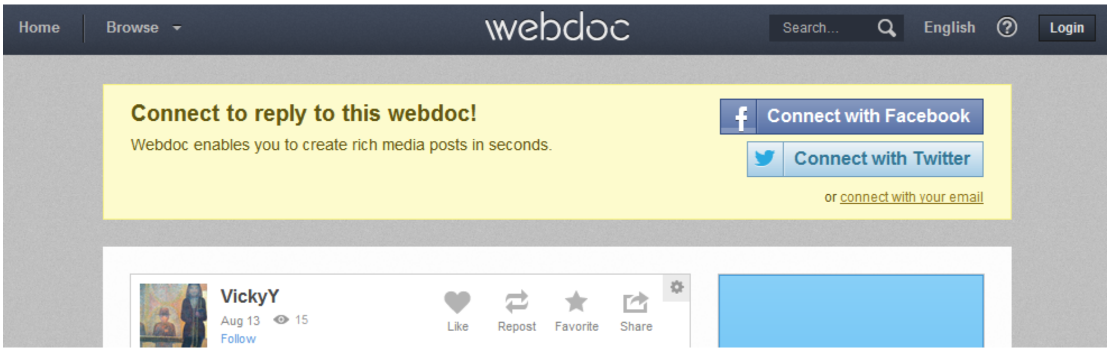

Figure 9. Reducing clicks to sign

3.2 Automatic continuation of pre-sign up action

Even with the sign up banner, many visitors are drawn to the post a reply, like, repost, or other action buttons. In this case the sign up popup still needs to be shown, as these actions can only be recorded by registered users. The difference lies in that whereas before the user would have to redo their action (re-click post a reply, like, etc.), the system is now being setup so that the action is remembered and automatically continued upon completion of sign up. This means if the user clicked to reply, after sign up, a draft will automatically open for them, rather than having to click the reply button for a second time. This is an ideal example of energy cost – certainly in terms of time the difference between the two is next to nil, but the perceived energy expenditure for the four step process is significantly more. The two different flows are shown below. The improved flow first – where post a reply is clicked (screen 1) from left to right, the connect takes place (screen 2) and the draft reply is automatically opened (screen 3). See Figure 10.

Figure 10. Automatic continuation of pre-sign up action

The second flow where the recently registered user is required to re-click post a reply (in screen 3) before being taken to the draft reply (screen 4). See Figure 11.

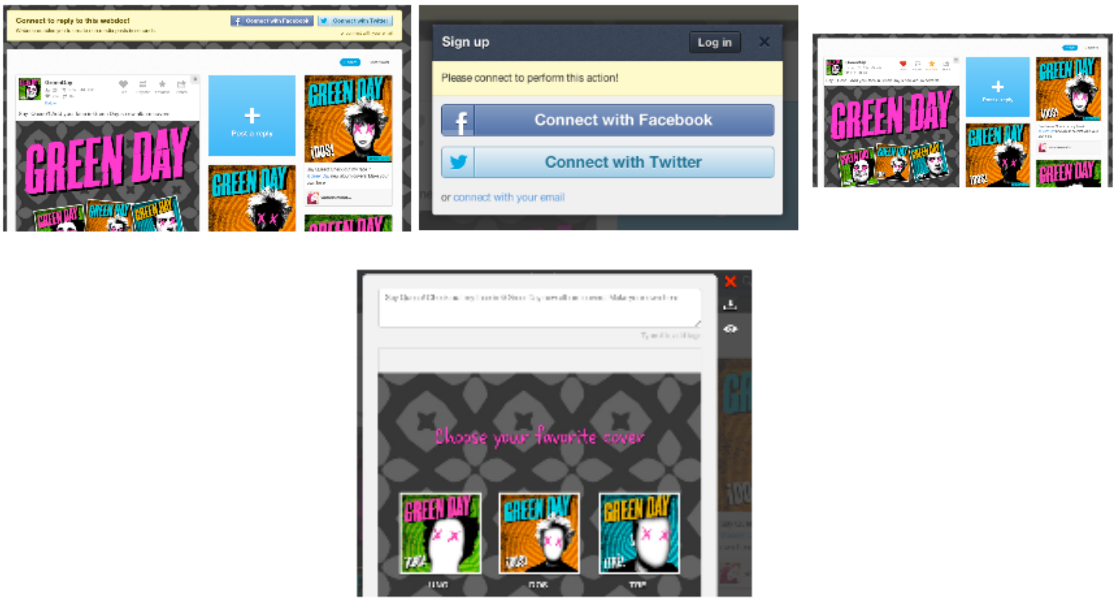

Figure 11. Non-automatic continuation of pre-sign up

The development costs of implementing such a solution are not trivial and consequently it has been decided to prioritize the continuity of the reply action. That is, reply would be the first supported action. Like, repost, and especially favorite are much less clicked by unregistered visitors, with nearly identical development costs, so their continuity has been deferred.

3.3 Changing terms of condition accept manner

A third optimization that was implemented to reduce non-monetary costs was changing the way in which visitors accept the terms and conditions. The existing approach had been to use a check box. This required explicit effort on the part of the visitor and often led to situations where the visitor would click finish, but then be prompted to tick the check box and have to redo their action.

Thus it was decided to reduce the unnecessary expenditure of energy by simply phrasing the accept as "By continuing you agree to the terms and conditions." Such an optimization is in fact common place on the modern web and given that the vast majority of sign-ups do not click to open and read it, the solution seems increasingly practical. At the same time, for those skeptical visitors who would like to take a look, it remains just as accessible (in fact even more so because the terms were summarized so they could be understood without diving into deep legal jargon). The new text is placed directly above the finish button, where the checkbox was previously located, so it cannot be missed. The updated version is shown below:

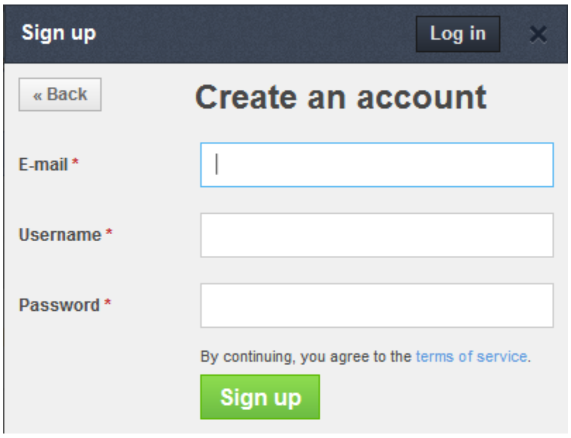

Figure 12. Changing the terms of the service acceptance manner

3.4 Reducing unnecessary fields on Twitter connect

Unlike the Facebook connect the Twitter connect unfortunately cannot be made to be a true one click sign up because we require an email address for each registered user and the Twitter API does not expose email addresses. They do not do so for the perfectly legitimate reason of protecting their users from spamming services. Thus to complete a Twitter connect the visitor then needs to enter their email address. In addition they were being requested for a password (which in reality could be machine generated, as is done for Facebook connects). The old and improved versions are as follows:

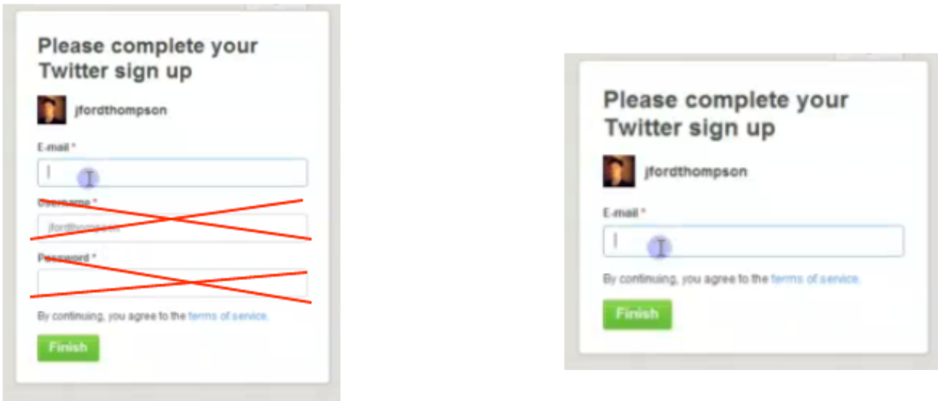

Figure 13. Reducing unnecessary fields on Twitter connect

3.5 Reducing Psychic Costs

Physic costs are perhaps the least intuitive and most difficult to address. It is in this area of optimizations that user intelligence tools emerge as especially useful.

3.5.1 Omnipresent social on and off

One of the major new features of the July 2012 release was integration with Facebook Timeline. This feature allows for users to automatically publish their actions (including views, likes, reposts, replies, main posts, and follows) directly on their Facebook Timeline. This is feature present in many web services, but often once a user enables the feature it is difficult to disable (either temporarily or permanently). Most often the switch is hidden deep within the account settings section placing significant psychic burden upon users. Thus, in an effort to reduce psychic cost (both for those wishing to enable the feature, as well as those wishing to disable it) the functionality to switch was placed directly in the global navigation drop down. This means in a single click users toggle their sharing, making it practical to share even partial sessions. The switch was implemented as shown in the Figure below.

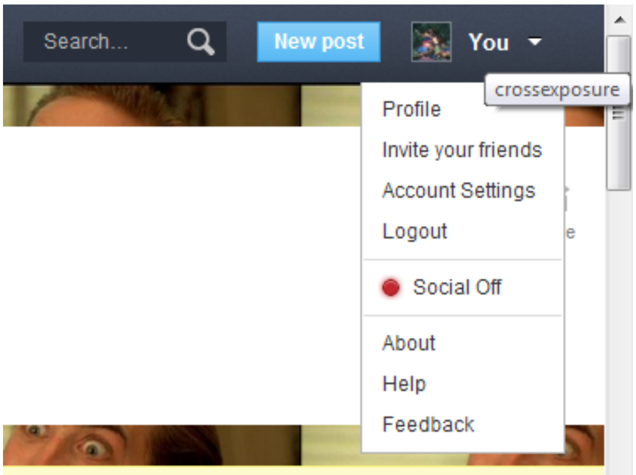

Figure 14. Omnipresent social on and off

3.5.2 Key user actions directly from mosaic view

Another important feature of the July 2012 release aimed at reducing psychic cost is the ability for users to engage with webdocs directly from the mosaic view. The mosaic view is the "mass" viewing format used in the user's home feed, all the browse sections, and in any document when the lightbox is closed. This means users can browse and like or repost webdocs as they view them in mass, without having to open each individually to take their desired action. Conversely, the actions can also be undone from the same view.

It is important to prioritize which actions are key and thus merit direct functionality from the mosaic as the space attributed to each document in the view is limited, unlike in the lightbox view where an individual document takes up the entire screen real estate. With this in mind like and repost were selected and subsequently in the August 2012 release reply was added. The reply opens up an inline text editor for quick comments, rather than the full editor, which is also still accessible but requires an extra button click. This was another deliberate decision made to reduce psychic cost as it was observed that often times users wished to reply with a quick comment, but were overwhelmed by the full reply editor that would emerge. A further consideration that had to be taken into account was when the action buttons would appear on the mosaic view – whether they would be omnipresent or appear on hover. The advantage with omnipresent buttons is the users know they are present as soon as they land on the page, but the disadvantage is the buttons become visually very repetitive. On the other hand, hover buttons are still rather intuitive, but do not disrupt the visual aspect, so the choice was made to go with these. A minor update in the August 2012 release was to add a text description for each of the buttons for further clarity.

3.5.3 Favorites of webdocs, searches, and profiles

A third important feature of the July 2012 release, with the goal of reducing psychic cost, was the ability for users to favorite webdocs and searches. This feature works in much the same way as the option to bookmark webpages in a browser. By making something a favorite, users can then easily retrieve it using the favorites dropdown of the global navigation bar. This feature was further enhanced in the August 2012 release with the ability to favorite user profiles. For the moment there is no possibility to organize favorites into any kind of hierarchy or folders. As the adoption of this feature continues the demand will become increasingly important. At that point an assessment will need to be made as to how to minimize the cognitive load while still providing an advanced capability such as folders. Perhaps the solution lies in activating such a feature in the account settings page.

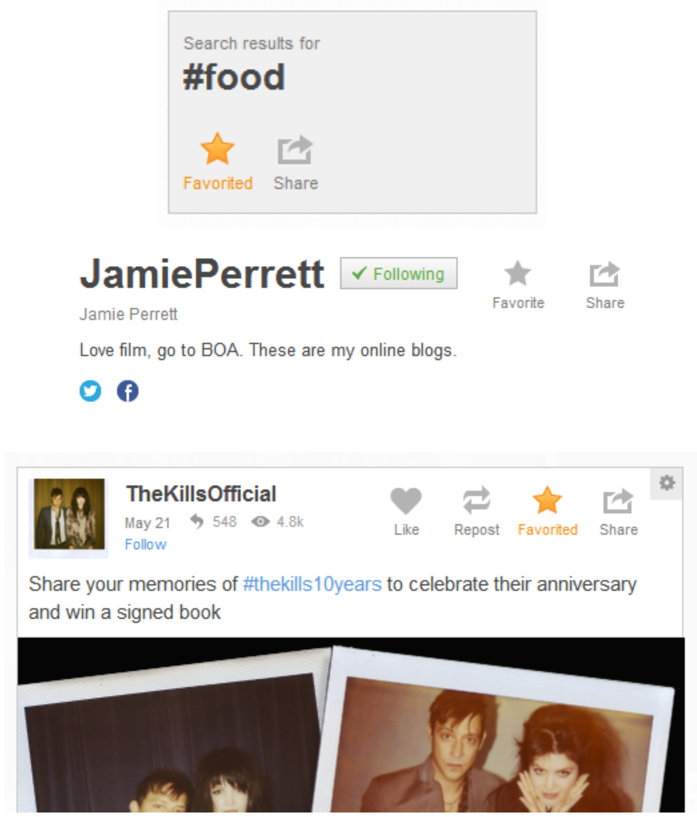

Figure 15. Favorites of webdocs, searches, and profiles

4. Conclusions

This paper presented the application of Customer Value Model in the social networking company Webdoc. The Customer Value Model provided analytical assistance in improving the net perceived customer value. The project was conducted in three main phases: surfacing customer value attributes, modeling and improving net perceived customer value. It was illustrated that the application of analytics and user intelligence packages can contribute to a better understanding of the customer's goals, beliefs and thus their value attributes. The next step was to determine the impact of each of these value attributes on the net perceived customer value. This step led us to the identification of the opportunities for improving the net perceived customer value. This improvement was realized by means of modifying the existing service components and introducing new service components that could generate the service features requisite to the improvement of the net perceived customer value. In the context of this project, as the service was offered free of charge, the improvement of the net perceived customer value was mainly realized through reducing the costs associated with the service such as energy and the time costs. The process should be implemented iteratively to maximize the net perceived customer value.

In the future work, we will analyze the impact of the new service components in the value capture activities of Webdoc. Understanding how the value created for the customer can translate into (non)monetary value for Webdoc stays as a relatively unexplored area that can definitely contribute to the viability of Webdoc as a service system.

There also lies considerable further work that can be done in the area of infusing the company culture with a metrics based approach. That is a change that already begun over the course of the project, transforming the collective mindset from a purely reactive one to a more pro-active approach as regards to analytics. The various teams of Webdoc are increasingly eager to use the wealth of data collected from the start of the decision making and product development process.

The next paradigm of analytics within the service systems context of Webdoc would be the ability for Webdoc to provide metrics directly to its service partners and potentially even service adopters. For example, partners such as Soundcloud would be interested in how much of their traffic goes through Webdoc. Similarly, end users, be they individuals or the management groups of artists that use Webdoc, could benefit from having a limited portion of metrics reported directly to them. These are metrics that they could then use to support their own strategic goals.

Appendix 2. Coopetition-Based Business Models: The Case of Amazon.com

Abstract. *Coopetition (collaboration between competing firms) is a phenomenon that has recently captured a great deal of attention due to its increasing relevance to business practice. However, current research on coopetition is still short on explaining how the potential advantages of coopetition can be realized over time as part of an individual firm's business model. In order to gain insights into this, we conduct a longitudinal, in-depth case study on the coopetition-based business models of Amazon.com. We find evidence of three distinct coopetition-based business models: (1) Amazon Marketplace, (2) Amazon Services and Web Services, and (3) the collaboration between Apple and Amazon on digital text platforms. We conclude by putting forward several propositions on how the potential advantages of coopetition can be realized by involving competitors within a firm's business model. As a whole, the results contribute to the current understanding of how firms—as well as their stakeholders—can better benefit from coopetition.*

1. Introduction

In the contemporary economy, firms increasingly collaborate with their competitors in order to gain benefits that they could not achieve alone, including risk and cost sharing, sharing distribution channels, co-marketing and collaborative innovation. In academic research, as well as in business practice, this phenomenon has been named coopetition (see e.g. Brandenburger & Nalebuff, 1996; Bengtsson & Kock, 2000). At the industry level, coopetition typically evolves over time and shapes the competitiveness of industry participants, as well as the overall logic of the industries themselves (Andersen & Fjelstad, 2003; Choi et al., 2010; Roy & Yami, 2009; Rusko, 2011; Wang & Xie, 2011). Coopetition is born either as the emergence of collaboration into the relationship of competitors, or as the emergence of competition into the relationship of collaborating firms (Padula & Dagnino, 2007).

While coopetition is generally defined as the simultaneous existence of competition and collaboration, the emphasis between collaboration and competition often varies in different relationships (e.g. Bengtsson & Kock, 2000; Kock et al., 2010). For instance, a typical development is where collaboration in technology and market development is followed by increasing competition and differentiation through branding and marketing (see e.g. Ritala et al., 2009, on ICT services; Tidström & Hagberg-Andersson, 2012, on manufacturing). Elsewhere, Roy & Yami (2009) illustrate how the French movie theater industry has been involved in strategic coopetition, where competitive and collaborative initiatives have been introduced at different phases of industry evolution (including both sequential and simultaneous appearances of collaboration and competition). Similarly, Rusko (2011) shows how coopetition has shaped the Finnish forestry industry, and how its dynamics have changed over time. Choi et al. (2010) discuss how Australian wine makers have started to collaborate in improving the competitiveness of the whole national industry and continue the collaboration, while competing intensely with each other, as well as with other firms in the global market. Kotzab and Teller (2003) describe how the European grocery industry has implemented an initiative called Efficient Consumer Response (ECR), where competitors in manufacturing and retailers are involved in improving the overall logistics in the industry.

In general, the above examples show that coopetition can be a beneficial relational strategy for firms and industries, and that there are many ways of how such coopetition-related advantages can be achieved. However, the existing strategy and marketing literature has not examined this issue systematically from the business model perspective, which would explicitly distinguish between different types of coopetition-related advantages. A business model has been defined as a generic platform between strategy and practice, describing the design or architecture of the value creation, delivery, and capture mechanisms the firm employs (e.g. Teece, 2010). Understanding how these mechanisms work in business models related to coopetition could be particularly useful for organizations encountering an environment where collaboration and competition may take simultaneous roles. In order to address this research gap, we focus on the concept of coopetition-based business models, and take into account not only the perspective of the focal firm, but also the whole coopetition logic or participants related to a particular business model. We suggest that this type of perspective helps in achieving a more concrete stance on how coopetition strategies are employed.

To provide evidence on this setting, we present a longitudinal, single-case study examining the Amazon.com's coopetition-based business models since the firm's establishment. As a concept, business model initially gained ground in e-business, since it was able to capture the industries' complex and varied nature (e.g. Timmers, 1998; Amit & Zott, 2001; Shin & Park, 2009). The empirical part of this study is also in this context, and thus we believe that the business model concept will be especially helpful for our analysis. In particular, the analysis is conducted on Amazon.com's coopetition in the global book industry. We have used data triangulation in order to incorporate rich evidence on the case: the sources include annual reports and financial statements, news releases, interviews, as well as existing research evidence (e.g. Harvard Business School cases, journal articles, books) on Amazon.com. The results of our study show that Amazon.com has successfully adopted coopetition-based business models in three particular phases over time—all of which have had a substantial impact on the global book industry, as well as on Amazon.com's survival, growth, and evolution.

The remainder of this study is formulated as follows. First, we discuss the key concepts of the study. Second, we develop a theoretical background for the generic drivers of coopetition-based business models and provide concrete examples from the existing literature. This is followed by a longitudinal case study over Amazon.com's evolution in terms of coopetition initiatives. Next, we put forward a set of propositions on the rationale of involving competitors within the business model of a firm. Finally, we present our conclusions and suggestions for further research.

2. Coopetition and Business Models

Coopetition has been broadly defined as collaboration between competing firms, or the simultaneous competition and collaboration between the same actors (Bengtsson & Kock, 2000). In this paper, we discuss coopetition as a simultaneously collaborative and competitive relationship, which takes place between two or more firms within the same value chain position, that is, between horizontal actors. The second key concept for this study is business model. In terms of the level of analysis, the business model can be seen as a structural template that takes into account the focal firm's transactions with its external constituents (Zott & Amit, 2008). This makes the concept especially suitable for the purposes of examining the rationale of coopetition. In fact, we follow the recent suggestions by Mason & Spring (2011) in analyzing the business model not only from the focal firm perspective, but as a larger construct also incorporating the collaboration architecture of the firm.

More specifically, the business model has been defined as a generic platform between strategy and practice, describing the design or architecture of the value creation, delivery, and capture mechanisms the firm employs (e.g. Teece, 2010), as well as the changes in these processes over time (Amit & Zott, 2010). Therefore, the seminal view of coopetition as a means to create a larger business pie (value) together and simultaneously compete in dividing it up (Brandenburger & Nalebuff, 1996) fits neatly with the chosen business model perspective. In fact, the strategic logic of coopetition has been recently discussed as involving collaborative activities that jointly create value and firm-specific activities in capturing, dividing, and appropriating that value (e.g. Gnyawali & Park, 2009; Ritala and Hurmelinna-Laukkanen, 2009).

Even though coopetition may sometimes develop in the form of emergent strategies (Mariani, 2007; Padula & Dagnino, 2007), we suggest that it is useful to build a suitable business model to fully reap the benefits of coopetition. This is because coopetition relationships are typically hard to manage (e.g. Tidström, 2009), but when successful, involve potential for major rewards in terms of increased innovativeness or profitability (Hamel, 1991; Quintana-García and Benavides-Velasco, 2004; Walley, 2007). To employ the coopetition strategy in practice, we suggest that it is useful to have a coopetition-based business model where certain competitors are positioned as collaborative partners. This type of business model describes how coopetition-related plans are executed to create customer value and how the firm is able to capture a portion of the profits generated by that value. In the following section, we discuss four generic drivers for coopetition-based business models, and examine how these models can facilitate the creation and capture of value.

3. Generic Drivers of Coopetition-Based Business Models

The mechanisms explaining how inter-firm relationships and networks help to create and capture value can be intuitively explained with resource-based arguments (see e.g. Dyer & Singh, 1998; Lavie, 2006). In general, through inter-firm relationships, firms integrate both supplementary and complementary resources in an attempt to create more value than if they were used separately (e.g. Das & Teng, 2000). Furthermore, the role of both relational and firm-specific resources essentially determines how much value can be created, and who is in the position to appropriate it (Lavie, 2006; Dyer et al., 2008). Value created in inter-firm relationships and networks can be linked to explorative issues such as innovation, market expansion, and differentiation, or more exploitative issues such as cost reduction through joint production and distribution (Möller & Rajala, 2007).

In the coopetition context, the resource-based logic has certain specific characteristics that should be discussed here. In particular, it has been suggested that through joint resource utilization, firms in coopetition can collaboratively create value, while they capture or appropriate a portion of that value by utilizing their firm-specific resources (Ritala & Hurmelinna-Laukkanen, 2009). Even though this is the case in any inter-firm relationship, in coopetition this issue is pronounced since the competitive positioning between the firms suggest that value capture takes place (at least potentially) in the same domain. In addition, the division between relational and firm-specific resources may not be clear-cut in coopetition. This is because the role of resources used to create value in coopetition is paradoxical, as the same resources can often be used for both competition and collaboration (Bengtsson & Kock, 2000), and conflicts may thus emerge (e.g. Hamel, 1991; Tidström, 2009). Therefore a coopetition-specific business model, which takes these issues into account, would be useful in avoiding conflicts over value capture and, at the same time, maximize the joint value creation through the utilization of shared supplementary and complementary resources.

The suitable coopetition-based business model naturally depends on the goals and motivations behind coopetition, and therefore there is no "basic model" in this context. Based on the resource-based rationale outlined above, we categorize the generic drivers of coopetition-based business models into four broad types: (1) increasing the size of the current markets, (2) creating new markets, (3) efficiency in resource utilization, and (4) improving the firms' competitive position. The categories are not mutually exclusive, but they are presented here separately for analytical purposes.

3.1 Market expansion

The first and often cited driver of coopetition is market expansion. Coopetition can act as a means of increasing the size of the participating firms' current markets, and in that way grow the "size of the pie", so there is more to divide (Brandenburger & Nalebuff, 1996). The basic relationship between competitors is that of a "zero-sum game", whereas the motivation behind market-expanding coopetition is to collaborate in finding ways to turn this setting into a "positive-sum game" (Ritala, 2009). As the competing firms operate in the same domain, collaboration to increase the value created in that domain can provide win-win situations for all the competitors involved (ibid.). Therefore, the competing firms are likely to have common interests in increasing the size of the current markets.

Two specific rationales can be identified behind the market-expanding business models in coopetition. First, even though competitors operate in the same domain and therefore provide more or less similar types of offerings to (at least partially) the same customers, they are still likely to use different, unique resources and capabilities in seeking benefits from coopetition (Bengtsson & Kock, 2000). Thus, is can be suggested that coopetition has an innate driver for firms to leverage their resource complementarities in market expansion efforts. For instance, one firm may have very strong marketing capabilities, whereas the other is strong in manufacturing and design. By combining these resources, the competing firms are able to build a more lucrative business model, which may enlarge the market potential for both firms. In particular, the utilization of complementarities may even be more effective in coopetition than in other relationship types, since the competing firms possess increased "relative absorptive capacity" between them due to ex ante similarity in knowledge domains and business logic (Lane et al., 1998; Dussauge et al., 2000; Ritala and Hurmelinna-Laukkanen, 2009). Second, collaboration between competitors is also often formed for the purpose of bundling sufficient quantities of similar, supplementary resources, in addition to solely building on synergies created through different or complementary resources (Garrette et al., 2009, see also Das & Teng, 2000). In fact, the competing firms, by their nature, have a high degree of resource similarity between them (e.g. Chen, 1996), and therefore there are opportunities to utilize the resources to enable market expansion efforts. As market expansion is always a risky and resource-intensive task, there should be major benefits in combining supplementary resources (e.g. financial assets, manufacturing and logistics capabilities).

The well documented coopetition case between Sony and Samsung (see e.g. Gnyawali and Park, 2011) is a good example in which both of the above-mentioned resource-based rationales are in use. By establishing joint technology development and manufacturing facilities in South Korea, the two firms were able to overtake market leadership in the LCD TV markets during the last decade. The superior technological knowhow of Sony and the marketing abilities and insights of Samsung can be seen as complementary resources, which created a very competitive alliance between the two. At the same time, the firms were able to share costs and risks by establishing joint facilities (and thus combining supplementary resources). The relationship has not been without tension, since Sony and Samsung compete head-to-head in the LCD TV markets, and they represent traditional rivals between neighboring countries (Japan and South Korea). However, as an outcome of the alliance, the LCD TV markets have grown worldwide, and Sony and Samsung have become central actors in this field. Another example of coopetition-based business models for market expansion are the alliances between car manufacturers in technology and platform sharing (see e.g. Gwynne, 2009; Segresting, 2005). In these cases, the firms share resources to develop and leverage technologies, and simultaneously compete head-to-head over customers through differentiation and branding. This does not happen only within multi-brand consortiums such as Volkswagen, but also between actual competitors such as Volvo and Ford, and Renault, Citroën, and Toyota.

3.2 Market creation

In addition to market expansion, coopetition-based business models sometimes aim for the creation of new markets. This is understandable, since this way the competing firms may create completely new value over which to compete, providing new possibilities for value capture for each firm involved. There are four main explanations for market creation as a driver of coopetition-based business models.

First, as competitors operate in similar domains, they also possess insights that can help in creating radical innovations and recognizing new markets where to expand their offerings (Quintana-García and Benavides-Velasco, 2004; Ritala and Hurmelinna-Laukkanen, 2009). In particular, knowledge similarity possessed by competitors on current markets, as well as on the possibilities in the business environment, may help the firms to exploit their complementary resources even more strongly to create new offerings to new markets.

Second, especially in high-growth sectors (such as the ICT sector), an individual firm cannot capture all the potential value created through new business models. In such contexts, having a large base of competing offerings (differentiated through firm-specific resources) in the markets often helps the firms to create competitive and appealing end markets from the customer point of view. In fact, Wang & Xie (2011) recently found that consumer product valuation is positively affected by the extent to which competitors have adopted the same solution. A broad repertoire of various smart phone manufacturers (e.g. Nokia, Samsung, Apple), for example, helps to serve different customer segments better and increase product and service awareness, compared to the situation where only one provider would be available.

Third, coopetition can be beneficial to the creation of industries and offerings where positive network externalities, compatibility and interoperability play a role (Spiegel, 2005; Mione, 2009; Ritala et al., 2009; Wang & Xie, 2011). Network externalities are related to offerings where the value the user receives from a product or service depends on the number of other users utilizing the same or a similar offering (Katz & Shapiro, 1985). A classic example of network externalities is the mobile phone and the GSM standard. Without seamlessly operating networks (hosted by competing firms), the end customers could not reach each other. By enabling such interoperability, the GSM system facilitated the creation of the markets of mobile communication at an extremely rapid pace. In such contexts, the competing firms are in a key role to form a common basis for utilizing resources that work together in a way that provides interoperability and, in the end, positive network externalities (see also Wang & Xie, 2011). In particular, a certain amount of resource similarity/supplementarity (i.e. market and technological knowledge, language, business logic) possessed by competitors enables them to form offerings enabling positive network externalities (see e.g. Ritala et al., 2009).

Finally, as in the case of market expansion, risk and cost sharing is an important motivation for collaborating with competitors in market creation (e.g. Gnyawali and Park, 2009). Radical innovations and offerings often involve major costs and a lot of uncertainty, and therefore the collaboration between horizontally positioned firms helps in pursuing such goals since they can bundle the needed supplementary resources together to tackle such market uncertainty (e.g. Perry et al., 2004; Möller & Rajala, 2007).

A well-documented example of coopetitive market creation is the so-called AIM alliance (Apple, IBM & Motorola), which focused on designing and manufacturing a new generation of microprocessors with reduced instruction set computer (RISC) architecture (see e.g. Duntemann & Pronk, 1994; Vanhaverbeke & Noordehaven, 2001). In the early 90s, Apple, IBM, and Motorola came to an agreement to establish an alliance to develop the PowerPC (Performance Optimized With Enhanced RISC Processor Chip). Apple was to adopt a single-chip implementation of IBM's RS/6000 (multi-chip processor), to be designed and manufactured by AIM, in their Macintosh personal computers. In addition, IBM and Apple intended to create a new open-system software platform and operating system that would be based on object-oriented technology. During the time of establishing the alliance, Apple and IBM were direct competitors in the personal computer market. The collaboration in the AIM alliance had the potential to create new value outside the current markets and to create new value capture opportunities for both firms with the introduction of new type of computer microprocessor architecture.

In terms of exploiting supplementary resources, coopetition-based business models harnessing network externalities and ensuring interoperability are typical in contemporary industries such as the ICT industry (Amit & Zott, 2001). An example of this is the format war between Blu-Ray and HD-DVD (see e.g. Christ & Slowak, 2009). In the end, the Blu-Ray consortium (involving competitors), led by Sony, eventually won the race for the dominant high-definition video standard. Coopetition had a major role in this by ensuring interoperability between the incumbent electronic manufacturers, as well as sharing the risks and bundling sufficient resources involved in pursuing the de facto standard. However, it should be kept in mind that some of the firms in the Blu-Ray consortium did not succeed as well as others, since the eventual value capture depends on the firm-level activities. Ritala et al. (2009) document another case example of coopetitive market creation where interoperability and similar resources were utilized. In this case, the collaborative development of technologies and services behind mobile TV in Finland involved competing telecom operators and media companies which together pursued to ensure market creation (Ritala et al., 2009). In this case, the collaboration did help to create common technologies and commercial pilots, but there were challenges when moving towards the actual value capture phase with individual, diversified business models.

3.3 Resource efficiency

While both of the above mentioned drivers of coopetition involve sharing risks and costs, there are also coopetition-related business models focusing solely on cost reduction and quality assurance within existing activities. This is a different logic in that it seeks to make existing value creation and capture mechanisms more efficient, i.e. to produce more with the same resources or to utilize fewer resources in producing the same amount of output. In fact, it has been widely suggested that the collaboration part of coopetition relationships often takes place far away from the customer and in operations that are linked to manufacturing, logistics, and other functions that can benefit from scale advantages (see e.g. Bengtsson & Kock, 2000; Walley, 2007). Indeed, it has been suggested that these "scale alliances" enable the competing firms to bundle similar/supplementary resources in their efforts to gain efficiency benefits and cost sharing (Dussauge et al., 2000). Competitors are, by definition, conducting similar types of activities in similar positions in the industry value chain, and therefore there should be plenty of possibilities to collaborate on resource efficiency related issues.

Based on the above, we suggest that business models related to efficiency in resource utilization are connected to the exploitation of supplementary resources and capabilities situated in the same part of the value chain. For instance, Swedish breweries collaborate to return empty beer bottles from the wholesalers (Bengtsson & Kock, 2000). The rationale here is that the distance and the transport methods are similar, and thus efficiency benefits from such collaboration are notable. It is also important to notice here that collaboration in this area leaves plenty of space for competition in other areas close to the customer, such as distribution and branding. Other well known examples of resource efficiency and coopetition include the airline alliances (Oum et al., 2004). In these cases, the alliances are formed around brands such as "Star Alliance" or "OneWorld", and they are used to save costs in marketing, ticketing, and logistics related to the airline business.

3.4 Competitive dynamics

In general, the rise of alliances and other networked governance forms have shifted the locus of competition towards network-against-network competition (Gomes-Gasseres, 1994; Gueguen, 2009). For instance, a common strategy in the ICT field is to compete with rival networks in pursuit of increasing the competitiveness of a certain coopetitive ecosystem (Gueguen, 2009). Lado et al. (1997) argue that the potentially most beneficial strategy for a firm may be connected to so-called syncretic rent seeking behavior, which combines both collaboration and competition in a way that firms collaborate with some competitors while competing even more intensively with others. In terms of coopetition, affecting the competitive dynamics of the industry is a separate driver of its own, as firms often seek to increase their own competitive position, as well as the competitive position of the whole collaborative network, through coopetition. According to Möller & Rajala (2007), the role of horizontal actors in the overall network is pronounced if they have products, channel relationships, or customer service systems that in combination help them to achieve an even stronger position in global competition. Thus, by combining their supplementary and complementary resources, competitors within one coopetition-based business model or network can make their position even more competitive against the rest. Several empirical results support this logic. First, the results of Gnyawali et al. (2006) suggest that centrally positioned firms in coopetitive networks will act in a more versatile manner in terms of their competitive actions. This is a reflection of superior resource access and thus increased bargaining power (ibid.). Second, the results of Oxley et al. (2009) suggest that coopetition can increase the competitiveness of firms participating in it at the expense of other industry actors. Based on this discussion, we suggest that this category of coopetition-based business models can improve the relative value held by the resources of the firm and its competitors by co-opting other rival offerings, firms, and networks.

This type of competitiveness enhancing motivation was apparent in the business model used by the participants of the AIM (Apple, IBM & Motorola) alliance to produce microprocessors that could tackle the dominance of the Microsoft and Intel ecosystem, known as Wintel (see e.g. Duntemann & Pronk, 1994; Vanhaverbeke & Noordehaven, 2001). The motivation for collaboration between the rivals Apple and IBM was the goal of increasing their competitiveness against Microsoft and Intel, which were dominating the markets at the time (ibid.). Several illustrative industry-level examples have also been mentioned in previous research. First, in their case study, Choi et al. (2010) show how Australian and New Zealand wine producers collaborated in introducing screw cap type bottles in order to make the whole industry more competitive in intense global competition. However, the producers simultaneously pursued to capture their own share of the market by utilizing their firm-specific resources and differentiated brands. Similarly, Rusko (2011) describes how the Finnish forestry industry relied on coopetition, especially in its development phase, to increase its competitiveness in global competition. The early years of collaboration focused on upstream activities, followed by mid-stream activities. Now, as the industry has matured and by the introduction of EU legislation, the coopetition initiatives have ended. Overall, Rusko (2011) suggests that coopetition had a notable effect on the growth of competitiveness and sustainability of the Finnish forestry sector.

In sum, we have thus far put forward four generic drivers for coopetition-based business models enabling market expansion, market creation, resource efficiencies, and competitive benefits by involving collaboration with competitive firms in the firm's business model in various ways. Table 1 summarizes the discussion so far.

Table 1. Coopetition-based business models

Business model emphasis	***Resource-based drivers for coopetition***	***Coopetition-related business model specifics in value creation***	***Coopetition-related business model specifics in value capture***	***Illustrative case examples***
Market expansion	Expanding the size of the current markets through leveraging on the synergies between competitors' complementary resources, and sharing market expansion costs through supplementary resources	Value can be created by utilizing the competitive position between firms to identify and pursue opportunities for market expansion.	Value can be captured in a positive, rather than zero-sum fashion when markets are expanding	• The rise of Sony and Samsung as the market leaders in LCD TVs by combining the unique capabilities of both and the utilization of joint facilities for cost sharing purposes (Gnyawali & Park, 2011) • Collaboration between car manufacturers to share and develop platforms and technologies, over which to build individually-branded products (Segrestin, 2005; Gwynne, 2009)
Market creation	Creating new markets through finding new places for value creation with the help of differentiated, complementary resources of competitors, and decreasing market uncertainty through utilization of shared, supplementary resources	Value can be created by utilizing the competitive position between firms to identify new market creation opportunities and ensure the creation of the market by providing unified platforms and offerings towards customers	In new markets, all value that has been created represents new value capture potential for the participating firms; the eventual value captured depends on the firm-specific business model and eventual differentiation	• Collaboration among Apple, IBM & Motorola to produce new, RISC-based microprocessors (Duntemann & Pronk, 1994; Vanhaverbeke & Noordehaven, 2001) • Coopetition for gathering resources behind the Blu-Ray technology to ensure the creation of a de facto standard for new technology (Christ & Slowak, 2009) • Coopetition for ensuring interoperability and development of new services for mobile TV in Finland (Ritala et al., 2009)
Resource efficiency	Increasing the efficiency of a certain part of the value chain through joint utilization of supplementary resources and capabilities	Since they are situated in the same phase of the value chain, competitors can create value by sharing and combining resources to increase the efficiency of their basic or standardized activities	Fewer resources are needed to realize a certain amount of value capture or more value can be captured by using the same resources	• Collaboration among Swedish breweries concerning returning of bottles from wholesalers (Bengtsson & Kock, 2000) • Collaboration in the global airline industry in the form of airline alliances that share costs related to marketing, logistics, and ticketing (Oum et al., 2004)
Competitive dynamics	Improving the relative value of resources held by the firm's and its competitors' by co-opting other rival offerings, firms, and networks	Value is created by finding opportunities to differentiate the offerings of firms utilizing the coopetition-based business model	Value capture possibilities are increased in relation to the firms outside the domain of the business model	• Apple, IBM, and Motorola alliance as a means to control Intel and Microsoft dominance (Duntemann & Pronk, 1994; Vanhaverbeke & Noordehaven, 2001) • Coopetition tradition as a means of ensuring the long-term sustainability and competiveness of the Finnish forestry industry (Rusko, 2011) • Coopetition among Australian wine producers to increase the competitiveness of the continent in global competition (Choi et al., 2010)

4. Methodology and Data Collection

We conducted a longitudinal, qualitative single-case study (Yin, 2003), which is a valuable method for the purposes of holistically analyzing previously unexplored phenomena (e.g. Eisenhardt, 1989) and also suitable for studying business network-related issues (Halinen & Törnroos, 2005). In particular, we utilize Amazon.com as a descriptive case study to explain a phenomenon and the real-life context in which it occurred (Baxter & Jack, 2008; Yin, 2003). The case study approach was chosen, since the research field of coopetition is still sparse and there is even less evidence of coopetition-based business models. Furthermore, we chose Amazon.com as the case company due to its special focus on various coopetition-based business models. Throughout the case study, we concentrate especially on the book segment of Amazon.com's business, in order to enable a detailed exploration of coopetition-based business models within a certain industrial domain.

To conduct the empirical study, we adopted an approach similar to Rusko (2011) in utilizing a broad repertoire of secondary data to gain an in-depth view of the coopetitive business models. The data gathering by the researchers took place between 2009 and 2013. The main body of data consists of a variety of secondary data sources, which have been accessed, analyzed, and synthesized in order to gain an accurate understanding of the diverse facets of the Amazon.com business model and in particular the firm's coopetitive relationships with other firms over time. The main data sources include 1) Amazon.com annual reports from 1997–2012, 2) Amazon investor relation presentations, 3) news releases, 4) books published on Amazon.com, written by industry or Amazon.com insiders (e.g. Kalpanik & Zheng, 2011; Spector, 2002; Brandt, 2011), 5) Harvard Business School cases (e.g. Anand et al., 2009; Applegate, 2002; 2008; Collura & Applegate, 2000), 6) interviews with Amazon.com CEO Jeff Bezos (e.g. Kirby & Stewart, 2007; Rose & Bezos, 2011; Levy, 2011; Ignatius, 2013), and (7) journal articles (e.g. Heck & Vervest, 2007).

While the usage of primary sources in particular has generally been seen as beneficial in obtaining in-depth evidence, there are several advantages in using secondary sources as well, even as the main source of data. For instance, Ambrosini et al. (2010) recently suggested that teaching cases are an unexploited and a rich source of data that should be used when primary data is not available. They also suggested that the reliability of such data is improved when researchers use reputable sources of teaching cases and combine them with other sources to attain data triangulation. In our data gathering, we sought to do just this in order to form a rich picture of the coopetitive business models throughout the history of Amazon.com. Amazon.com is a firm which is under exceptionally large public interest, and therefore there is large amount of secondary data available. To ensure the quality of the secondary data used here, we mainly rely on more or less direct interview data on Amazon.com insiders (mostly the CEO Jeff Bezos), and also use Harvard business school cases, as well as official and subjective reports written by Amazon.com insiders or industry experts. We also provide many illustrative direct quotes in order to make the analysis more transparent. It should be acknowledged that the secondary data also has limitations that should be taken into account here. These limitations include the difficulty of assessing the reliability of the data, as well as a lack of relevant data access (e.g. Saunders et al., 2009). We pursue to tackle (at least some of) these limitations with the actions outlined above.

In addition to the secondary sources, also primary data was gathered in order to increase and validate the researchers' understanding on Amazon.com's coopetition-based business models through data triangulation (e.g. Creswell & Miller, 2000). Two semi-structured interviews were conducted with a person being in charge of one of Amazon.com's international websites. The interviews were conducted in 2010 and 2013, and the themes of the first interview discussed covered Amazon Marketplace, Infrastructure, and Web Services in general, while the themes of the second interview covered questions on the researcher's perceptions of the three coopetition-based business models of Amazon.com, as well as the assessment of the role of coopetition in Amazon.com's business model in the future. The insights gained from these interviews were used to complement the secondary data sources, especially in assisting the researchers in interpreting the Amazon.com's business models from coopetition perspective.

5. Case study: Amazon.com

Amazon.com is currently the leading e-commerce firm in the world, and to achieve this, it has used unique business models, which provide interesting evidence on how value is created and captured effectively while collaborating with competitors. When most of the dot com companies typically operate on the basis of straightforward business models with pre-specified revenue streams, Amazon.com has continued to evolve its business model, pushing forward the boundaries of what could be accomplished on the Internet (Brandt, 2011; Collura & Applegate, 2000). In particular, it can be suggested that a major part of the evolution of Amazon.com's business model rests heavily upon the firm's coopetitive strategies, and in this study we focus especially on the coopetition-based business models introduced by Amazon.com over time. In the following section, we first briefly review the history.

5.1 Short history and business model evolution of Amazon.com

In July 1995, Amazon.com began as an online bookseller, and by September 1995, the company was selling $20,000 per week. After nearly three years as an online bookseller, the company began aggressively diversifying its offerings to include other product categories beyond books, initially adding music, videos, toys, and electronics. These diversifications were followed by the launch of several other stores, such as home improvement and software. In parallel with such product diversifications, in October 1998, Amazon.com expanded geographically by launching its first international sites, Amazon.co.uk and

Amazon.de through the acquisition of the UK-based online bookstore Bookpages and German-owned Telebook. The rationale behind this was Amazon.com's strategy of "get big fast", to turn Amazon into the biggest mass merchandiser in the online world (Brandt, 2011; Kalpanik, 2011; Spector, 2002).

The "get big fast" strategy was combined with an overall business model that puts the customer as the top priority. The Annual Report of Amazon.com in 1997 specified that growth was the main goal over profitability within the business model, and that it could be achieved by focusing on customers in the long term (Amazon.com, 1997). In the Annual Report of 1998, the company's mission was already defined to be "the most customer-centric organization in the world" (Amazon.com, 1998). This focus remains even today. The Amazon.com website states that the company's mission is "to be Earth's most customer-centric company where people can find and discover anything they want to buy online." (Amazon.com, 2013) This statement has been followed through by product and service introductions that have expanded from initial book sales on the web to selling any possible item online and also delivering online content and services through Kindle devices and tablet computers.

5.3 The role of coopetition in the overall business model of Amazon.com

Throughout its existence, Amazon.com has become known as an extremely customer-oriented company, even at the expense of not following or reacting to competitors. Amazon.com CEO Jeff Bezos has commented this by saying: "We don't ignore competitors; we try to stay alert to what they are doing, and certainly there are things that we benchmark very carefully. But a lot of our energy and drive as a company, as a culture, comes from trying to build these customer focused strategies. And actually I do think they work better in fast-changing environments" (Kirby & Stewart, 2007, 59). In fact, the customer centricity of Amazon.com's overall business model and strategy has been shown in its unique approach to competitors. In particular, coopetition has had a major part in Amazon.com's business model, since the company sees it as a way to create even larger customer value than otherwise possible. While such value creation potential is the basis in all coopetition initiatives (e.g. Brandenburger & Nalebuff, 1996), Amazon.com has been especially explicit from early on in its understanding on how competitors can also collaborate in the quest of increased customer value.

The first clue of Amazon.com's coopetitive orientation is the company's recognition that the online commerce market can fit many competing firms in many roles, and that there is also room for collaboration in these growing markets. The early signs of this mindset are visible in the 1997 Letter to Shareholders which states that "…online bookselling, and online commerce in general, should prove to be a very large market, and it's likely that a number of companies will see significant benefit." (Amazon.com, 1997). This was again more recently recognized explicitly by Jeff Bezos: "There is room for many winners here" (The Economist, 2012).

The second major issue in driving Amazon.com's coopetitive initiatives is in the recognition that the processes, infrastructure and brand of Amazon.com are more valuable to the customers when they are utilized as broadly as possible including the use of competitors. The early signs of this focus are also mentioned in the 1997 letter to shareholders, where the long-term investment goal was recognized "to expand and leverage our customer base, brand and infrastructure as we move to establish and enduring franchise" (Amazon.com, 1997). At that point the utilization of these resources was not yet fully recognized as a platform for coopetition-based business models, but later on this issue became much more explicit when Amazon.com started actively sharing its infrastructure with the competitors. This was commented by the CEO Jeff Bezos: "The common question that gets asked in business is, why? That's a good question, but an equally valid question is, why not? This is a good idea, we have a lot of skills and assets to do this well, we're already going to do it for ourselves—why not sell it, too?" (Levy, 2011). Furthermore, on the same issue, Amazon.com manager (authors' interview) commented: "If you want to be a platform, you have to sign up as many of the market players as possible – even if that means branding for competitors (who then become customers). Otherwise you can never become the predominant player."

As the above-mentioned discussion and quotes show, Amazon.com has been oriented towards customer value creation and identified that coopetition can have a major part in it. These approaches and philosophies related to coopetition as part of customer value creation have been put to practice in several of the coopetition-based business models in the company's history (and present). Furthermore, the role of coopetition can be seen as an emergent part of Amazon.com's strategy, as it has been gradually included within its business model over time. Amazon.com's overall strategy perspective is as long as seven years (see Ignatius, 2013), and this means that successful business models do realize as profitable or die out over a long—rather than short—time span. For this reason, the specific business models involving coopetition can be seen as partly emergent, yet initially recognized as part of the overall strategy.

In the timeline in Figure 1, we summarize Amazon.com's coopetitive business models within the broader development of the company. These fall into three basic groups. First, the launch of Amazon Marketplace, where competitors of any size can leverage Amazon.com'e e-commerce platform and customer base by placing their items alongside Amazon.com's offerings. Second, the Borders website is powered by Amazon.com e-commerce platform through Amazon Services, as well as Amazon Web Services providing infrastructure for the fierce content rival Netflix. Lastly, Amazon.com has pursued coopetitive benefits in making the Kindle app available on Apple's iPad. This application allows iPad

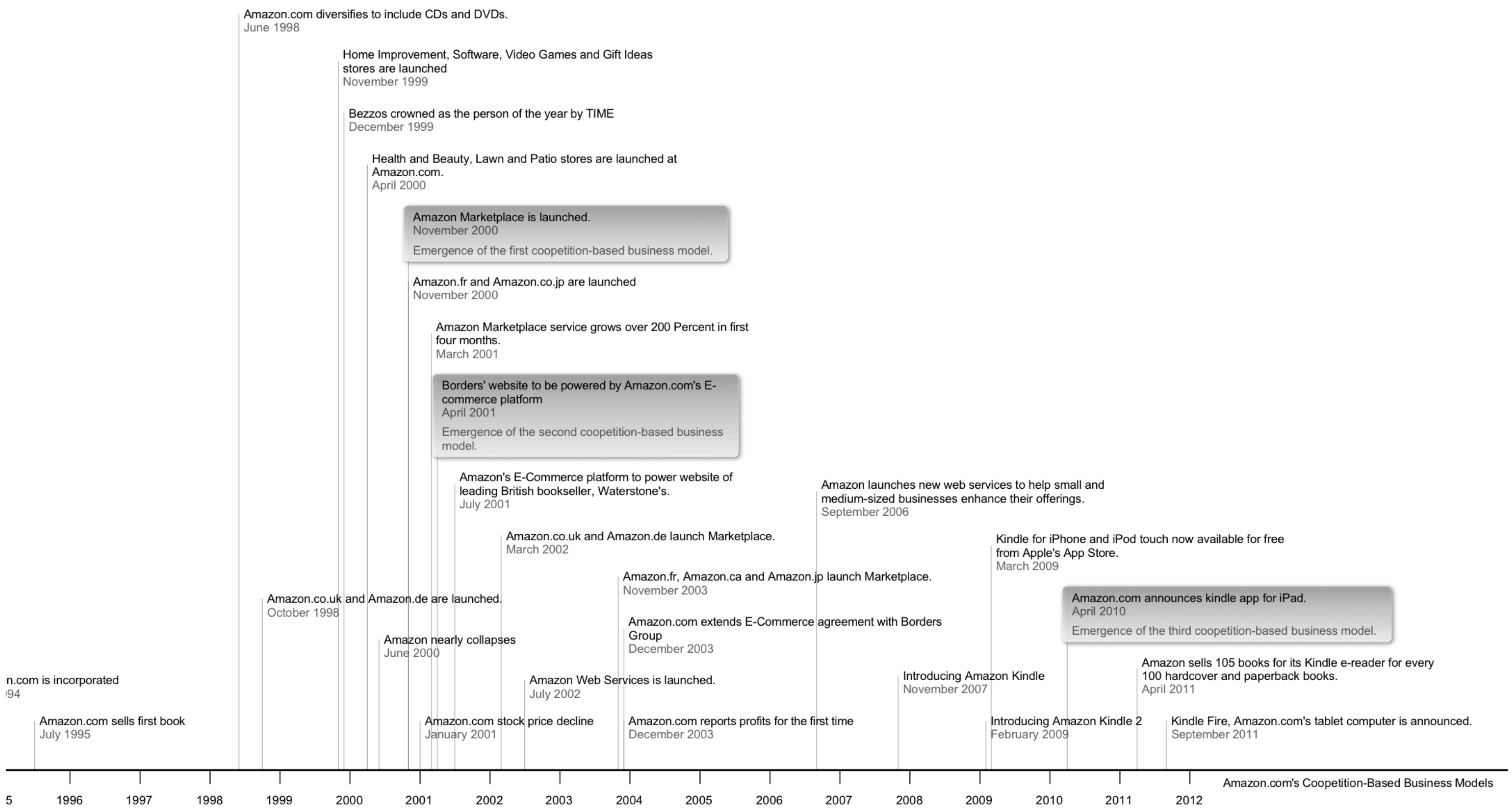

Figure 1 – Amazon.com Timeline

-owners to read e-books in Amazon.com's proprietary e-book format AZW, while Amazon.com's Kindle e-reading devices (including recent Kindle Fire) compete with Apple's iPad.

In the following sections, we go deeper into Amazon.com's coopetition-based business models and discuss how they have affected the possibilities of value creation and capture for both Amazon.com as well as its coopetition partners.

5.4 Amazon Marketplace

Following its evolution from an online bookseller to a consumer shopping portal by diversifying its product offering through new store openings, Amazon.com extended its business model to become a third-party marketplace by launching Amazon Marketplace in November 2000. As illustrated in the timeline in Figure 1, this idea was then implemented in Amazon.com's international websites, UK and Germany in 2002, and France, Canada, and Japan in 2003. In the following we examine the contribution of coopetition to the implementation of this strategy, as well as to Amazon.com's value creation and capture.

Amazon Marketplace was the first instance of Amazon.com's coopetition-based business models. Basically, it enables sellers to draw on the e-commerce services and tools to present their product alongside Amazon.com on the same product detail page on the website, hence pursuing what Jeff Bezos phrased as "the single store strategy". In other words, a single page provides the customer a choice between purchasing a new product from Amazon.com or a new or used product from another seller (i.e. Amazon.com's competitor) on the Amazon Marketplace (Kalpanik, 2011; Kalpanik & Zheng, 2011). According to an Amazon.com manager: "the Marketplace demonstrated a leap in our business model – a transformation from a retailer to a true Marketplace, was that merchants were able to offer their items right next to Amazon´s, right there side by side on the same page." (Kapanik & Zheng, 2011). To illustrate this business model from the customer perspective, Figure 2 depicts the product information interface on the Amazon Marketplace as viewed by a customer who intends to buy a book.

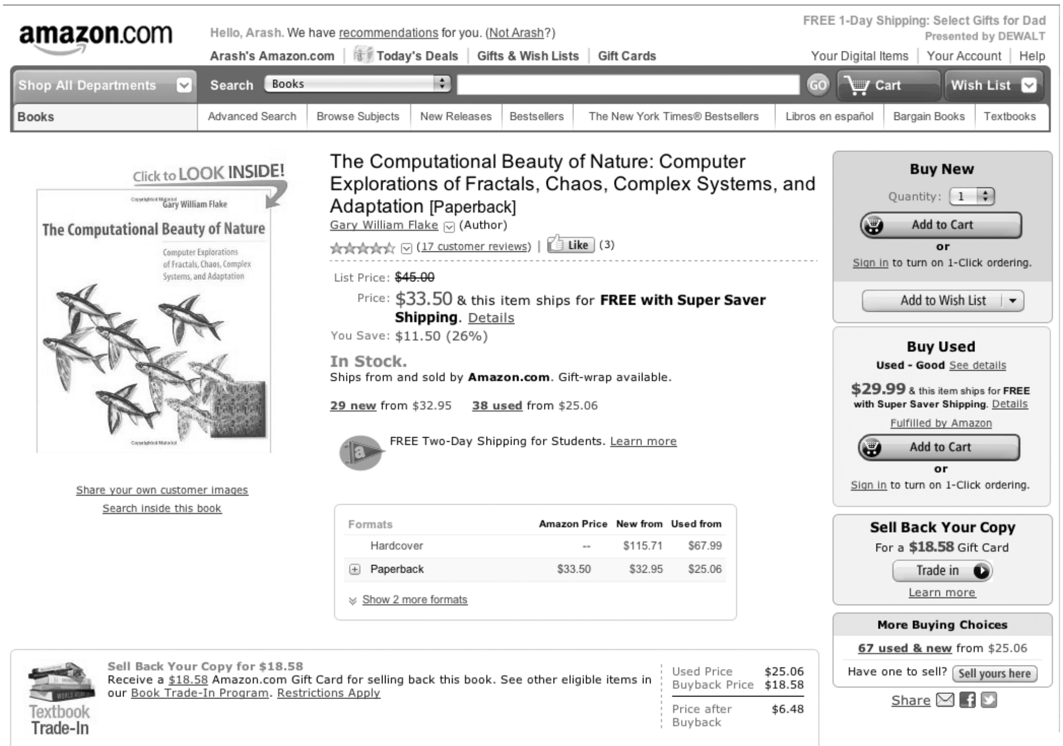

Figure 2. Amazon Marketplace Product Information Interface

As it can be seen, the product information page lists Amazon's price as well as the lowest price from other booksellers for a new book and a used copy. More information about the vendors such as their ratings, shipping rates, and return policies is provided on the supplier information page as shown in Figure 3.

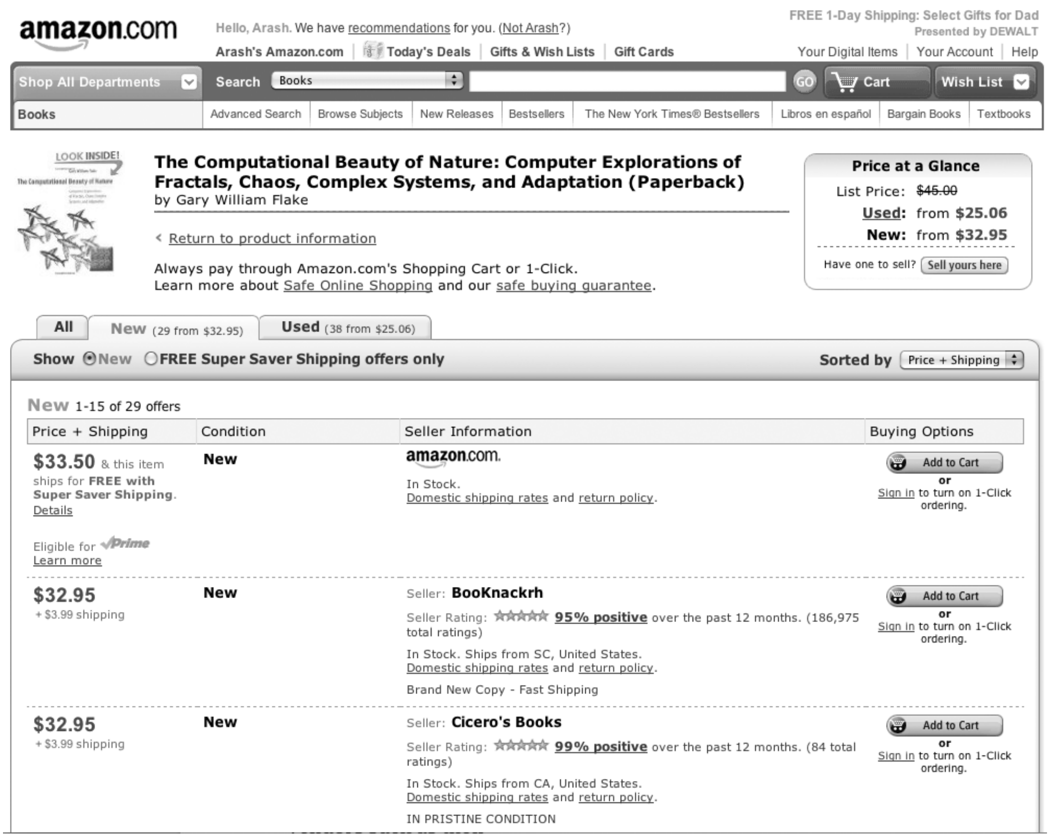

Figure 3. Amazon Marketplace Seller Information Interface

Amazon Marketplace is, in effect, the epitome of a coopetition-based business model. In terms of collaboration, Amazon.com provided third-party sellers with automated tools to migrate their catalogs of millions of new, used, and out-of-print books onto the new product pages within the Amazon.com books tab. This created the opportunity for them to merchandise their products on the highly trafficked web pages that historically had sold only Amazon.com's products. Amazon.com even went further by providing a feature that allowed individual book buyers to list a single book item for sale on the Amazon.com product page (see Figure 3, the bottom section).

While collaborating with the bookstores by providing them with the infrastructure and technical means to market and sell their products online, Amazon.com and the booksellers on the Marketplace are in a head-to-head price competition to win over customer orders. In the 2005 Annual Report the CEO of the company, Jeff Bezos expresses his opinion about Amazon.com's coopetition-based business model with Amazon Marketplace in the following way:

"….in 2000 we invited third parties to compete directly against us on our "prime retail real estate"—our product detail pages. Launching a single detail page for both Amazon retail and third-party items seemed risky. Well-meaning people internally and externally worried it would cannibalize Amazon's retail business, and—as is often the case with consumer-focused innovations—there was no way to prove in advance that it would work. Our buyers pointed out that inviting third parties onto Amazon.com would make inventory forecasting more difficult and that we could get "stuck" with excess inventory if we "lost the detail page" to one of our third-party sellers. However, our judgment was simple. If a third party could offer a better price or better availability on a particular item, then we wanted our customer to get easy access to that offer. Over time, third party sales have become a successful and significant part of our business. Third-party units have grown from 6% of total units sold in 2000 to 28% in 2005, even as retail revenues have grown three-fold."

In fact, there was a lot of internal and external doubt and resistance about including third party sellers within Amazon.com's own webstore. First, according to Kapanik & Zheng (2011), the introduction of Amazon Maketplace "…was initially a cause of concern since many people felt that third party sellers would sell their products at prices lower than the price we were selling the same product for, thus cutting into our sales." Some vendors also advised Amazon not to offer third party products on their front page and let the customer decide which price was the most attractive one. The decision to let customers write reviews of the books on the company's web page was also frowned upon by some. The company admitted that many of these "odd" decisions reduced their profits, but their effects should not be assessed in the short run. These actions are part of their strategy to focus on serving the customer. Although the company has taken these bold steps, some of the risks paid off and helped Amazon cope with the turbulent environment. (Amazon.com, Letter to Shareholders, 2001–2003). Furthermore, in 2007, Jeff Bezos admitted that at the time the decision to implement Amazon Marketplace was controversial and not at all an easy decision, as it [Marketplace] gets the seller customer but loses you the buyer customer (Kirby & Stewart, 2007, 77). In addition, he said that “we talked a lot about that [Marketplace] before we did it. But when the intellectual conversation gets too hard because of these potential cannibalization issues, we take a simple minded approach… …Well, what’s better for the consumer?” (Kirby & Stewart, 2007, 79). Thus, it can be said that Amazon Marketplace—as a coopetition-based business model—was situated within the overall customer-oriented approach of Amazon.com, and this is why it was eventually chosen to be implemented.

Despite the criticism and debate, Amazon Marketplace was eventually deemed as a success. Before the establishment of Amazon Marketplace, by summer of 2000, Amazon's stock price had dropped by more than two-thirds and, by the end of 2000, was down more than 80% from the beginning of 2000 leading to speculation about bankruptcy or acquisition (see e.g. Applegate, 2002, 2008; Brandt, 2011). It can be suggested that Amazon Marketplace was part of the solution that helped to achieve eventual profitability at Amazon.com, since it helped to offset operating expenses and increase sales (other activities to increase profitability included laying off workers, closing warehouses, improving logistics and cutting down unprofitable products, see Frey & Cook, 2004). First, it lowered operating expenses because there was less need to store products. The incremental cost of each sale for Amazon.com was close to zero with very low incremental variable fulfillment costs associated with the sale for Amazon.com (Chiles & Dau, 2005). Thus, the company was able to gain brokerage fees almost without any additional costs. Second, in terms of revenues, an Amazon.com manager was recently quoted as saying: ”The combination of commissions and subscriptions ensured we will make pretty good money independent of whether customer bought the product from us (Amazon) or from a 3rd party merchant; and we made money either way by charging commissions and subscription fee.” (Kalpanik & Zheng, 2011). As early as in the second quarter of 2002, Amazon reported that third-party transactions accounted for 20% of its North American units sold. In 2010, Amazon Marketplace accounted for over 35% of Amazon.com’s revenues (Amazon, 2011; Brandt, 2011).

This type of coopetition-based business model is not only beneficial to Amazon.com. In fact, it has been particularly beneficial to small bookstores: prior to their online presence on Amazon Marketplace, they were having a tough time competing with Amazon.com and the book superstores such as Barnes & Noble and Borders. The period 1993–1996 marks the launch of Amazon.com and over 450 openings of book superstores with Barnes & Noble and 348 with Borders. During the same period, over 200 independent bookstores went out of business (Brandt, 2011). Amazon Marketplace gave these booksellers the opportunity to present their offerings to millions of potential customers.

5.4 Amazon Services and Amazon Web Services

April 2001 marks the emergence of Amazon.com’s second coopetition-based business model, related to its transition to an e-commerce service provider. This business model started intitially when Amazon.com made an agreement with Borders, one of its toughest brick and mortar competitors, to launch and power Borders’ online operations on Borders.com. Based on the agreement, Amazon.com provided Borders with an e-commerce solution of technology services including inventory, fulfillment, site content, and customer service in order to help Borders establish online operations. The agreement between Amazon.com and Borders was in fact part of a broader business perspective. Amazon.com had realized that in time the traditional retailers would begin to realize how difficult it is to succeed on the Internet. With such insights, Amazon.com had perceived the creation of a whole new market as retailers became more interested in outsourcing their online presence. Thus, it began to build resources and capabilities in order to collaborate with companies so that Amazon.com would be responsible for significant portions of their online operations under the brands of Amazon Services and Amazon Web Services. Bezos has recently commented this logic as follows: “Then we realized, Whoa, everybody who wants to build web-scale applications is going to need this. We figured with a little bit of extra work we could make it available to everybody. We’re going to make it anyway—let’s sell it” (Levy, 2011).

In addition to Amazon Marketplace, this type of coopetition-based business model can be seen as a natural continuation to the firm’s customer value creating approach to coopetition. In a recent interview (Levy, 2011), Jeff Bezos points to controversies surrounding the decision to provide e-commerce services to competing companies and explains Amazon.com’s vision of becoming “Earth’s most customer-centric company” stressing that, unlike most companies, Amazon focuses on its customers rather than its competitors.

In 2003, the official launch of the subsidiary Amazon Services, established to help other retailers improve their online presence, was announced. Amazon Services offer a variety of e-commerce services that allow retailers to set pricing and other transaction conditions, manage, and coordinate the logistical processes for the transfer of the physical or digital goods, assure the quality of the goods sold, verify the credibility of buyers and sellers, as well as settle payments and arrange fund transfers (van Heck & Vervest, 2007). As expected by Amazon.com, following Borders, other companies started adopting Amazon.com e-commerce services (such as Waterstone’s, the UK’s leading specialist bookseller, Target Corporation, the second largest retailing company in the US, Marks & Spencer, the leading United Kingdom retailer, Sears Canada, Canada’s most popular retail website). By working with Amazon Services, such merchants could power their e-commerce offering from end-to-end, including technology services, merchandising, customer service, and order fulfillment.

As a parallel development, Amazon.com introduced Amazon Web Services (AWS) in July 2002. By launching AWS, Amazon.com distinguished itself as a web service provider in terms of cloud computing and data storage, which followed the same coopetition-based business model logic as in terms of Amazon Services, but provided even larger infrastructure and resource sharing. In a recent interview (Levy, 2011), Jeff Bezos recognized this issue explicitly: “Over the past eight years, the company has capitalized on its data center expertise to build a vast cloud computing platform, which hosts web operations for some of the world’s largest Internet companies—even competitors like Netflix.” In fact, the coopetitive relationship between Netflix and Amazon.com vividly illustrates the logic of this business model. While Amazon.com is making storage and web operations cheaper for Netflix, it is making its operations harder elsewhere through tough competition on the streaming video contents front (for discussion, see Dignan, 2012). The business model embedded in AWS makes possible that Amazon.com and Netflix both participate in value creation by providing cost-effective content over the AWS infrastructure, even though they at the same time compete to capture value in the customer end.

5.5 Amazon Kindle and the digital text platform

In November 2007, Amazon introduced Kindle, its e-reading device, to the market. Kindle displays books that are in Amazon.com's proprietary e-book format "AZW". In February 2009, Amazon.com introduced an enhanced model of Kindle to the market, known as Kindle 2. On May 20th, 2011 it was announced that Kindle books outsell print books on Amazon.com. Amazon announced that since April 2011, it has sold 105 books for its Kindle e-reader for every 100 hardcover and paperback books sold, including books without Kindle versions and excluding free e-books. It is intriguing to know that Amazon.com print book business dates back 15 years, whereas Amazon.com has only been in its Kindle book business for less than four years. It is estimated that three out of every four books sold are in Kindle format (Brandt, 2011). Thus, the e-book growth is an integral part of Amazon.com's "get big fast" strategy, and also in this case the coopetition-based business model was introduced after the expansion had started.

Apple, a major rival, challenged Amazon.com by releasing iPad in April 2010 as an e-reader device/tablet with an iBooks application that was developed for reading e-book contents in E-PUB format. E-PUB has also been adopted by several other companies in the e-reader market, such as Sony. Soon after the launch of iPad, Amazon.com and Apple began coopetition by which Apple is distributing Amazon.com's e-book content through the Kindle app on the iPad platform (see e.g. Kalpanik & Zheng, 2011). Prior to this, the Kindle app was made available by Amazon.com on Apple's iPod touch and iPhone, where Apple iBooks was already available. In January 2010, Amazon.com announced that authors and publishers around the world could then use the self-service Kindle Digital Text Platform (DTP) to create content in Kindle format, upload, and sell books in English, German, and French to customers worldwide in the Kindle Store. Capitalizing on its coopetitive relationship with Apple, Amazon.com managed to increase the sales of books in AZW format and establish AZW as one of the standard formats in the e-publishing market, right next to E-PUB (Anand et al., 2009). This also led to the increasing popularity of Amazon.com's AZW format among authors who could develop their content for this platform and self-publish their books.

In September 2011, Amazon.com introduced a new family of Kindle devices including Kindle Fire, Amazon.com's tablet computer. The launch of Kindle Fire in November 2011 made the coopetitive relationship between Apple and Amazon.com even more apparent. In 2010, when the Kindle application was released for Apple iPad, Amazon.com's Kindle device was considered merely as an e-reader whereas Apple's iPad was a more expensive tablet computer with countless other features as well. However, the two companies were already in competition in the e-reader market. In early 2011, Kindle had an estimated 47 percent of the market share while Apple's iPad had a 32 percent share. Other actors such as Sony Reader and Barnes & Noble Nook lagged behind with 5 and 4 percent of the market share, respectively. The launch of Kindle Fire put Amazon.com and Apple in a head-to-head competition in the tablet computer market. Marketing experts in the computer industry suggested that Kindle Fire is to be the fiercest rival for Apple's iPad (Levy, 2011).

This development can be recognized as the third instance of Amazon.com's coopetitive business, and it relies on sharing resources and content among competitors to create larger customer value than otherwise possible. Amazon.com gets a broader distribution for its Kindle and DTP content, which in turn increases the attractiveness of Apple's iPad as a content providing platform. Thus, both firms create value together, and also capture value together in the domain of iPad content providing, while they simultaneously compete with Kindle Fire and iPad platforms. The overall Kindle business model for Amazon.com is based on content, and the device is more a complementary resource. In a recent interview, Bezos commented this approach (Ignatius, 2013): "Well, our approach to our hardware Kindle devices, Kindle Fire and our Kindle readers, is to sell the hardware at near break even, and then we have an ongoing relationship with the customer where they buy content from us-- digital books, music, movies, TV shows, games, apps." This approach illustrates the rationale of the coopetition-based business model, as it is all about the content, and much less about the medium over which the content is delivered. Thus, the medium of direct competitor (Apple's iPad) is one way to create value for the customer. Table 2 summarizes all Amazon.com's coopetition-based business models discussed in this section.

Table 2. Summary of Amazon.com's coopetition-related business models

	Amazon Marketplace	*Amazon Services and Amazon Web Services*	*Amazon Kindle*
Coopetition logic	Offering increased the variety of new, used, and out-of-print books in the Amazon.com web store	Sharing the Amazon.com's web store platform and infrastructure with competing actors	Distribution of electronic book content across different, competing platforms
Amazon's main coopetitive partners	Independent, 3rd party bookstores and book sellers	Borders, Target (utilizing Amazon's web store platform); Netflix (utilizing Amazon's web infrastructure)	Apple (Amazon.com's content in iPad through the Kindle app)
Value for Amazon.com	More valuable and varied end customer offering; margin of the competitors' profits	Profits for running the service; broader utilization and development possibilities for the web store platform	Access to a broader customer base; profits from content sales; an increased user base for the DTP standard
Value for Amazon.com's competitors	Access to a broader customer base; increased sales	Establishing an online presence; highly reliable e-commerce service	Increase of the attractiveness of iPad as an e-reader due to increased content
Potential issues / problems	Cannibalization of Amazon.com's own sales, internal and external resistance	Helping to boost/create competition; cannibalization of Amazon.com's own sales	Reduction in the sales of the Kindle devices

6. Analysis of Amazon.com's Coopetition-based Business Models

Overall, with the help of the aforementioned coopetition-based business models, Amazon.com has evolved in approximately 15 years from an online retailer to one of the world's leading ecosystems in media and web services. The longitudinal case presented in this study suggests that coopetition can shape the individual business models of the central actors, and that the coopetitive interactions taking place can provide value for the industry participants in a way that would not be available through the separate utilization of competitive and collaborative strategies.

In the following, we formulate a number of propositions based on the insights of the case study and the earlier outlined theoretical categorization of the generic drivers of coopetition-based business models. In particular, we take into account the coopetition motivations and drivers of not only the focal firm, but also other actors to understand how coopetition-based business models may optimally work. Our aim here is to link back here to the business model's purpose of architecture of value creation and capture (e.g. Amit & Zott, 2010; Teece, 2010), and thus formulate propositions on how a particular firm can create value for competitors by including them in its business model, and what are the mechanisms through which the firm itself can capture value in such settings.

6.1 Letting your competitors win

A seminal game theoretic rationale by Brandenburger & Nalebuff (1996) is that "letting your competitors win too is ok, as long as you win yourself." Later on this has been extended in discussion suggesting that when markets grow, coopetition is especially lucrative since it allows a "positive-sum game" between actors in coopetition (see Ritala and Hurmelinna-Laukkanen, 2009). On the basis of the case study, this has resonated in the success of the first coopetition-based business model of Amazon.com, where competitors were able to create value for their customers through the Amazon Marketplace. This type of approach has increased the size of the whole market for electronic book sales worldwide. In this case, the competing firms were able to explore wider markets by complementing each others' resources and capabilities (e.g. Amazon providing the platform, customer base, and infrastructure, and the 3rd party bookstores providing improved variety and broader availability). The Kindle app for iPad is a similar case where the content in Amazon.com's proprietary format has been made available for Apple's customers, and thus the market base has been broadened through complementary offerings.

Both of the above-mentioned business models show that it can be beneficial to let the competitors increase their markets as part of the firm's business model. We suggest that the benefit for a focal firm comes from the firm's possibility to capture a portion of the added value that has been created (which is an integral part of any business model, see e.g. Teece, 2010). In addition, customers tend to appreciate if they have more options to choose from. As customer value is increased along the variety of competing offerings in a similar domain (Wang & Xie, 2011), by consciously sharing its platforms to competitors, Amazon.com could enhance such value. Based on these discussions, we put forward the following proposition:

Proposition 1: Increasing the size of the competitor's markets as part of the firm's business model provides potential for the firm to capture a portion of the increased customer value.

The same intuition also applies to completely different markets that were created for Amazon.com's rivals in the case of Amazon Services. By delivering a platform for Borders, Amazon.com was able to capture a portion of the unique value associated with the brand and customer base loyal to Borders. In fact, there are certainly some customer segments that want to be associated with Borders, rather than Amazon.com, and through coopetition both types of customers could be satisfied (supporting the findings of Wang & Xie, 2011). Furthermore, although such customer segments are somewhat out of Amazon.com's reach, the value created by Borders can be partially captured by Amazon.com through the business model of Amazon Services. The same argumentation certainly holds for recent relationship with Netflix as well, and potentially even more strongly: by collaborating with Netflix, Amazon.com is able to capture some of the value created by the lucrative content portfolio Netflix has to offer.

In both of these instances it can be recognized that creating a new market for competitors requires a critical amount of shared resources within the coopetition-based business model (here: the Amazon.com infrastructure). By utilizing this joint resource base, the firms could create value which would not otherwise be available and engage in competition in the customer end (as suggested by Ritala et al., 2009; Ritala and Hurmelinna-Laukkanen, 2009). Furthermore, as suggested by Lavie (2006) and Dyer et al. (2008), the relative share of value capture potential is higher for actors that share more valuable resources to enable value creation in the first place. Thus, the design of the coopetition-based business model in the way that creates new markets for competitors, allowed Amazon to capture their own—otherwise not existing—share. This discussion allows us to formulate the following proposition:

Proposition 2: Creating new markets for competitors as part of the firm's business model provides potential for the firm to capture a portion of the newly created customer value.

6.2 Sharing costs and risks with competitors to gain resource efficiency

Amazon.com had sunk huge investments and resources into developing its web-based platforms and infrastructure. By transforming the platform to suit the needs of its competitors in the form of Amazon Services and Amazon Web Services, Amazon.com was able to realize notable resource efficiency benefits. By sharing the platform, it was not only Amazon.com, but also others that could benefit from exploiting the already sunk costs and resources.

There are several reasons why sharing resources with competitors for efficiency purposes may be lucrative. First, the overall ratio of benefits versus costs will improve within the business model when resources are shared with competitors in activities where they have joint interests, and are often far away from the customer end (Dussauge et al., 2000; Bengtsson & Kock, 2000). In fact, when competitors create value together by sharing their resources, they are well placed to individually compete for the created value through differentiated offerings. This has been illustrated in the Amazon.com case through numerous coopetitive relationships where the joint infrastructure has been shared to enable competitors to spread their offerings to markets. In summary, in certain situations it is valuable for the focal firm to enlarge the group of actors exploiting its resources even when it helps its competitors. Based on this discussion, the following proposition can be put forward:

Proposition 3: Increasing the size of the competitor's markets or creating new markets for the competitors as part of the firm's business model provides potential for the firm to gain resource efficiency benefits.

6.3 Increasing competitiveness

In the global marketplace, some firms operate through utilizing Amazon.com's platforms and some through other platforms, representing network or ecosystem-level competition (Gomes-Casseres, 1994; Gueguen, 2009). Thus, competitiveness against other (groups of) competitors was increased in the case of Amazon Marketplace and Amazon Services, since certain segmentation within the global book markets can be defined in terms of competitive groups going head-to-head with each other. The same intuition goes for the case of Kindle: by enabling Amazon.com to offer content through the Kindle app, the competitive positions of both Apple and Amazon.com are increased against other book market industry competitors. Thus, the firms were able to utilize coopetition to bundle their supplementary and complementary resources together, and therefore increase their competitiveness against other rivals outside the scope of the business model (see e.g. Lado et al., 1997, on syncretic rent seeking behavior). Taking into account the aforementioned evidence, we suggest that in certain conditions it is beneficial to improve the market potential of the firm's competitors, especially when this improves the competitive positioning of the focal firm as well. The following proposition summarizes this discussion.

Proposition 4: Increasing the size of the existing markets or creating new markets for certain competitors as part of the firm's business model provides potential for the firm to improve its own competitive position and thus increase its value capture potential.

7. Conclusions

In this study, we have focused on how the potential advantages of coopetition (collaboration between competitors) can be realized by involving competitors in the firm's business model. To examine this issue, we conducted an in-depth case study of Amazon.com's coopetition-based business models throughout its history. The results provide evidence on how Amazon.com has utilized such business models in three particular phases since the year 2000. This has led to market growth, resource efficiency and increased competitiveness not only for Amazon.com, but also for its coopetitive network of 3rd party sellers, content providers, and large multi-national competitors. Based on the case study, we create propositions on the benefits for a firm to formulate coopetition-based business models that increase the size of its competitor's markets or create new markets for its competitors. At first glance, these types of suggestions are quite counterintuitive when assessed through the lens of the traditional competitive paradigm. Indeed, Sharma (2002) suggested that when companies are moving towards simultaneous competition and collaboration there is a shift towards "non-traditional" competitive strategies. Based on the case, we show that such non-traditional strategies and business models need to be used in order to provide potential for positive-sum results for each actor involved, which is a requirement for crafting successful coopetition relationships in general (Brandenburger & Nalebuff, 1996; Lado et al., 1997; Ritala & Hurmelinna-Laukkanen, 2009).

Our main contribution in this study is to show distinct aspects inherent in the firm's business models that can help to capture value from coopetition relationships. In doing this, we have taken into account the larger network environment where the firm is embedded, the supplementary and complementary resources available through such network, as well as the role of technologies and market offerings, following the recent suggestions of Mason & Spring (2011). On a more detailed level, we first proposed that by increasing the size of the competitor's markets or creating completely new markets for them as part of the firm's business model provides potential for the firm to capture a portion of the increased customer value. This result resonates with the recent findings suggesting that the presence of a variety of competing offerings is seen as valuable from the customer perspective, and can eventually be helpful to the focal firm as well (Wang & Xie, 2011). Furthermore, the results support the notions that compatibility, interoperability and joint utilization of similar, supplementary resources are major value creation drivers in coopetition (Gnyawali & Park, 2009; Mione, 2009; Ritala & Hurmelinna-Laukkanen, 2009). Secondly, we proposed that the firm can capture resource efficiency benefits by sharing its solutions with competitors and thus increasing the size of the competitors' markets. This result complements earlier research that has focused on cost saving more from the focal firm perspective (e.g. Dussauge et al., 2000; Oum et al., 2004). Thirdly, we proposed that increasing the size of certain competitors' markets—or creating new ones—as part of the firm's business model provides potential for the firm to increase also its own competitive position. This suggestion is in line with the discussion about competitive dynamics moving towards competition between networks and ecosystems, rather than residing solely between individual firms (e.g. Gueguen, 2009; Möller & Rajala, 2007; Vanhaverbeke & Noordehaven, 2001).

For business practitioners, our study proposes several interesting implications. First, in general the Amazon.com example shows that coopetition, although a risky business, can lead to the survival, growth, and evolution of a company over time. Second, the competitors are operating in the same domain and recognizing that this can lead to new and valuable business opportunities. By collaborating with its competitors the company can build new competences and get better leverage on its current capabilities, brand, and technologies (such as in the case of Amazon Services). This mechanism also works vice versa, in that the company can leverage its competitors' resources through coopetition and this way increase the overall value for its own customers. Finally, the case shows that coopetition can have long-term structural effects on the whole industry. Managers should thus watch closely for the potential that coopetition-based business models can offer to their companies in order to stay aboard and ahead of industry evolution.

Our results suffer from the typical limitations of a case study in that the results are bound to a particular industry and company, as well as from the limitations related to using mainly secondary data. Being an Internet-driven company, Amazon.com has been able to exploit the many advantages of coopetition that are not necessarily available for other types of companies in other industries (e.g. network externalities, platform sharing). We believe, however, that the propositions presented here are sufficiently universal, and that future research could further examine their applicability, as well as the interesting boundary conditions. Particularly useful would be studies focusing on different industries and different types of business models than those presented here. For example, future studies could compare coopetition-based business models in different industries to see how the different drivers (e.g. the ones mentioned in this study) of coopetition are utilized in practice. Other research could also go to the specifics of business model evolution for particular companies and industries to see how coopetition has affected them over time. Especially studies using primary data and the longitudinal case approach could find out whether business models are deliberately planned from the coopetition perspective or is the phenomenon more emergent. Finally, quantitative studies could focus on the effectiveness of including coopetition as part of the firm's overall business model, and examine potential performance implications.

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Appendix 3. Integrating the Competence-Based Strategic Management (CBSM) theory with the Viable System Model (VSM)

Abstract: *In this appendix, we explain the main conceptualizations from CBSM theory and their integration with the viable system model (VSM) (Beer, 1979, 1984). In the competence-based strategic management (CBSM) theory (Sanchez & Heene, 1997, 2003), an organization is represented as a goal-seeking open system. Explicitly elaborating organizational system effects within and across the boundaries of organizations, CBSM theory provides a set of concepts for identifying essential system elements of organizations as goal oriented human systems for sustainable value creation and distribution.We also graphically represent the ontological relationships between the concepts that form the basis for a model.*

1. Competence-Based Strategic Management Conceptualizations

As illustrated in Figure 1, CBSM conceptualizations are grouped into three main categories: Business Concept, Organization Concept, and Core Processes. The linking line in Figure 1 indicates that the Business Concept, Organization Concept, and Core Processes are "part of" (the larger set of) CBSM Conceptualizations.

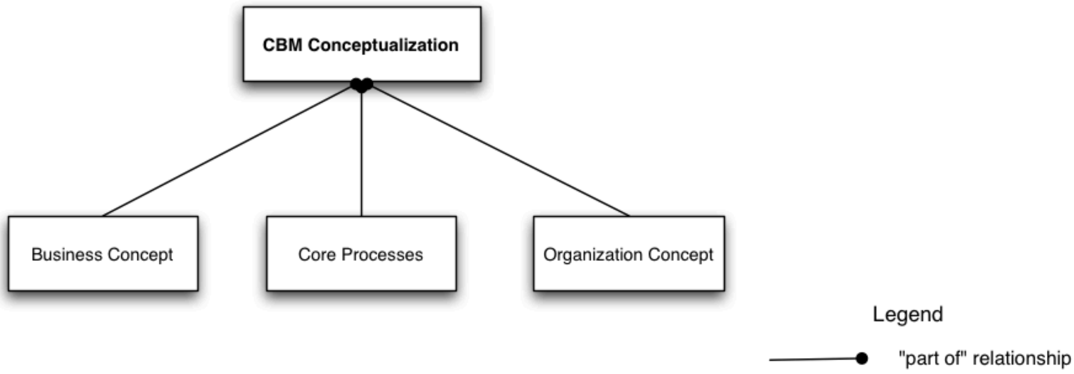

Figure 1. Overview of CBSM conceptualizations

1.1 Business Concept

The Business Concept defines the strategic focus of an enterprise that sets boundaries around and delimits the activities the enterprise will undertake. It defines the market segment(s) targeted by the enterprise (i.e. *who* will be served by the enterprise) and the product offers it will create for its targeted segment(s) (i.e. *what* will the enterprise offer its intended customers). The Business Concept also enables analysis of *how* a product offer is intended to impact the customers' perceptions of cost and value by integrating the net delivered customer value (NDCV) framework developed by Kotler (2000). Figure 2 shows the ontology of concepts that compose the Business Concept.

We now define the concepts that comprise the constituent elements of the Business Concept. In so doing, we introduce a second kind of ontological relationship between concepts—the "association" (or "is associated with") relationship, the nature of which is described by a word or phrase written above the association arrow.

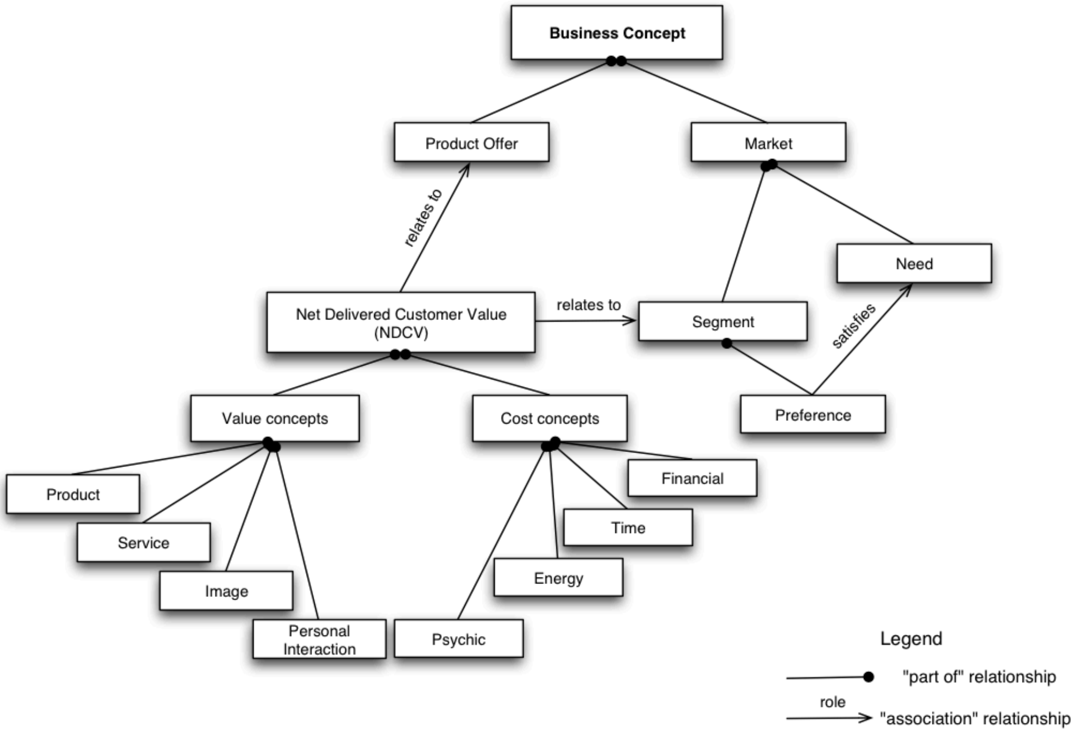

Figure 2. Business Concept

1.1.1 Market

A *market* is a process through which demand for goods and services to meet human *needs* is supplied. Markets are characterized as being composed of *market segments*. A market segment is a grouping of potential customers with relatively similar preferences for specific kinds of goods and services to satisfy their needs.

1.1.2 Product offer

A product offer is the bundle of benefits and costs that an enterprise presents to targeted market segments when it offers its goods and services.

1.1.3 Net delivered customer value (NDCV)

NDCV refers to the net value that customers in targeted market segments perceive in the bundle of benefits and costs to be derived from the goods and services offered by an enterprise. NDCV includes all the benefits and costs a customer expects to experience during the full life cycle of the product, including learning about, purchasing, taking delivery of, using, maintaining, repairing, upgrading, and retiring a product. Customers will prefer a product offer that delivers the highest available (and positive) NDCV (i.e. the greatest excess of perceived value over perceived cost).

1.2 Organization Concept

The Organization Concept defines the essential organizational building blocks needed to implement a Business Concept. The Organization Concept provides the organizational framework through which the enterprise's (operational) management processes will work in leveraging the organization's current competences. An

Organization Concept answers the following questions about the organizational building blocks that will compose the enterprise and enable its processes:

- What *resources* will be used by the enterprise to develop and deliver its product offer(s)?
- What *organization design* should the enterprise use to coordinate its resources?
- What *control mechanisms* should the organization use to monitor its implementation of the business concept in an enterprise, and what *incentives* should the organization use to motivate performance by the resources in the organization?

In the following discussion we elaborate the building blocks of the Organization Concept. Figure 4 depicts the ontological relationships between the three building blocks of the Organization Concept, and between the Organization Concept and the "higher level" concepts used in articulating CBSM theory. Figure 4 also introduces the third kind of relationship used in ontological mapping in the SEAM methodology, represented by the "is a" relationship arrow.

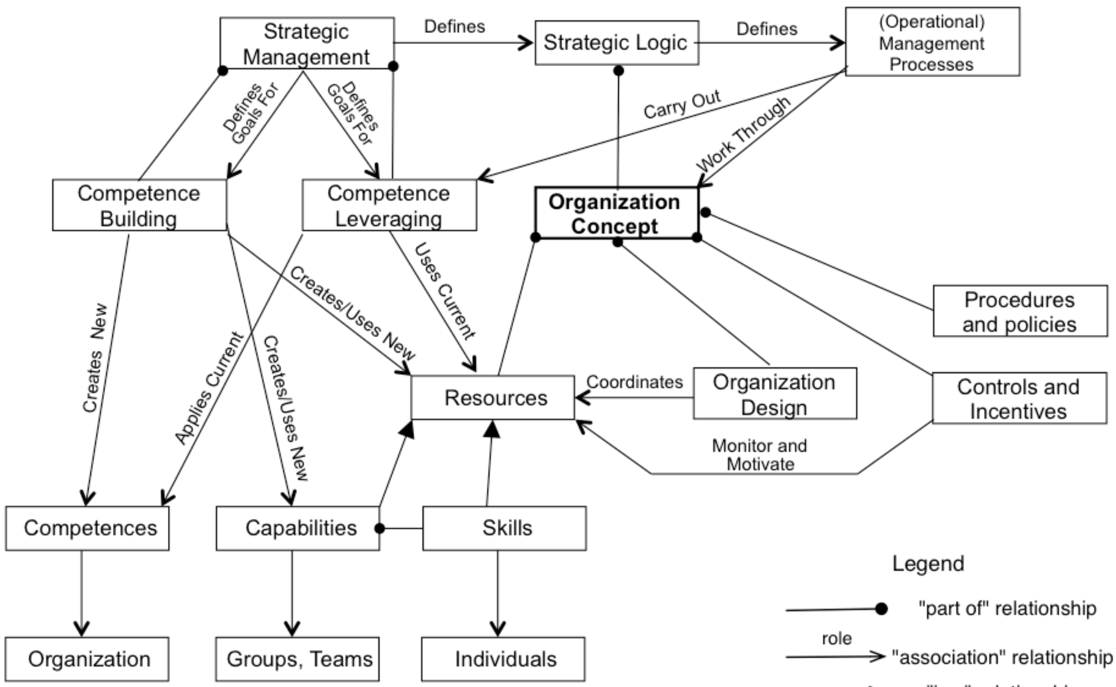

Figure 4. Organization Concept

1.2.1 Resources

Resources are any assets that a firm can access and use in developing and realizing its product offers. (Assets are defined, though not indicated in Figure 4, as anything tangible or intangible that would be useful to a firm in developing and realizing product offers.)

CBSM theory has developed a hierarchal representation of the abilities of individuals, groups, and organizations to use resources. At the most fundamental level of this hierarchy are the *skills* of individuals in applying their knowledge and energy (as resources) to the performance of specific tasks. Groups and teams may then develop *capabilities* in coordinating various uses of the skills of individuals. Capabilities are *repeatable patterns of action* in using the skills and other resources (machines, information, etc.) available to an enterprise.[5] At the highest level of the hierarchy is the *competence* of an organization -- defined as the ability of an organization to sustain coordinated deployments of its resources and capabilities in ways that help an organization achieve its goals.

1.2.2 Competence building and leveraging

In order to sustain its value creation and value distribution activities, an enterprise must both leverage its existing competences and build new competences for use in the future. *Competence leveraging* refers to the use of an organization's existing competences to create product offers and carry out other activities that do not require qualitative changes in the resources the organization uses or in the way the organization coordinates its resources. *Competence building* is any process through which an organization creates or accesses qualitatively new kinds of resources and capabilities and/or develops new ways of coordinating and deploying new or existing resources and capabilities.

1.2.3 Strategic logic

The Strategic Management defines the Strategic Logic of the organization, which is defined as The Strategic Logic is the enterprise's operative rational for achieving its goals through coordinated deployments of resources.

The Strategic Logic determines the strategic balance between competence building and leveraging within the enterprise by specifying the competences to be built; the ways to build them and the ways to leverage current and the new competences. The Strategic Management thereby, defines the Operational Management processes that work through an organization design in order to carry out the competence leveraging activities of the organization.

1.2.4 Organization Design

To coordinate the use of resources in carrying out the Core Processes[6] of an enterprise, managers must define *task allocations* (who will *do* what), *authority distributions* (who will *decide* what), and *information flows* (who will *know* what) – the three classic dimensions of *organization design.*

1.2.5 Controls and incentives

Control systems provide the mechanism through which managers may monitor the performance of the various tasks allocated within the organization. Incentives may (or

[5] In CBSM theory, capabilities meet the general definition of *resources*, because they are useful in developing and realizing product offers. However, capabilities are recognized as a special kind of resource because they operate on other (tangible and intangible) resources. Thus, CBSM theory is always careful to refer to an enterprise's resources *and* capabilities, and does not equate capabilities with other resources, as is commonly done in the Resource-Base View (RBV).

[6] The Core Processes are explained in section 1.3

may not) provide a system of rewards and punishments that serve to motivate performance by the human and organizational resources (employees and suppliers) used in the organization's value creation processes. Procedures specify the step-by-step sequence of actions to be followed in a specific situation or to achieve a given objective. Policies are rules or guidelines that express limits or boundaries within which action should be taken.

1.3 Core Processes

The current Business Concept and Organization Concept of an enterprise will determine the specific objectives and nature of the value creation and distribution activities undertaken within the enterprise. CBSM theory characterizes an enterprise's current value creation and distribution activities as fundamentally consisting of three "Core Processes:" Product Creation, Product Realization, and Stakeholder Development as illustrated in Figure 5.[7]

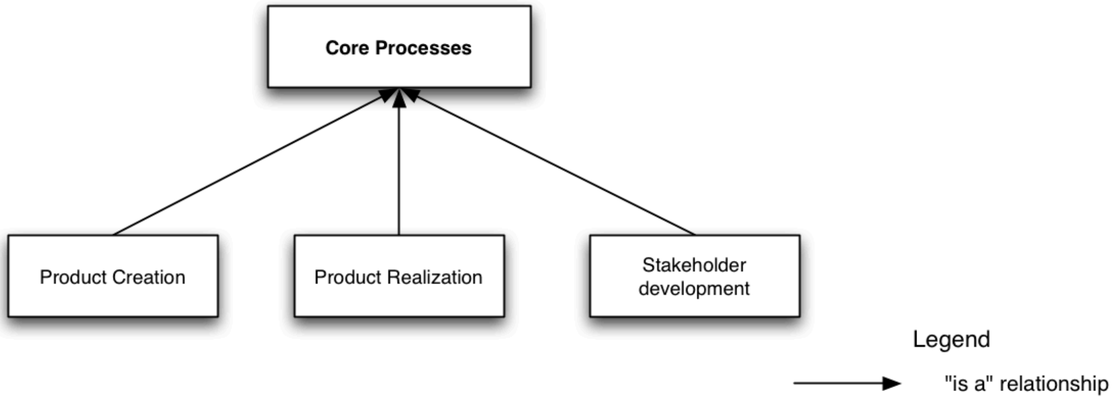

Figure 5. Core Processes

1.3.1 Product Creation

Product Creation includes all the activities an enterprise performs in defining, designing, and developing new product offers. The activities may include marketing research in various forms, and developing or acquiring new technologies to use in new products, among others.

1.3.2 Product Realization

Product Realization refers to all the activities an enterprise undertakes in producing, shipping, and providing customer supporting for product offers.

1.3.3 Stakeholder Development

Stakeholder Development includes all the activities an enterprise undertakes to attract, retain, and develop the best possible resources for use in and support of its value creation activities. Such activities may include recruiting employees with special knowledge and skills, developing effective supplier relationships, managing

[7] CBSM theory also recognizes a fourth kind of Core Process -- called Transformative Processes – whose objective is to change the way the organization "thinks and acts." This core process is typically involved in building new competences.

relationships with financial markets to improve flows of financial resources, and building supportive relationships with host communities.

2. A Generic Enterprise Model

In order to represent various aspects of an organization and its interactions with other entities in we developed a generic Enterprise Model as shown in Figure 6. The Enterprise Model embodies conceptualizations from Business, Organization, and Core Processes from CBSM theory, the classic systems analyses of Stafford Beer, and other systems frameworks.

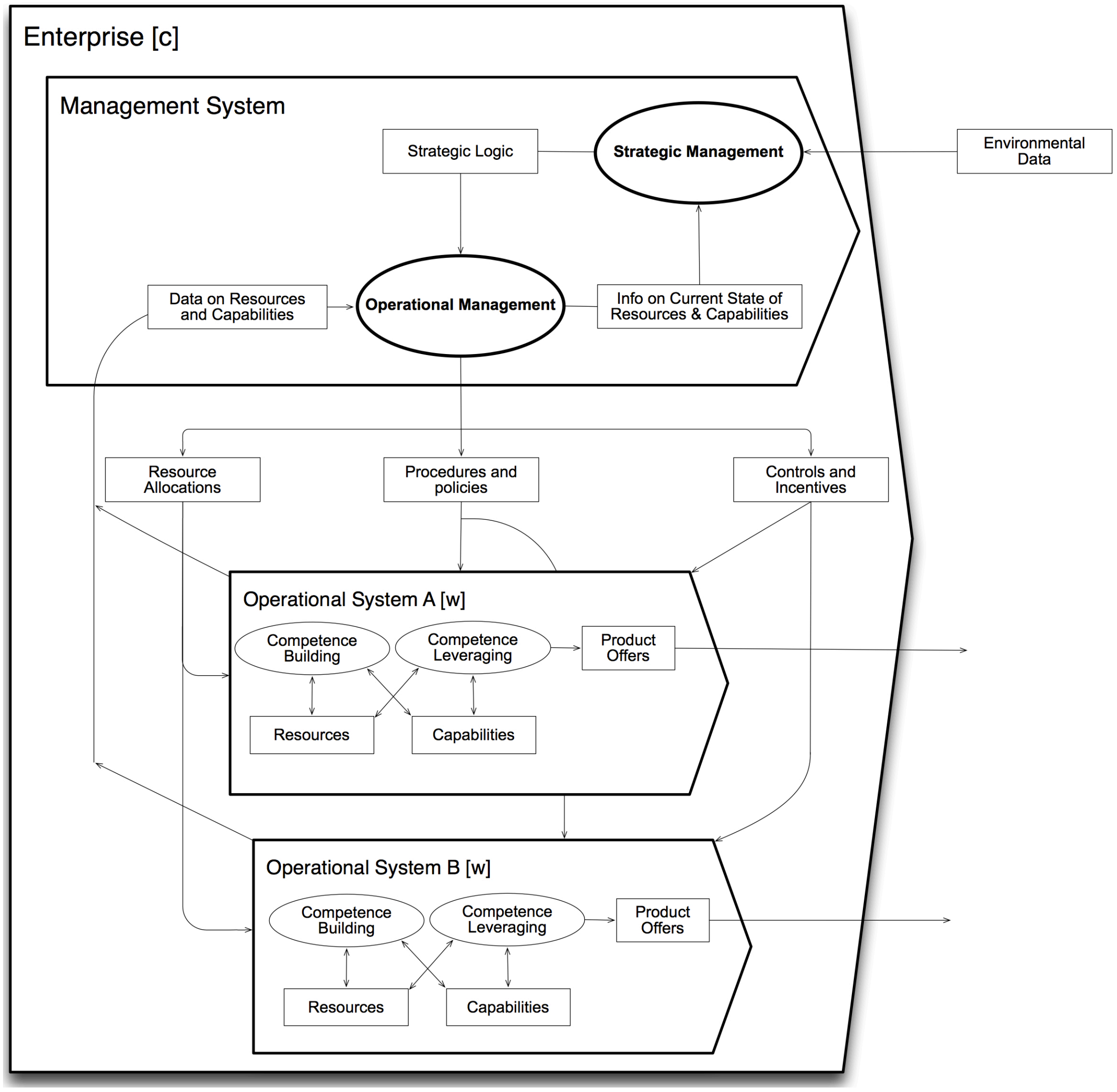

Figure 6. SEAM Enterprise Model

In the following discussion, we explain the underlying concepts, notations, and systemic and modeling principles required for gaining an understanding of the Enterprise Model.

2.1 System and Observer

The concept of an observer is central to the Enterprise Model. A system is defined as a set of interacting entities leading to correlated actions, as detected and identified by the observer. The observer invents the system by perceiving a purposive unity among the entities within a universe of discourse. In this context, observation is therefore the act of choosing a set of entities (believed to be systemic in their interactions) from among a set of all possible entities that are observed by the observer. The selected entities comprise the system to be modeled, and the remainder of the entities observed constitute the elements in the environment of the system. The Enterprise Model broadly decomposes an enterprise into a set of Operational Systems and a Management System. Operational Systems carry out the Core Processes within the enterprise. In the Enterprise Model in Figure 6, Operational Systems A and B and the Management System are denoted by block arrows. These basic enterprise systems may then be elaborated in various ways deemed appropriate to the universe of discourse. Figure 6 indicates how the basic systems included in the Enterprise Model may be elaborated through CBSM conceptualizations.

3.2 The Principle of Recursion

The principle of recursion holds that any system contains (sub)systems, and at the same time is contained within a hierarchy of larger systems. When a system is decomposed into its component (sub)systems, the component systems can in turn be decomposed into their component systems, and so on. Thus, in SEAM systems are represented as nested hierarchies. Figure 6 illustrates the highest level of recursion of an enterprise. In order to go down one level of recursion, Operational System A or B would be decomposed into their constituent Operational (sub)Systems with their own Management (sub)Systems, and so on.

3.3 States, Properties, and Actions

In SEAM a system is represented by properties and actions. An *action* causes the state of the system properties to undergo a transition from a pre-condition to a post-condition. In SEAM, actions and properties are denoted by ovals and rectangles, respectively. In the Enterprise and Market models, properties and actions are assigned different names depending on how the states they relate to influence a system. For instance, in the Enterprise Model, the Management System is modeled by “Strategic Management” and “Operational Management” actions and Customers in the Market Model in Figure 7, are modeled by their Needs and Preferences as their emergent properties and an NDCV property is attached to the Product Offer of enterprises in the market.

3.4 Whole-composite Principle

An observer can view a system as a whole (i.e., adopt a “black box” view of a system) or as a composite (i.e., a “white box” view that reveals the subsystems and inner workings of a system). When a system is seen as a whole (the “black box” view), the system’s subsystems and their interactions are ignored. Instead, the overall system’s emergent actions and properties that result it the overall behavior of the system are observed. On the other hand, when an observer adopts a “white box” view of a system as a composite, its component (sub)systems and their interactions are observed directly. Applying the whole-composite principle assists in observing the hierarchy of recursive systems that obtains in any universe of discourse and enables setting boundaries that delimit the system and subsystems of interest.

In the Enterprise and Market Model, whole and composite views of the Enterprise and the Operational Systems are denoted by [w] and [c] respectively. As illustrated in Figure 6, the Enterprise is represented as a composite, and therefore we can observe its Management System and Operational Systems. The Operational Systems A and B, on the other hand, are represented as wholes, and therefore we can only observe their emergent actions and properties.

Modeling an Operational System or an Enterprise as a whole, we represent competence building, as the actions the Operational System takes to modify its resources and capabilities as in order to output a new resource, and competence leveraging as the actions the Operational System takes to use its current resources and capabilities in order to output a current kind of resource. A resource output may be a product offer by the enterprise as a whole to the market, or an intermediate resource that serves as an input to another Operational System in the enterprise.

3.5 Channels

The second law of thermodynamics holds that in the absence of further inputs, the order in a closed system will dissipate over time (or in the terminology of thermodynamics, the system will gain in entropy). Hence, a system must interact with its environment in order to maintain its order and viability. *Channels* enable the interactions between a system and its environment, and among the entities that comprise a system. These interactions may have the properties of *communication* of information or *exchanges* of physical resources.

The following sections draw on CBSM conceptualizations to explain the principal interactions (communications and exchanges) among various entities within the Enterprise Model.

3.5.1 Interactions Between Operational Systems

Operational Systems may interact by communicating information (in order, for example, to coordinate the delivery of inputs from one process that become the inputs to another process) and by exchanging various resources required to carry out Core Processes (for example, subsequently delivering the outputs).

3.5.2 Communication between Operational Systems and Operational Management

- The Management System plans for delivery of resources to the Operational Systems;
- The Management System communicates procedures and policies to the Operational Systems to establish overall guidelines and rules for the use of resources (an information property).

- The Management System establishes controls and incentives for monitoring and motivating the use of resources by the Operational Systems (communication of controls and incentives constitute an information property, while payment of incentives may involve exchanges of tangible resources).
- Operational Systems provide data to the controls established by the Management System (another information property).

3.5.3 Interactions between management functions within the Management System.

- Operational Management processes the data it gathers on the resources and capabilities of the Operational Systems and outputs information on the current state of resources and capabilities.
- Strategic Management processes the environmental data as well as the information on the current states of resources and capabilities in the enterprise and identifies "strategic gaps" in resources and capabilities that must be closed in order to implement the enterprise's Strategic Logic successfully. The Strategic Logic serves as an information property that is inputted to Operational Management. The Strategic Logic defines the current competences to be leveraged (and how) and identifies any new competences to be developed

3.5.4 Interaction of the Operational Systems and the Management System with the environment.

- The Operational System gathers information on market preferences, demand, and competition. It outputs product offers to the environment in exchange for resources.
- The Management System interacts with the environment primarily through the Strategic Management. It establishes means for gathering and processing various environmental data in order to ensure the ongoing adaptation of the enterprise to the environment.

4. Conclusions

The Enterprise Model presented in this appendix, embodied conceptualizations from competence-based strategic management (CBSM) and theoretical insights from Stafford Beer's Viable Service Model (VSM). The Enterprise Model can provide analytical assistance in understanding the system component and the organizational structure and processes requisite to the viability of an enterprise. In the coopetition context, the enterprise model can provide useful insights into the organization design organization design required for accommodating and addressing the complexities and dynamics of such a multi-faceted relationship and can thus serve as a complement to the Value Network Model illustrated in the chapter.

Thus, we can conclude that the application of the Customer Value Model sheds light on the strategic incentives behind a coopetitive relationship, the Value Network Model provides insights into the design of the coopetitive value networks and the Enterprise Model can help in designing the organizational structure requisite to the coopetitive relationship. Our future work focuses on assessing the applicability and usefulness of the Enterprise Model by applying it to a prospective business case. As the next step and in order to make the framework prescriptive, we intend to explore the possibility of translating the Enterprise Model to System Dynamics simulations models.

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PART 3

INTEGRATION OF THE SYSTEMIC ENTERPRISE ARCHITECTURE METHOD WITH OPERATIONS RESEARCH METHODS

Chapter 5: Comparing the Performance of Problem Structuring Methods in System Dynamics Modeling

Abstract: *The understanding embedded in the mental models of participants in organizations is considered a crucial source of information for building System Dynamics (SD) models. However, SD as a modeling methodology has not developed a standard way of eliciting and recording this understanding. Currently, several methods of elicitation known as problem structuring methods (PSMs) are employed in the SD community to facilitate problem situation conceptualization in group model building (GMB) with organizational participants. Despite a growing literature on the application of PSMs, very limited research has been undertaken to assess and compare the relative performance of alternative PSMs, when it comes to establishing and facilitating a communication within the organizational participants in a GMB session and between the participants and the SD modeler. This communication is deemed crucial to an effective SD intervention. Our first research objective is to develop a framework to measure the performance of the PSMs used in SD modeling. Then, we investigate the relationship between the performance of a PSM and the conceptualization of the problem situation. In other words, we seek to understand whether a PSM with high performance can result in a better representation of the problem situation. To this end, to develop theoretical concepts and measurable constructs, we apply theoretical insights from cognitive science, in particular Cognitive Fit Theory, and visual notation analysis. These constructs are then measured for four PSMs that are widely used by the SD community: (i) Causal Loop Diagrams (CLDs), (ii) Influence Diagrams (ID), (iii) Cognitive Maps, and (iv) (Magnetic) Hexagons. Based on the results, IDs were found to have the highest cognitive effectiveness, followed by CLDs, (Magnetic) Hexagons, and Cognitive Maps. Moreover, the results suggest that the higher the performance of a PSM is the better the conceptualization and representation of the problem situation is. We also included the Goal-belief Model in the study. The initial results showed that Goal-belief model is not as cognitively effective of other four PSMs, therefore it was not included in the study. As an alternative we explored the integration of the System Diagram with the Stock and Flow diagram in SD. To this end, we devised a six-step process in which the System Diagram can be applied in Tandem with the Stock and Flow diagram for problem solving interventions in situations of dynamic and structural*

complexities. An example inspired from a real case was used to illustrate the way the integration can work. To sum up, in the context of integrating SEAM with the SD we face two alternatives: 1) simplifying the semantics and the syntax of the Goal-belief Model, this can lead to a representation of the problem situation that can then be translated into a causal structure based on which the Stock and Flow diagram can be developed 2) Applying the System Diagram in tandem with the Stock and Flow diagram in SD.

1. Introduction

In System Dynamics (SD) modeling, the organizational participants' (hereafter "participants") mental models and perceptions about a problem situation are considered as crucial sources of information (Forrester & Wright, 1961) (Vennix, et al., 1992). Increasingly, System Dynamics simulation models are built in close cooperation with participants in order to elicit and capture the understanding embedded in their mental models and thereby improve decision-making or problem-solving performance. In the SD literature, this process is usually referred to as "group model building" (GMB) (Andersen, et. al, 1997; Vennix, 1996, 1999; Vennix, et al., 1992, 1996). By involving participants and facilitating collaborative modeling processes with these parties, GMB is intended to create a shared perspective on a problem at hand and on potential solutions by surfacing implicit assumptions and beliefs held by participants (Richardson & Andersen, 1995; Vennix, 1996).

Richardson and Pugh (1981) outline SD modeling as a seven-step process that begins with the identification of a problem, followed by system conceptualization. In essence, System Dynamics can result in an effective intervention when a problem has been correctly identified, conceptualized and the Stock and Flow simulation model appropriately addresses and captures the content of the problem (Zagonel, 2002). These two imperatives are reflected in Figure 1.

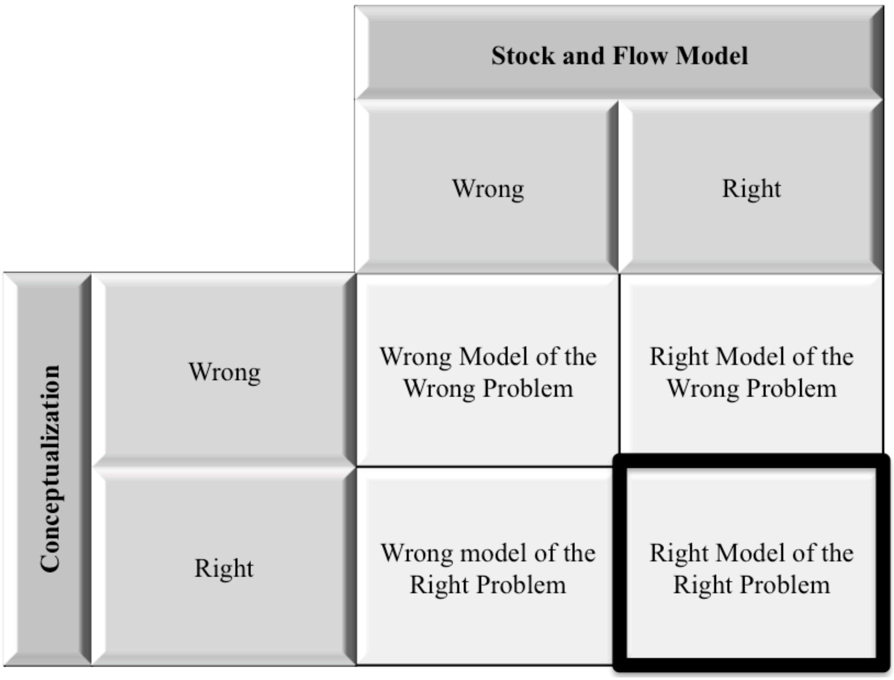


Figure 1. The imperatives of an effective SD intervention

Prior to the emergence of GMB, an SD modeler formed his conceptualization of a situation; today increasingly participants are directly involved in mapping aspects of a problem situation into "modeling constructs" used in the simulation model. The involvement of participants is widely regarded as resulting in models that deliver better representations of problem situations (Lane & Oliva, 1998). This representation or shared conceptualization is in essence a synthesis of the group's negotiated view of “reality” and thereby results in a sense of ownership and the development of commitment to action, when it comes to the action/ implementation phase (Zagonel, 2002). Nevertheless, the SD literature offers few insights into the relative merits of alternative ways of eliciting and recording participants' understandings in the SD modeling process (Lane, 1994; Lane & Oliva, 1998). We suggest that SD should begin to take more seriously and address more actively the strengths and weaknesses of alternative approaches to helping participants surface and articulate their understanding relevant to a problem situation.

This conceptual gap in SD modeling methodology has precipitated increasing interest among the SD community in developing frameworks and tools that can facilitate and improve the conceptualization phase of model building. To assist in eliciting participants' understanding, several tools and techniques have been developed inside the SD community. These tools and techniques are commonly referred to as problem structuring methods (PSMs) (Mingers & Rosenhead, 2004; Rosenhead, 1996; Rosenhead & Mingers, 2001; Smith, 1988; Woolley & Pidd, 1981). Lane (1994) provides a detailed description of the PSMs employed in SD modeling. Moreover, a number of hybrid approaches integrating elements of System Dynamics and other PSMs have also emerged to support problem conceptualization. Lane and Oliva (1998) , for example, develop a theoretical framework (i.e. Holon Dynamics) that integrates System Dynamics and soft systems methodology.

We suggest that a key research question facing the SD community is how to usefully compare and assess the relative performance of these actual and other potential PSMs, given the facilitative role PSMs play in the establishment and increase of the quality of the communication within the participants and between the participants and the SD modelers (Akkermans & Vennix, 1997; Eden, 1994). This communication is indispensable to the effectiveness of the intervention. Furthermore, as noted by Franco and Montibeller (2010), this question takes on greater importance as PSMs are increasingly being taught to participants to enable them to conceptualize problem situations without requiring facilitation by a modeling expert.

To be able to assess the performance of PSMs, we need a construct system capable of measuring the performance of the PSMs when it comes to conceptualizing a problem situation. Considering the cognitive aspects involved in problem situation conceptualization, concepts and theory from the cognitive sciences are clearly not only relevant but also indispensible to the analysis of this important aspect of PSMs. Thus, we invoke theoretical perspectives from cognitive science, in particular, Cognitive Fit Theory, related to dual task problem-solving (Shaft & Vessey, 2006; Vessey, 1991) and the work of Larkin and Simon (1987) to understand how the gap between the conceptualizations of participants and the representations of SD modelers can be bridged to increase problem-situation modeling and problem-solving performance. Based on this understanding, we propose a number of concepts that can be invoked to measure the performance of a PSM. Next, we translate the “concepts” to measurable “constructs” by drawing on insights from visual notation analysis, in particular the work of Moody (2009).

These constructs were measured by conducting an exploratory laboratory study that involved 12 groups of participants, each consisting of two Ph.D. or MSc students in the field of computer and communication sciences at Ecole Polytechnique Fédérale de Lausanne (Switzerland). The groups were asked to develop conceptualizations of a pre-defined problem situation by using four problem structuring methods widely used in the SD community: (i) Causal Loop Diagrams (CLDs) (Sterman, 2000) (Senge, 1994); (ii) Influence Diagrams (Coyle, 1998, 2000; Diffenbach, 1982); (iii) Cognitive Maps (Eden, 1994; Eden, et. al, 1983); and (iv) (Magnetic) Hexagons (Lane, 1993; Wong, et al., 2011; Hodgson, 1992). We chose these four PSMs because they are the most widely used methods in the SD community for group model building. This laboratory study also helped us explore whether a PSM with a higher performance can result in a better conceptualization of the problem situation.

The rest of this chapter is structured in the following way. In Section 2, we briefly discuss the underlying theory of cognitive fit in dual task problem solving, delineating the role of external and internal representation in problem solving performance. We analyze the SD modeling process from the cognitive fit standpoint and suggest a number of concepts to measure the performance of PSMs in the problem conceptualization phase of group model building with SD. Next, drawing on visual notation analysis and group model building, we explain how these concepts can be translated to measurable constructs. In Section 3, we report the results of our exploratory laboratory study conducted to measure the constructs and explore the relationship between the performance of a PSM and the quality of the problem situation conceptualization. Section 5 includes conclusions and suggestions for further research.

2. System Dynamics Modeling from a Cognitive Standpoint

In this section, we draw on insights from cognitive science, in particular from the work or Shaft and Vessey, (2006) and Vessey (1991), to understand the cognitive processes involved in group model building with System Dynamics. This understanding help us develop a number of concepts that can contribute to our knowledge about the performance of PSMs in terms of the conceptualization and the representation of the problem situation. Next, we will illustrate how visual notation analysis (Moody, 2009) can help us to translate these concepts into measurable constructs.

2.1 Cognitive Fit Theory

Cognitive Fit Theory (Vessey, 1991) can be applied to shed light on the cognitive processes involved in carrying out tasks such as constructing SD models. The theory proposes that achieving a good "correspondence" between a problem situation and the representation of the problem situation leads to superior problem-solving task performance. Vessey (1991) defines mental representation as “the way the problem is represented in human working memory” and suggests that in carrying out a problem-solving task, individuals create mental representations of the problem that incorporate the characteristics of both the representation of a problem and the representation of the problem-solving task (Vessey, 1991). When individuals need to solve problems in a certain domain, their performance will be enhanced if their representation of a problem corresponds well to the problem-solving task. Figure 2 summarizes the tenets of Cognitive Fit Theory.

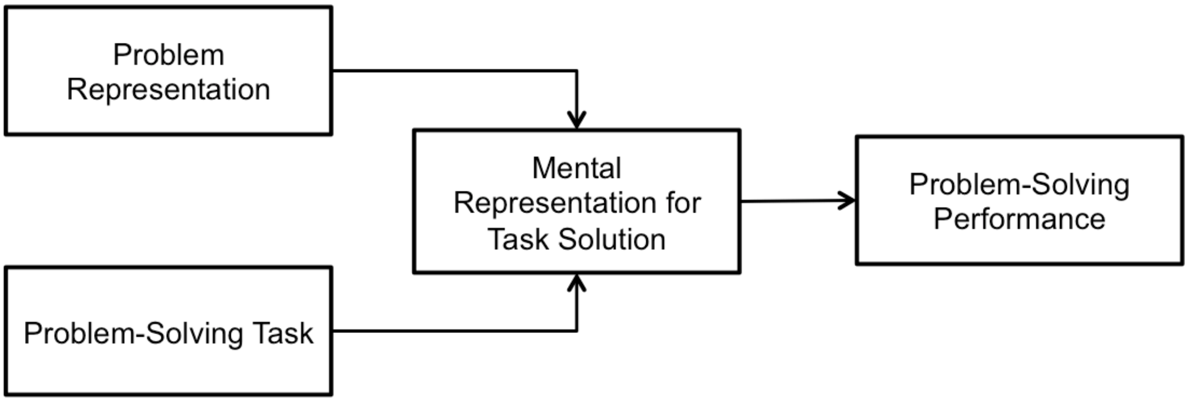


Figure 2. Cognitive fit model for problem-solving (Vessey, 1991)

From the perspective of Cognitive Fit Theory, SD model building entails two distinct tasks: one is related to problem situation conceptualization, and the other is related to SD model construction. Thus, SD model building involves a dual-task problem solving process. Looking at SD modeling as a dual-task problem-solving exercise helps us to understand the interrelationships between a problem-solving task and the cognitive processes of participants involved in the task.

Shaft and Vessey (2006) extended the cognitive fit theory to address dual-task problem solving, which they characterize as occurring "when problem solvers perform two (or more) tasks simultaneously where each task is referred to as subtask." Drawing on the work of Zhang (1997) and Zhang and Norman (1994) on distributed cognition, Shaft and Vessey (2006) modified their original model to include the concepts of external and internal representations, as noted in Figure 3.

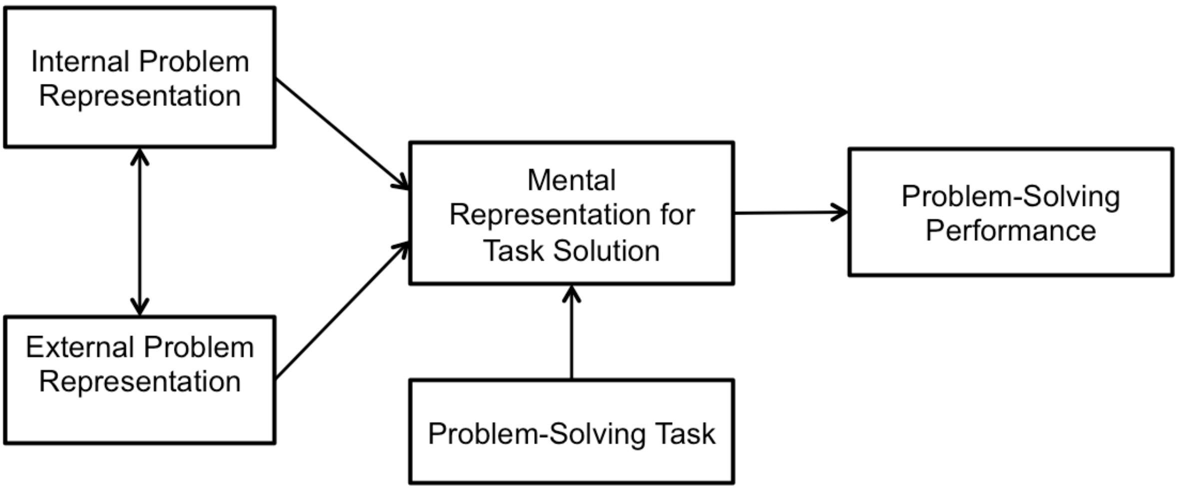


Figure 3. Extended cognitive fit model for dual task problem-solving (Vessey,1996)

Zhang (1991, P.1) defines internal and external representations in the following way:

Internal representations are the knowledge and structure in the memory, as propositions, productions, schemas, neural networks, or other forms. The information in internal representations has to be retrieved from memory by cognitive processes, although the cues in external representations can sometimes trigger the retrieval processes.

External representations are the knowledge and structure in the environment, as physical symbols, objects, or dimensions (e.g., written symbols, beads of abacuses, dimensions of a graph, etc.), and as external rules, constraints, or relations embedded in physical configurations (e.g., spatial relations of written digits, visual and spatial layouts of diagrams, physical constraints in abacuses, etc.) For example, problem solvers use external representations when they use a list for grocery shopping or when they use graphs to understand economic trends.

A dual-task problem-solving model reflects the fact that both internal and external representations, and the interactions among them, contribute to the mental representation for task solution developed to solve a problem. Zhang (1997, P.2) explains the interaction between the internal and external representation by considering multiplication as a problem-solving task:

"Let us consider multiplying 735 by 278 using paper and pencil. The internal representations are the meanings of individual symbols (e.g., the numerical value of the arbitrary symbol "7" is seven), the addition and multiplication tables, arithmetic procedures, etc., which have to be retrieved from memory; the external representations are the shapes and positions of the symbols, the spatial relations of partial products, etc., which can be perceptually inspected from the environment (Zhang and Norman, 1994). To perform this task, people need to process the information perceived from external representations and the information retrieved from internal representations in an interwoven, integrative, and dynamic manner."

2.2 System Dynamics Modeling as Dual-task Problem Solving

Figure 4 represents SD model building from the dual-task problem solving standpoint. As illustrated, the performance of SD models in capturing a problem situation and in helping to develop solutions that improve the problem situation requires carrying out "problem situation conceptualization" and "SD model construction" subtasks.

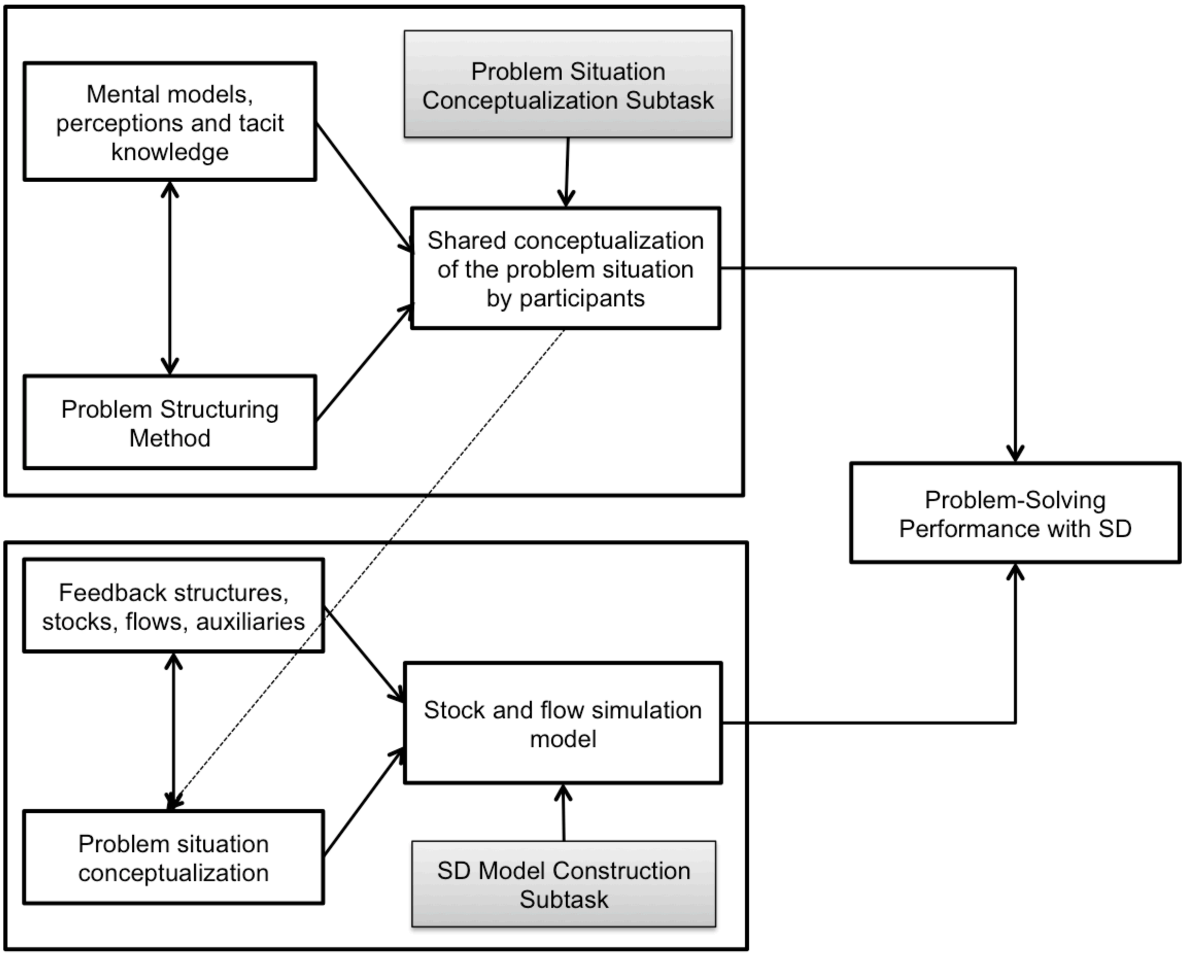


Figure 4. Cognitive view of SD modeling as a dual-task problem-solving

PSMs come into play as external representations applied by participants to develop a conceptualization of the problem situation. The mental models, tacit knowledge and the perceptions participants have about a problem situation, constitute the mental representations. These two representations then go through interactive iterations until a shared conceptualization of the problem situation is achieved among the participants and the problem situation is considered adequately represented. An SD modeler can then employ this representation of the problem situation as an external representation to identify the feedback structures, the stock, the flows and auxiliary variables and to build the simulation model. We now explore the conditions that need to exist to achieve cognitive fit in problem solving with SD.

2.3 Achieving Cognitive Fit in System Dynamics Modeling

Vessey (1991, P. 3) states that:

"Matching representation to tasks leads to the use of similar problem-solving processes, and hence the formulation of a consistent mental representation. There will be no need to transform the mental representation . . . to extract information from the

problem representation and to solve the problem. Hence, problem-solving with cognitive fit leads to effective and efficient problem-solving performance."
We can thereby formulate the following conditions:

- The knowledge emphasized in PSMs as external representations should trigger the elicitation and retrieval of participants' perceptions tacit knowledge and mental models as the internal representations they employ in the problem solving task.

The complexity of problem definition and conceptualization mainly derives from the differences in interpretation and perception of the stakeholder in a problem situation (Ackoff, 1979; Pidd, 2003). Thus, the PSM should enable the stakeholders to carry out a dialog and exchange their points of view and concerns and establish a common base of understanding about the problem situation. This can immensely contribute to the effectiveness of problem solving (Rosenhead & Mingers, 2001).

- The format and the knowledge emphasized in the conceptualization of the problem situation should facilitate the identification of entities incorporated in the Stock and Flow simulation model (i.e. stocks, flows and auxiliaries).

If a given PSM effectively supports an SD model construction subtask, the SD modeler does not need to try to transform the "problem situation conceptualization" generated by the PSM so that it becomes compatible with the format of the representation in the SD model.

If the two aforementioned conditions do not prevail, there is likely to be little or nothing to guide the SD Modeler or the participants in deriving a task solution, and both must then exert a greater cognitive effort to transform their respective representations into a form suitable for solving the problem specified in the task. This excessive effort will result in a decreased problem-solving performance (Vessey & Galletta, 1991). The SD model can be expected to result in higher performance in the problem-solving task if the format and the type of the participant understanding addressable through the PSM (i.e. the problem situation conceptualization) matches the entities and relationships incorporated in an SD Stock and Flow simulation model. Thus, the co-existence of the two conditions results in cognitive fit in problem solving with SD and increases the effectiveness of the SD intervention. In this research we focus on the first situation. Exploring the cognitive fit of different PSMs and the SD Stock and Flow diagram is part of our future work. The question in focus is what characteristics should a PSM possess to trigger and facilitate the elicitation of the perceptions and the mental models the participants have about why a situation is problematic and how it should be addressed.

2.4 The Characteristics of an Ideal PSM

As mentioned earlier, a PSM should in essence be facilitative device that enables dialog among the participants in the problem solving task. Therefore, a PSM can be referred to as a learning device, that can enable people to explore alternative ideas, refine their thoughts, build confidence in their views, and finally establish a common understanding of the problem and the course of action that needs to be developed to address the problem (Pidd, 2003). In order for this to happen, the PSMs representing the problem structure should be easily understood by the participants and should be cognitively accessible to people from a wide range of backgrounds without requiring special training (Mingers & Rosenhead, 2004).

Graphical representations, in particular graphical models and diagrams, are more cognitively effective than other form representations such as sentential or verbal representations in conveying both qualitative and quantitative information of a complex nature (Larkin & Simon, 1987; Tufte, 1990). Employing mathematical, logical or other forms of quantitative models in representing the structure of a problem situation renders the analysis incomprehensible for the participants and does not help them interpret and understand the problem situation. Diagrams facilitate problem-solving by assembling all pieces of information and thereby reducing the time required to make inferences. Additionally, such representations support cognitive operators that can recognize features easily and make inferences directly (Larkin & Simon, 1987).

In the realm of System Dynamics modeling where interconnectedness and causality between the entities, events and decisions that compose the problem situation are emphasized, employing diagrams as modes of representations is hardly surprising. A diagram-based PSM results in a better representation of a problem situation by making the relationships between the entities in a problem situation explicit and visible by facilitating the representation, communication and discussion of causal assumptions held by the participants. This sheds light on why the PSMs used in the SD modeling process are diagrammatic in nature.

The four PSMs employed in our study are: Causal Loop Diagrams (CLDs) (Stermann 2000; Senge 1990), Influence Diagrams (Coyle 1998, 2000; Diffenbach 1992;) Cognitive Maps (Eden, 1994; Eden, et. al, 1983) and (Magnetic) Hexagons (Lane 1993; Hodgson 1992; Wong et al., 2011). Diagramming is integral to all these methods. The question we seek to address now is which of these PSMs has a higher performance in carrying out these tasks.

2.5 Concepts and Constructs to Measure the Performance of PSMs

Larkin and Simon (1987) suggest that the ease and accuracy with which a diagrammatic representation can be processed by the human mind determines the cognitive effectiveness of the representation. The cognitive effectiveness of a PSM therefore reflects the ability of a particular PSM to communicate or "connect" cognitively with a given group of participants. Therefore the performance of a PSM to elicit and represent the problem situation can be measured in terms of how cognitively effective the PSM is.

$$\text{Performance of a PSM} \propto \text{cognitive effectiveness of a PSM} \qquad (1)$$

(i.e. Performance of a PSM is *directly proportional* to its cognitive effectiveness)

Based on the definition of Larkin and Simon (1987), we can assert that a PSM is cognitively effective when participants can easily understand and generate accurate representations of the problem situations using the PSM, therefore

Cognitive effectiveness of a PSM $\propto$ *ease and accuracy of understanding and generating representations with a PSM* (2)

(i.e. cognitive effectiveness of a PSM is *directly proportional* to the ease with which a PSM is understood by the participants and accuracy of the representations made by participants using the PSM)

A diagraming notation is composed of two elements: syntax and semantics. The graphical symbols (visual vocabulary) and the compositional rules (visual grammar) form the syntax of a diagraming notation. Semantics of a diagraming notation include the definitions of the meaning of each symbol (Moody, 2009). In Table 1, we compare the syntax and the semantics of the four PSMs we employed in our study.

Table 1. Syntactical and semantic characteristics of four PSMs

PSM	Syntax	Semantics
Cognitive Maps	Phrases with (contrasting) poles Arrows with +/- polarity	Causality
Magnetic Hexagons	Phrases, Clusters Arrows	Relationships
Causal Loop Diagrams	Noun variables Arrows +/- Balancing and reinforcing Feedback Loops	Causality
Influence Diagrams	Noun variables Arrows +/- Balancing and reinforcing Feedback Loops Causal chains	Causality

Analyzing a diagrammatic notation based on its syntax and semantics helps us formulate the following two constructs to measure the ease and accuracy concepts in relations 2. Once these two constructs are measured, we can quantify the cognitive effectiveness of a PSM in function 1.

Level of Facilitation. This construct represents the syntactical and sematic ease of a representation. The more facilitation required in a group model building session, the more complex the syntax and the semantics of the PSM. We measure the Level of facilitation by the number of questions participants ask about the syntax and semantics of a PSM (Franco & Montibeller, 2010). We employ this construct to measure the ease with which a PSM can be understood or used to generate a representation of the problem situation. Therefore,

The ease with which a PSM can be understood $\propto$ *1/ level of facilitation* (3)

(i.e. the ease with which a PSM can be processed is *inversely proportional* to the level of facilitation required)

(Semantic and Syntactical) Correctness. This construct represents the correctness of the models developed by the participants, from the perspective of the syntax and the semantics. This construct is employed to measure the accuracy with which the participants in the study could generate a representation of the problem situation using a PSM. Therefore,

The accuracy of the representations using a PSM $\propto$ *(semantic and syntactical) correctness* (4)

(i.e. the accuracy with which a PSM can be processed is *directly proportional* to the semantic and syntactical correctness of the representations of the participants).

Based on the functions 1 - 4, we can measure the cognitive effectiveness of a certain PSM using the following formula:

$$CE = \frac{Crt.}{FL}$$

Where, CE is cognitive effectiveness; FL is the facilitation level (FL); and Crt. Is the (semantic and syntactic) correctness. FL ranges from 1 to 5 (very low to very high facilitation) and Crt. ranges from 1 to 5, (very low to very high syntactical and sematic correctness of the model).

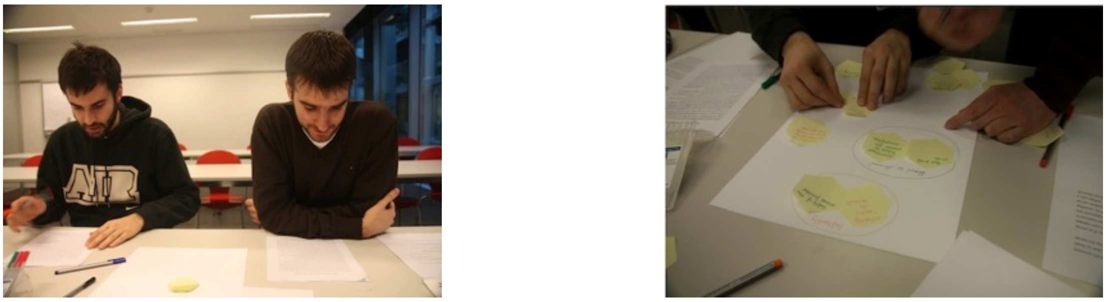
In the next section, we describe the exploratory laboratory study we conducted with student subjects at Ecole Polytechnique Fédérale de Lausanne (EPFL), between February and March 2012, to measure the cognitive effectiveness of the PSMs employed in our study. Next, we empirically assess and compare the impact of PSMs that have been widely applied in the SD community for the conceptualization of a problem situation

3. Exploratory Laboratory Study

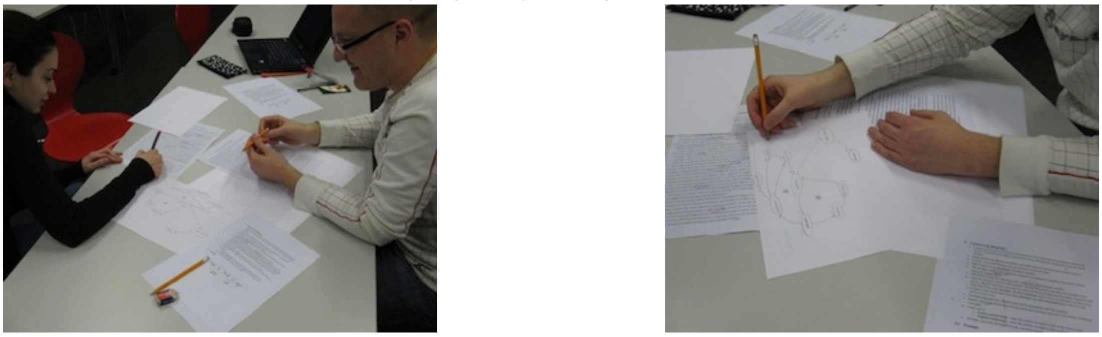
An exploratory laboratory study was designed and conducted to gain an understanding of the cognitive effectiveness of the PSMs subject to the study and the relationship between the problem situation conceptualization and the cognitive effectiveness of a certain PSM. Twelve groups of participants, each consisting of two Ph.D. or MSc students in the field of computer and communication sciences at EPFL, took part in the experiment. One of the four PSMs being studied was assigned to each group (each PSM was used by three groups). As the participants shared the same academic background, their familiarity with the diagrammatic representations was roughly the same. None of the subjects had a prior knowledge of the PSMs used in the study.

3.1. Study Procedures

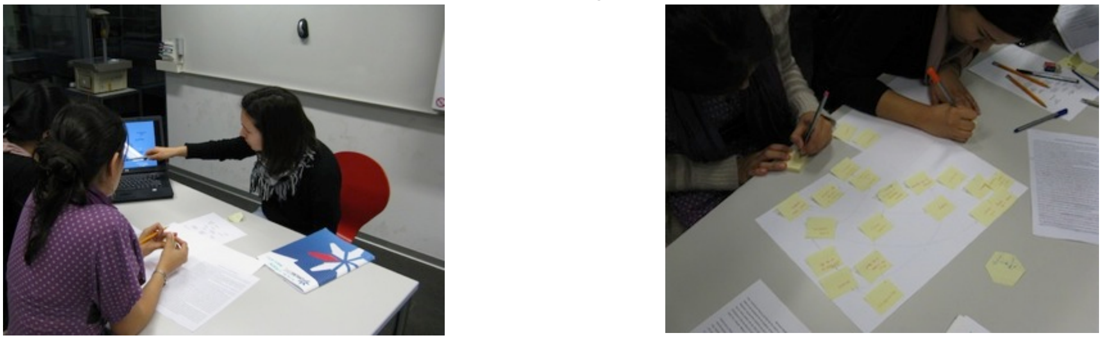
Each group was provided with a description of a problem situation (see Appendix 1) and a set of guidelines (see for e.g., Appendix 2) on how to represent the problem situation using a certain PSM. The guidelines were extracted from the seminal papers published on the methods. The experiments were done one at a time, and during the sessions a facilitator was present and interacted with the participants. Some pictures from the modeling sessions are shown in Figure 4.



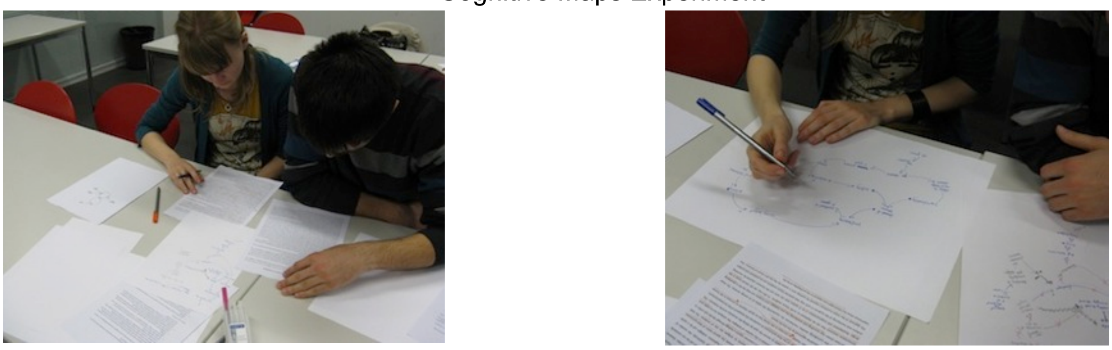
(Magnetic) Hexagons Experiment



Causal Loop Diagrams Experiment



Cognitive Maps Experiment



Influence Diagrams Experiment

Figure 4: Pictures from the modeling sessions

Each modeling session lasted for about one hour. At the beginning of the modeling sessions, the facilitator gave a brief explanation of the PSM, as well as a usage example.

During the sessions, the participants asked questions to check their understanding of the problem situation, as well as the syntax and semantics of the PSM.

See Appendix 3 for a sample of the questions asked in the experiment. The models developed by the participants were then re-drawn by using the software application specific to the PSM (for e.g. Vensim in case of the CLDs and Decision Explorer in case of Cognitive Maps) or with general purpose applications such as Microsoft PowerPoint. See Appendix 4 for some sample models.

3.2 Study Results

In Figure 5, we compare model (syntactical and semantic) correctness, level of facilitation and cognitive effectiveness (CE) for the four PSMs.

In order to understand the relationship between CE and conceptualization of the problem situation, we developed the conceptualizations of the problem situations using the four PSMs.

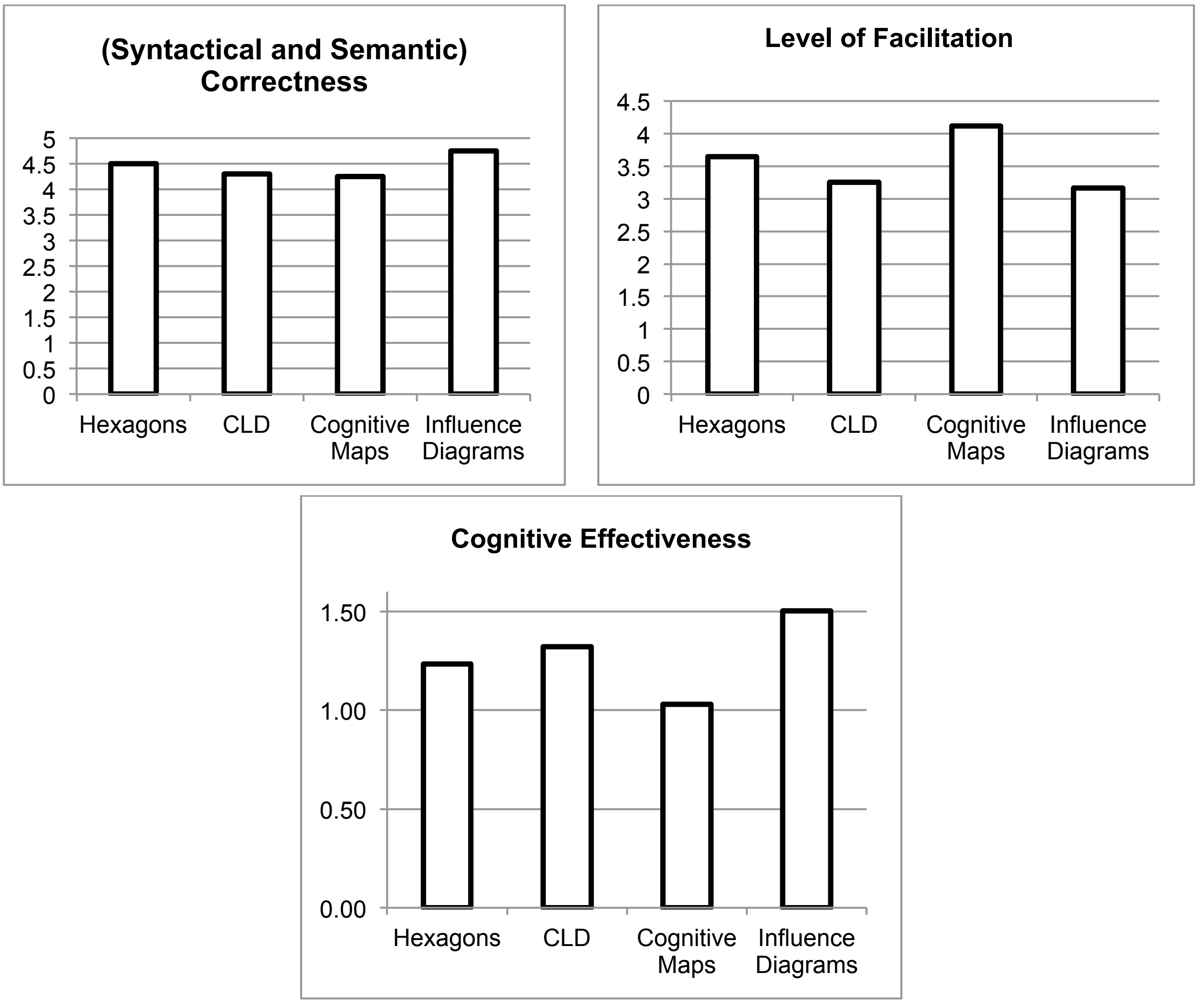


Figure 5. Model correctness, facilitation and cognitive effectiveness for the four PSMs

As we did not have enough experience using the (magnetic) hexagons and cognitive maps, the models we developed, along with the description of the problem situation, were sent to the developers of the modeling technique and were modified based on our recommendations for a better representation of the problem situation (see Appendix 5 for a sample of the models we developed to capture the problem situation).

Next, the models developed by the participants were compared to the models we developed and were graded on a scale of 1 to 5 (5 being the best representation of the problem situation). In comparing and ranking the models, we did not look for a one-to-one mapping, as no single correct model of a situation exists. Rather, we checked for the main variables, issues and concepts (depending on the modeling framework) and their interactions. In Appendix 6 we document how the causal loop diagrams were graded with respect to the problem situation conceptualization, LT, SYN and SEM.

The results reported in Figure 5 suggest that influence diagrams have the highest cognitive effectiveness among the PSMs used in our study. Based on our observations, the participants managed to build their representations of the problem situation using influence diagrams without much facilitation, and the models they constructed were syntactically and semantically superior to other PSMs. The difference between influence diagrams and causal loop diagrams, is the existence of influenced-only factors or variables. This means a causal chain should not necessarily be a part of a causal loop (Diffenbach, 1982).

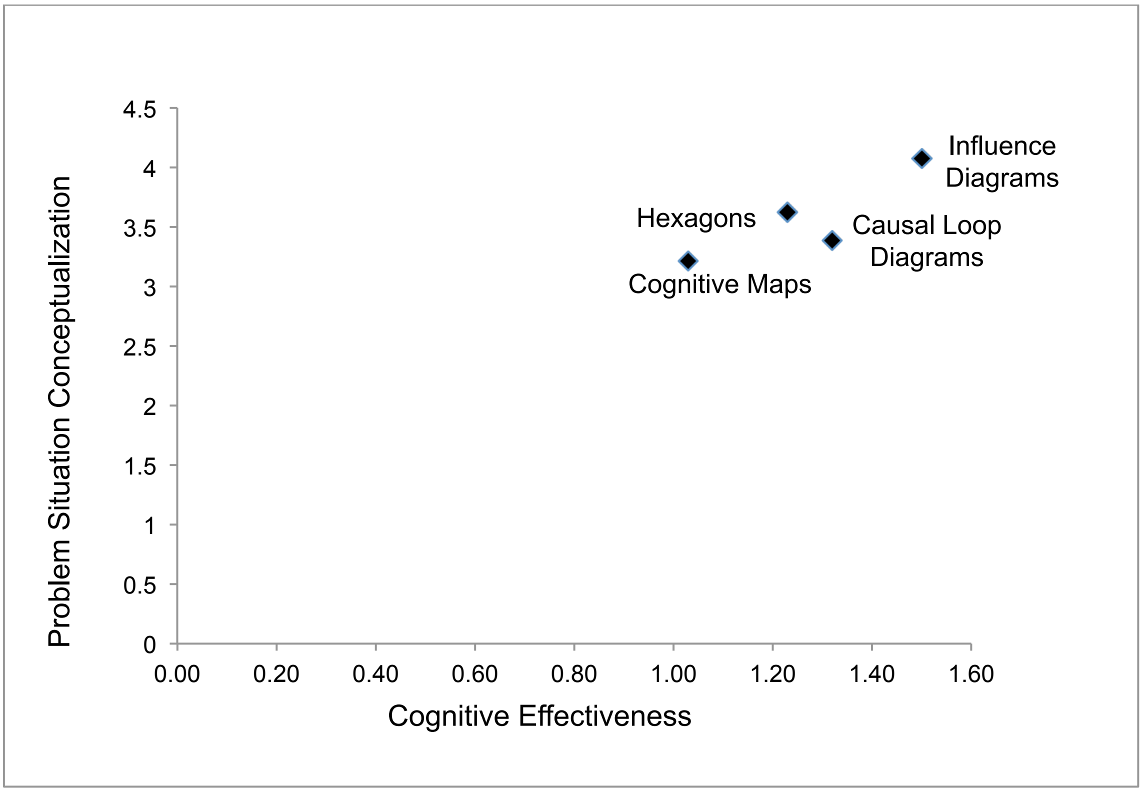


Figure 6. The relationship between cognitive effectiveness and the problem situation conceptualization

Finally, in Figure 6 we illustrate the relationship between cognitive effectiveness and the problem situation conceptualization. As it can be seen the cognitive effectiveness of a PSM is positively linked to the quality of the Problem Situation Conceptualization. In other words, the participants can construct better models of the problem situation when a cognitively effective PSM is employed in the group model building.

4. Integrating the Systemic Enterprise Architecture Method with SD

The Goal-belief Model (Regev, 2003; Regev & Wegmann, 2004) as a part of the Systemic Enterprise Architecture Methodology (SEAM) (Wegmann, 2003), was also studied as a PSM that can be used to conceptualize the problem situation in problem solving interventions with SD. In Appendix 7, the guidelines for developing the Goal-belief Model as well as some pictures from the modeling session are provided. The initial results of our study suggested that the Goal-belief Model is not as cognitively effective as the other four PSMs that are widely applied in the SD community. The participants had to ask quite a few questions before they understood the essence of Goal-belief modeling. Thus, a very high level of facilitation was required compared to the rest of the methods in the study. We concluded that the while the Goal-belief Model can aid in surfacing the unstated beliefs and assumptions of the stakeholders in an organization, it might not be a suitable method for conceptualization of a problem situation to be used as an input for the System Dynamics modeling.

As an alternative, we studied the integration of the System Diagram (Rychkova et al., 2007; Wegmann et al., 2007) with the Stock and Flow diagram in SD. We designed a six-step process in which the System Diagram is used in tandem with the Stock and Flow diagram for a problem solving intervention. The results of this study is presented as a paper in Appendix 8.

5. Conclusions

In this research, we applied theoretical insights from cognitive science to gain an understanding of how PSMs can improve problem-solving in group model building with System Dynamics modeling. We predicted the key characteristics of a cognitively effective PSM which, could lead to a better conceptualization of the problem situation by participants in group model building sessions and thus improve problem-solving performance. Based on these insights we developed a number of concepts and constructs that can help in measuring and thereby in comparing the performance of PSMs employed in problem definition conceptualization in System Dynamics intervention. We measured the constructs through an exploratory laboratory study for four main PSMs that are widely applied in the SD community, namely Causal Loop Diagrams (CLDs), Influence Diagrams, Cognitive Maps and (Magnetic) Hexagons.

The results of the study show that problem structuring with influence diagrams has the highest cognitive effectiveness, followed by CLDs, (Magnetic) Hexagons and cognitive maps. Based on our observations, the main reason behind the relatively superior performance of the influence diagram is the existence of the influenced only factors or variables. This means that every variable is not necessarily part of a feedback loop. We observed that the participants had difficulties in conceiving feedback loops.

We also conclude that the cognitive effectiveness of a PSM is directly related to the quality of the representation that captures the problem situation conceptualization.

We also explored how the Goal-belief Model as a part of the Systemic Enterprise Architecture Methodology (SEAM) can be integrated with SD. The results of our study showed that the Goal-belief model is not as cognitively effective as the four other PSMs included in our exploratory laboratory study. The main reason behind this cognitive inefficiency was the high level of facilitation (the high number of questions asked by the participants in the model building session) required by the participants to generate a Goal-belief representation of the problem situation description used in the study. As an alternative we explored how we can integrate the System Diagram with the Stock and Flow diagram in SD modeling. Thus, for integrating SEAM with SD two distinct alternatives can be considered: 1) developing a lightweight version of the Goal-belief Model such that it can be more easily used to generate representations of the problem situation that can then be translated to a causal structure to be captured by the Stock and Flow diagram, and 2) applying the System Diagram in tandem with the Stick and Flow diagram in a problem solving intervention process to address the dynamic and structural complexities residing in a choice situation.

The research presented in this chapter is limited for a number of reasons. Firstly, the exploratory laboratory study was conducted with only twelve groups of participants who were Ph.D. or MSc students in the field of computer and communication sciences. To increase the generalizability of the results the study should be conducted with more participants with variety of backgrounds. Revisiting the research on individual and group cognitive processes can provide insights into the way the cognitive effectiveness of different modeling frameworks can be measured. In our future work we will plan to repeat the study with participants from industry and model real problem situations that are faced in the organizational setting. A part of our future work also focuses on investigating the technical requirements of a PSM that can result in cognitive fit, from the perspective of system dynamicist who constructs the Stock and Flow simulation model on the basis of the problem situation conceptualization captured by the PSM.

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Appendix 1 – Problem Description

A utility company provides energy services (electricity, gas, etc.) to the residents of a city in Europe with the population of nearly 500 000. From an organizational perspective the Utility Company is divided into different business units (BUs): Gas BU, Electricity BU, etc. So far, the utility company has been known by the stakeholders, including the customers, as a safe and reliable provider of energy services. The profitability of the Utility Company depends on the demand for its services, this demand is influenced by the reliability and the safety of the services provided. The stakeholders' perception of safety is linked to the number of the incidents that occur due to the leakages in the pipes, and reliability is perceived by the stakeholders as the ability of the utility company to meet the energy demand.

The Gas BU conducts the following important functions: the purchase of the gas, sales of gas and distribution to the end users, and the management of the infrastructure. Recently, due to the rise in oil prices, the government has developed some policies and incentives to promote gas consumption over electricity consumption. These incentives boosted the demand for gas. To remain profitable, the Gas BU has to maintain the reliability of its services by ensuring that the increasing demand is met.

The easiest, fastest and the cheapest way for the Gas BU is to meet the demand by increasing the pressure in the pipes. Higher pressure in pipes means higher supply hence, meeting the increase in the demand. Therefore, the Gas BU enables the Utility Company to maintain its identity as a reliable energy service provider. However, the increased pressure has drawbacks. This is the first time that their system is run constantly with a pressure higher than normal; so more leakages in the system are expected. Statistically, the number of leakages is positively linked to the number of incidents that occur, such as explosions. Leakages call for quick interventions in order to minimize the risk of incidents. The Gas BU already has special teams of field technicians equipped and trained to take all the necessary security measures to mitigate the risk of incidents. The field technicians are dispatched to the leakage spot as soon as a customer reports a leakage through the BU call center. With the rising pressure and the possible increase in the number of leakages, the company has to make sure that there are enough field technicians available to secure the spot by taking the necessary security measures. This might mean an increase in the number of the field technicians to counteract the drawback of the increased pressure. But, such an increase in manpower implies an increase in the hiring, which requires an increase in the human resource budget that should be approved by the Gas BU board.

The Gas BU also considers another mechanism for maintaining the safety of its energy services. The initial analyses show that recording and monitoring the past leakages and incidents can help the BU in developing preventative measures that can be deployed to avoid future incidents. To this end, the BU should invest in the design, development and implementation of an IT system that can carry out the functions required for the recording, analysis and monitoring of the incidents in such way that potential future incidents can be predicted and avoided. The approval of the initial investment required for putting such a system in place, is given by the Gas BU's board of directors. Past experiences show that board approvals depend on the profitability of the BU.

Appendix 2 – Guidelines

Guidelines for Developing Cognitive Maps

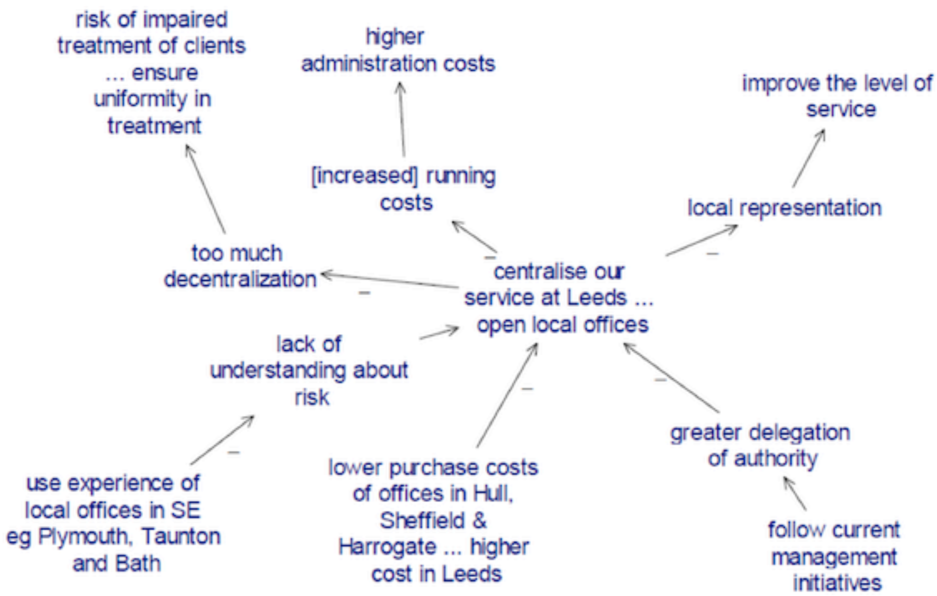
- Read carefully the problem description and make sure you understand the overall situation.
- Confirm your understanding with your partner and the facilitator
- Read it again so you can identify important sentences
- You can write them down, underline them directly in the text, etc.
- Separate these sentences into distinct phrases, and make concepts from these phrases.
- A pair of contrasting phrases may be united in a single concept by using contrasting pole of a concept (the meaning is retained through contrast).
- By discussion with your partner, try to find and write this kind of contrasting poles in the concepts.
- If you cannot find a contrasting pole for an important concept, write it down anyways.
- The concepts (with or without contrasting poles) should be phrases no longer than 10-12 words which together explain the problem.
- These phrases should retain the language from the problem description (avoid abbreviating).
- If you believe that one concept is the cause of the other, connect them by an arrow, where the cause is at the tail of the arrow.
- A network of nodes (concept) and arrows as links should be formed, by connecting the concepts, where the direction of the arrow implies believed causality. The arrows indicate perceived cause and effect relationships and they are of two types:
    - The arrow with no sign (or rarely a + sign) means that the positive pole of the first concept pairing is associated with the positive pole of the second pairing (also for negative with negative)
    - The arrow with a negative sign indicates that the positive pole of the first pairing tends to lead to the negative pole of the second pairing (also negative to positive)
- Cognitive maps should be characterized by a hierarchical structure where goal type statements are at the top of the hierarchy.
- Often it can be found circularity in the map in which a chain of means and ends loops back on itself and this is often regarded as a fundamental structural characteristic of a map.

Example

Example of a cognitive map from an interview transcript (taken from [Getting started with cognitive mapping]) [2]:

"We need to decide on our accommodation arrangements for the York and Humberside region. We could centralize our services at Leeds or open local offices in various parts of the region. The level of service we might be able to provide could well be improved by local representation but we guess that administration costs would be higher and, in this case, it seems likely that running costs will be the most important factor in our decision. The office purchase costs in Hull and Sheffield might however be lower than in Leeds. Additionally we need to ensure uniformity in the treatment of clients in the region and this might be impaired by too much decentralization. However we are not sure how great this risk in this case; experience of local offices in Plymouth, Taunton and Bath in the south east may have something to teach us. Moreover current management initiatives point us in the direction of greater delegation of authority."

The final and complete map from this interview text:



[1] Robert T. Hughes et al., The use of causal mapping in the design of management information systems
[2] Fran Ackermann, Colin Eden and Steve Cropper, Getting Started with Cognitive Mapping
[3] Colin Eden, Analyzing cognitive maps to help structure issues or problems, European Journal of Operational Research 159, pg. 673-686, 2004

Appendix 3 - Questions

Hexagons:
Do we need to define the clusters first?
Can we have the same hexagon twice?
Can we have only one hexagon in a cluster?
Can there be a cluster within a cluster?

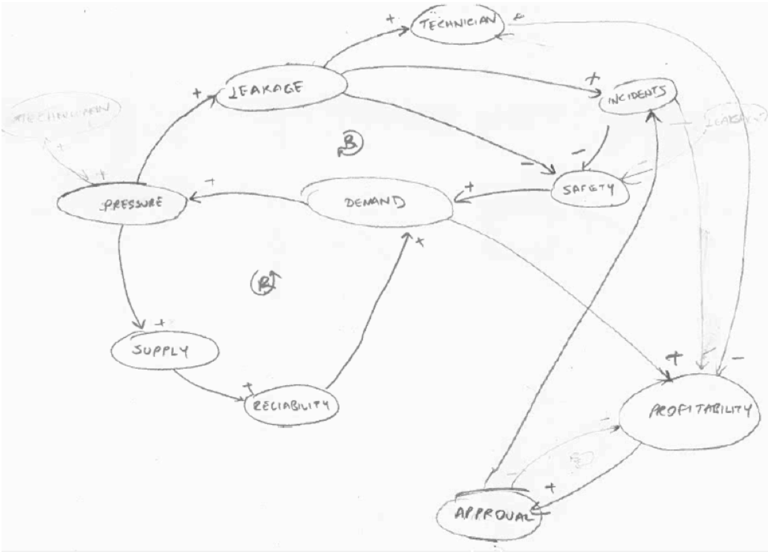
CLD
How many nodes can there be in a loop?
Does the diagram have to be very detailed (more than 6 nodes)?
Can there be two outgoing links from one variable?

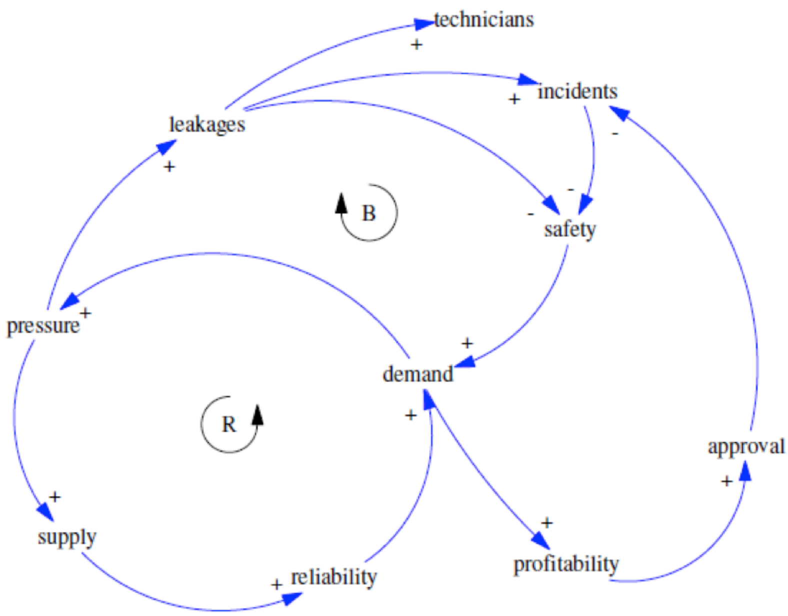
Cognitive Map
Does +/- mean consequence?
Does the - link has a negative meaning?
Does each issue must have a contrasting pole?

ID
What does the dashed lines mean?
Can there be an arrow going outside the loop?

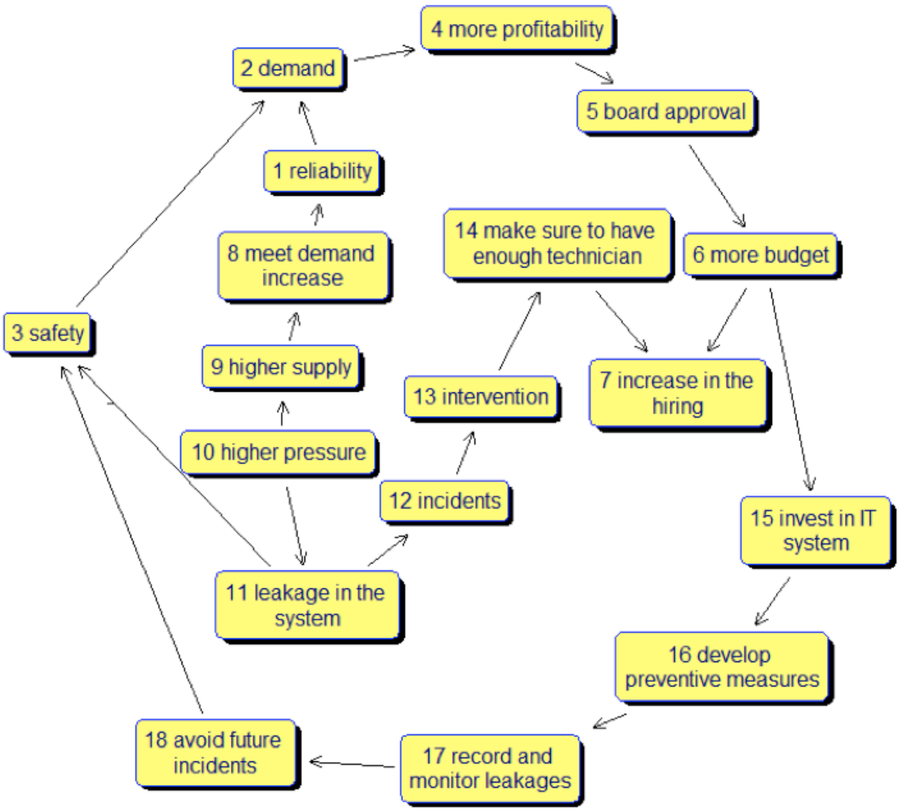
Appendix 4 – Participants' Models

Influence Diagrams

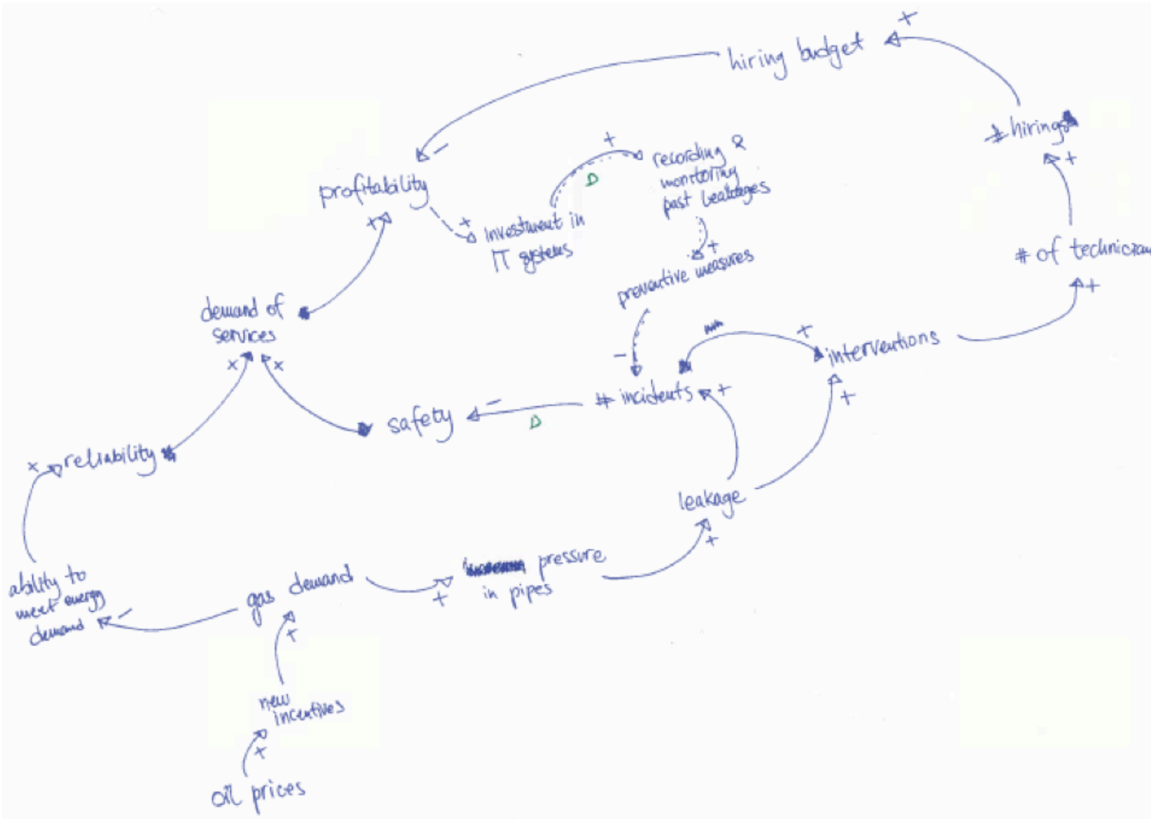


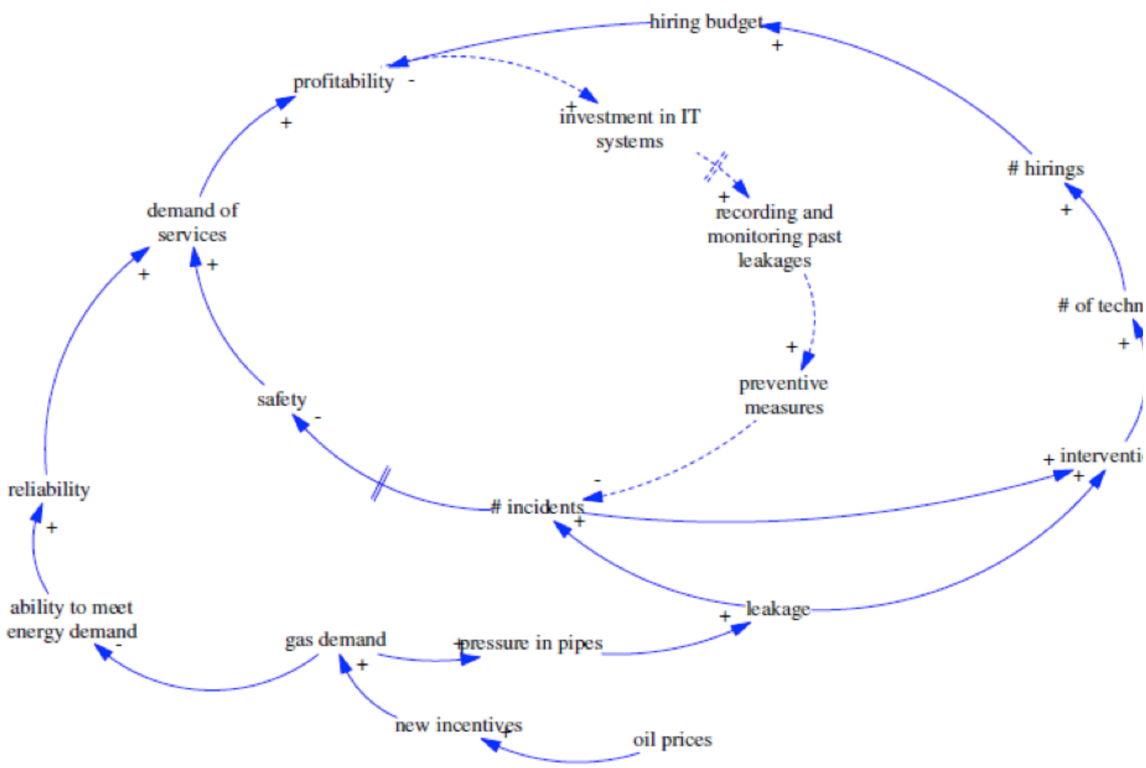


Cognitive Maps

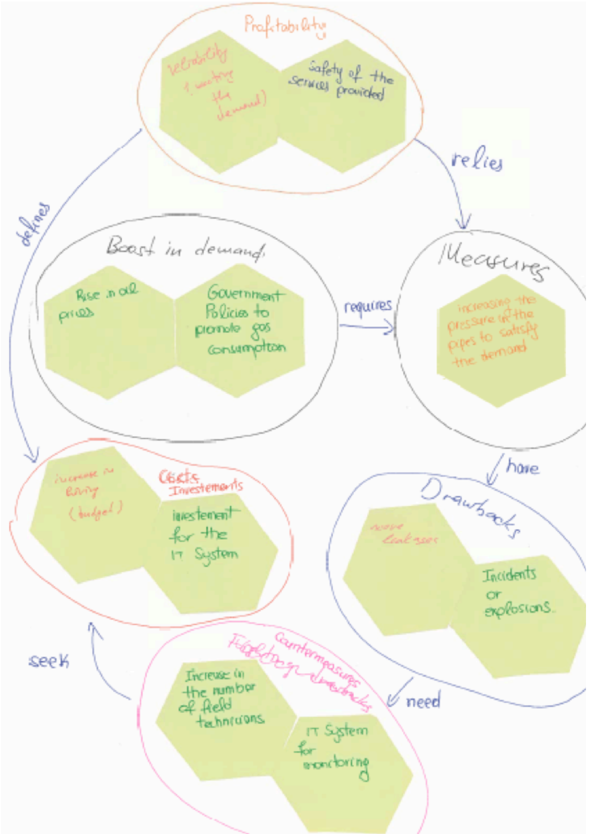


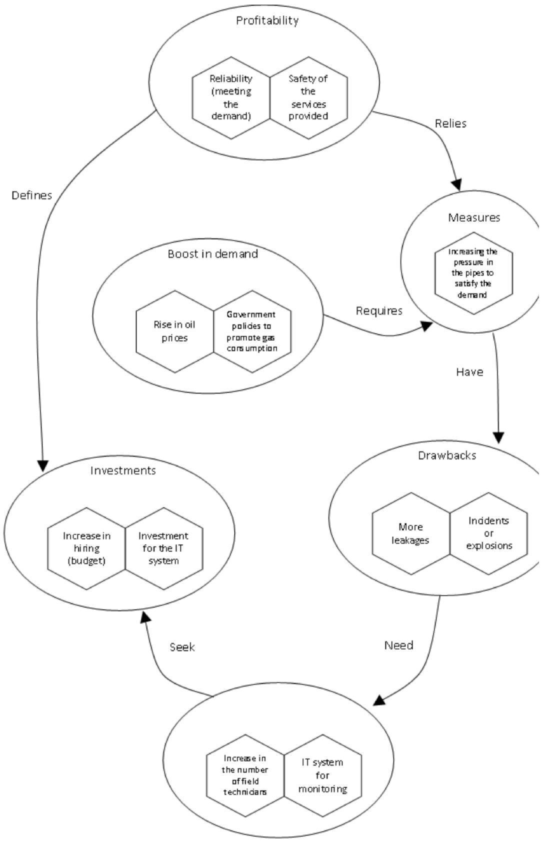
Causal Loop Diagrams



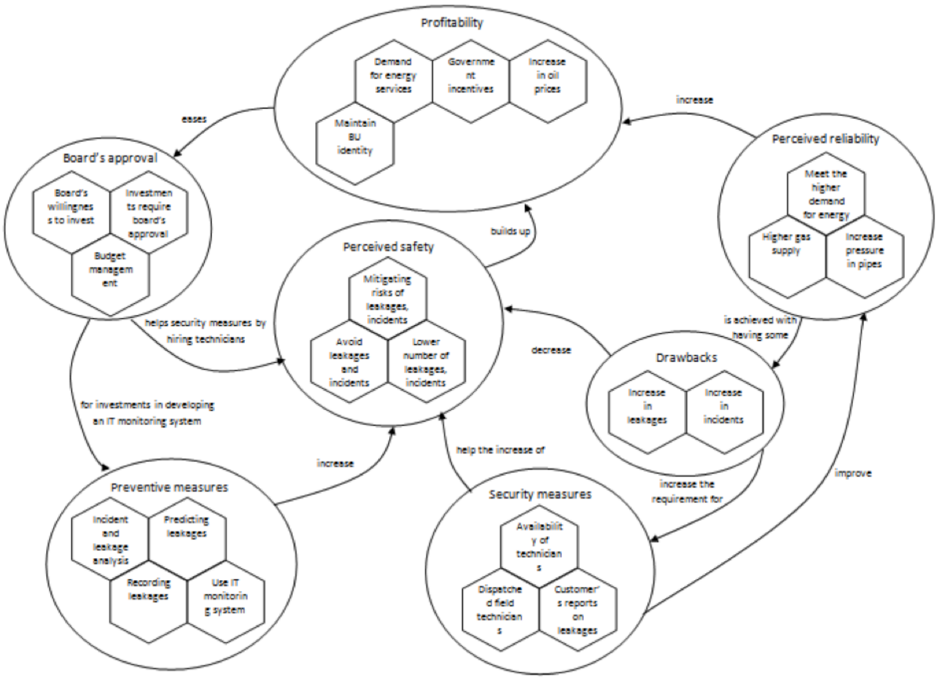


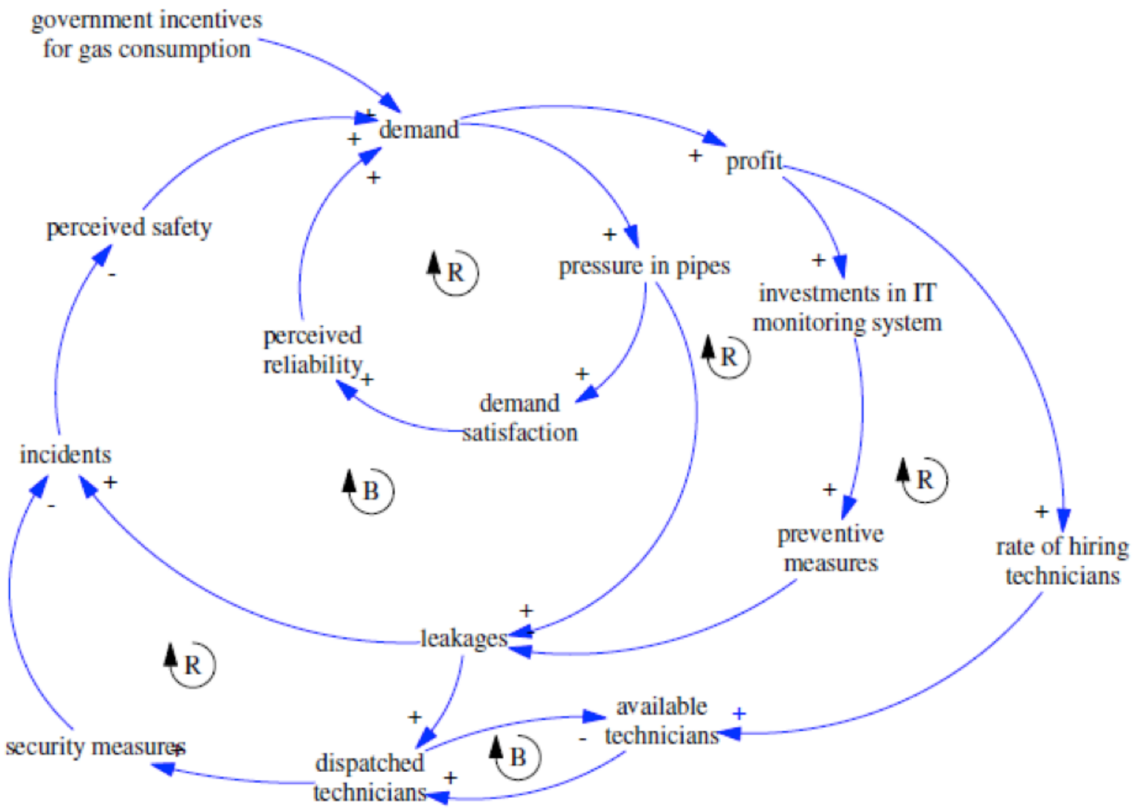
(Magnetic) Hexagons





Appendix 5 – Reference Models





Appendix 6 – Calculations

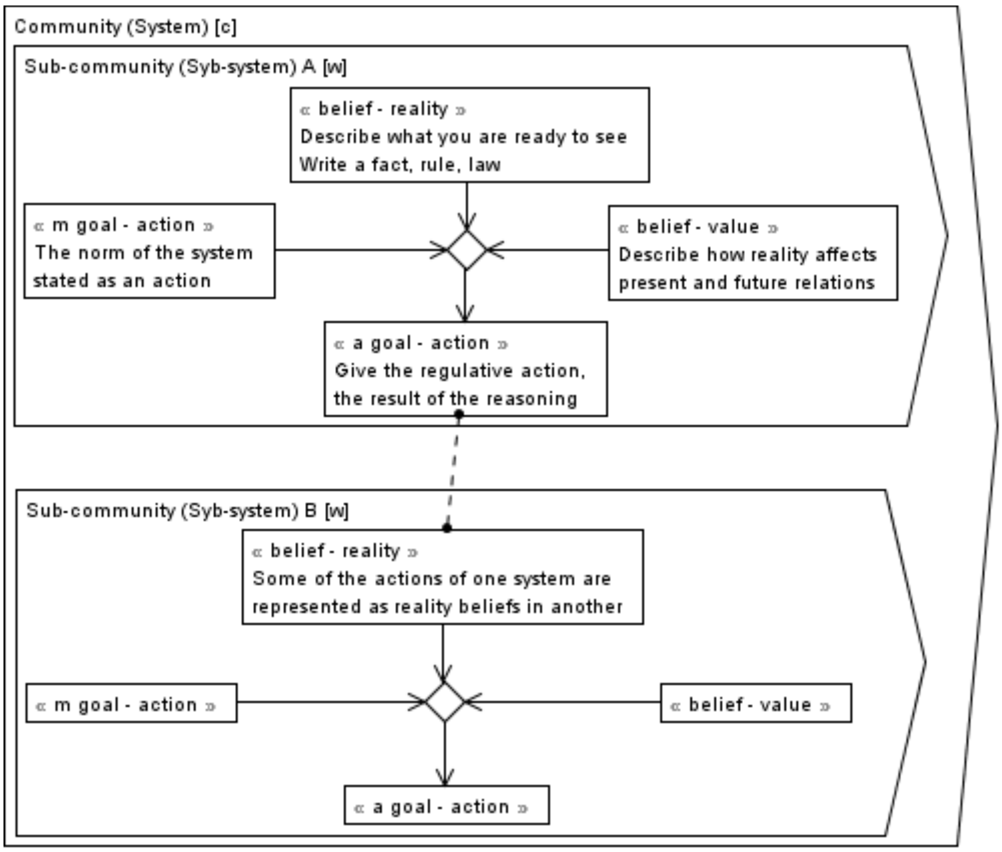
	Main Variables	Group 1	Group 2	Group 3	
1	Demand	0.25	0.5	0.5	
2	Supply	0	0.5	0	
3	Profitability	0.5	0.5	0	
4	Technicians	0.25	0	0.5	
5	Preventive measures	0.5	0	0	
6	IT investments	0.5	0	0.25	
7	Leakages / incidents	0.25	0.25	0.5	
8	Security	0	0	0.5	
9	Safety	0.25	0.25	0.5	
10	Reliability	0.5	0.5	0.25	
	Total (5):	**3.0**	**2.75**	**3.0**	
Additional points for the feedback loops (0.25 point per identified loop):		0.25	0.25	0.5	
Problem situation conceptualization		**3.25**	**3.0**	**3.5**	**3.25**
(Syntactic and Semantic) Correctness:		**4.5**	**4**	**4.5**	**4.33**
Facilitation:		**2**	**3**	**3**	**2.66**
Cognitive Effectiveness (Correctness/Facilitation):					**1.62**

Appendix 7 – Goal-belief Modeling Guidelines and Pictures from the Modeling Session

This Goal-belief model has the following notational elements:

- a **Community** which represents a system
- a **Belief** within a community represents an interpretation of the system. There are two types of beliefs:
    - o **Reality** – this type of belief describes what the enterprise and its stakeholders are ready to notice in themselves and their environment and usually they define what the enterprise is interested in. It represents readiness to see.
    - o **Value** – this type of belief describes how what is noticed will affect present and future relations within the enterprise and within its environment. It represents readiness to value.
- a **Maintenance goal** (super goal) within a community represents a norm of the system
- an **Achievement goal** (sub goal) of a community represents a regulative action the system

Note: the goals are always formulated as actions, meaning that while writing them, verbs must be used to represent the action.
A simple Goal-belief Model is shown on the next Figure:



Here are some guidelines on how to write and model a goal-belief:

1. Prepare yourself

- Get to know the communities well (by communities we mean different departments of the enterprise, or other enterprises that participate in the segment that is being modeled).
- Define and differentiate each of them. Be aware of which one is part of another one. For instance one community is the company, and the departments in that company are the **sub communities**, and they are drawn inside the company.
- Identify the scarce resource (if there are any, but most often, there are)

2. Identify and differentiate super action
   - Define the goal of each community, its purpose, the action that leads to a desired state.
   - While writing these super actions, use verbs in infinitive (make more profit, become a GP…) because this action describes the maintenance of the whole community.
3. Identify the realities in each community
   - These are the beliefs that cannot be changed; those are the facts, rules, laws…
   - While writing these beliefs use active verbs like: is, has, wants etc.
   - Note: the sub action of one community (explained in the next point) may be the condition of doing something in another community. This condition is mapped into a reality belief. But if we are working on the same community, we can also map this sub action into a super (maintenance) action.
   - Hint: if the system we are modeling is consistent of many details, entities, the best thing to do is focus only on the things we are interested in, so we will have the important things, and everything else. This is in alignment with the way of human reasoning.
4. Identify and define the logic that gives the value
   - In other words, this represents what the realities mean to the community in terms of achieving the super goal. Find the appropriate words to express these beliefs. As a guideline so far we have noticed that conditional (if…then…else) statements are used.
5. Reasoning with the help of the above mentioned, give the sub action(s) in each community
   - Every sub action is a consequence of the way the reasoning is modeled using the beliefs and trying to achieve the super action. Try to find the chain that leads to that conclusion. Sometimes, if there isn't a connection between beliefs that lead to a certain sub action, then the model can be wrong, or there is a belief that shouldn't be there, or simply the belief is not written well.
   - Note: if one community depends on another's community actions, like it was said before, map these actions as reality beliefs.
   - Hint: don't forget your super goal. The process of modeling can make you aware of the tiniest details that appear in the enterprise, but very often these details don't play any role in maintaining the super goal, so therefore they are not important.

Pictures from the Goal-Belief Modeling Session

Appendix 8 - Integrating System Dynamics and the Systemic Enterprise Architecture Methodology

Abstract: *The ability of enterprise managers to come up with the decisions leading to the best outcome for the enterprise is hampered by their cognitive limits in understanding and addressing the dynamic and structural complexities residing in choice situations. Dynamic complexities deal with the behavior of the enterprise and its environment over time. Structural complexities, on the other hand, arise from the number of the departments within the enterprise, their interactions and the interactions between the enterprise and the entities across its boundary. The policy aiding methods developed to assist managers in the analysis of choice scenarios address these two types of complexities in separation. In this paper adopting a holistic approach, we integrate Stock and Flow diagram in System Dynamics (SD) - a method for understanding the behavior of systems over time - and the System Diagram in the Systemic Enterprise Architecture Methodology (SEAM) - a modeling method that provides insights into how an enterprise and its interactions with other entities are structured. Integrating SD and SEAM, we present an approach to modeling, analysis and simulation of choice scenarios aiming at reducing the dynamic and structural complexities involved in the decision making process. We illustrate the applicability of our approach by applying it to an example of a choice situation in a manufacturing company.*

1. Introduction

In many cases, managers in enterprises are faced with choice situations where a decision should be made under high levels of uncertainty. In such cases, managers' ability to come up with the decisions leading to the best outcome for the enterprise is hampered by their cognitive limits in understanding and addressing the structural and dynamic complexities of the enterprise. To understand the dynamics and structural complexities we should adopt a systemic view of the enterprise. An enterprise as a system is composed of sub-systems and is embedded in a hierarchy of larger systems such as segments, markets, industry and etc. Structural complexities arise from the number of the subsystems of an enterprise as well as, the interactions within the internal systems and between the internal and external systems across the boundary of an enterprise. The dynamic complexity, on the other hand, deals with the behavior of the enterprise over time (Sanchez & Heene, 2003). In some cases a change in the state of an enterprise system element leads to a chain of reactions by other system elements and may take years to fully play out its effect due to the existence of causal ambiguities and delays (Sterman 2000). There is a significant need for approaches that help managers gain a better understanding of and address such inherent complexities the and thereby come up with decisions that can help the enterprise achieve its strategic objectives.

In this paper we propose an approach to address the challenges arising from decision making in situations of dynamic and structural complexity. Our approach consists of a process that integrates the System Diagram (Rychkova et al., 2007; Wegmann et al., 2007) as a part of the Systemic Architecture Enterprise Model (SEAM) (Wegmann, 2003) and the Stock and Flow diagram in System Dynamics (SD) methodology (Forrester and Wright 1961).

SD is a methodology for understanding the behavior of complex systems over time. It provides fundamental contributions to framing, understanding, and discussing complex issues and problems. System Dynamics originally developed by Jay Forrester's work at MIT in the 1950s, is centered on modeling and simulating complex systems through systemic representation of the system in terms of stocks, flows, and feedback loops. SD methods provide "essential insight into situations of dynamic complexity," especially when experimenting the real systems is impossible or not feasible (Sterman 2000).

SD provides significant insights into the behavior of the system over time but does not provide any implication on how the system elements should be reconfigured to yield a desired behavior. SD, in other words, captures the "what" of the dynamic behavior but does not address "how" the behavior of the system can be modified.

SEAM provides a consistent set of modeling principles and constructs to model an enterprise at different abstraction levels. The System Diagram as a part of SEAM represents the hierarchy of the systems that compose an organization (the departments, management system, etc.) and in which the organization is embedded (value networks, market segments, etc.). It can be used to delimit the problem on focus and identify the decision stakeholders and lead to a better understanding of how an enterprise functions. The System Diagram represents the environment in which the enterprise is embedded and hence creates the possibility and supports modeling of the business strategies. In a System Diagram, an enterprise is viewed as a nested hierarchy of systems. At a micro level we model the *enterprise*, the various *departments* inside the enterprise and the *processes* within each department. At a macro level we model and analyze how enterprises work as a *value network* can cooperate to achieve commercial objectives in a *value segment*. Such systems (i.e. value segments, value networks, enterprises and the departments) can be represented as wholes (black boxes) abstracting the components or composites (white boxes) showing the system components. Whole and composite representation helps the modeler simplify the conceptualization of the structural complexities inherent in the business environments.

Table 1: Comparison of System Dynamics and SEAM

System Dynamics – Stock and Flow Diagram	**SEAM – System Diagram**
Allows interpretation and prediction of the behavior of a system over time (i.e., prescriptive in nature).	Provides a static image of the system elements and the details of their interactions at a point of time. (i.e., descriptive in nature).
Focuses on modeling an issue or a problem. The System Dynamics process starts from a problem to be solved (Forrester & Wright 1961).	Focuses on building models of the enterprise for the purpose of documenting, communicating and sharing an understanding of an enterprise.
Provides a limited set of graphical notations (i.e. stocks, flows and information objects)	Provides a set of constructs and graphical notations to capture systems, information and material flows, processes, and etc.
A model of reality can be built in different ways by different modelers.	Reference models and model building blocks as well as the graphical notations lead to a shared understanding of the model developed.
Suitable for scenario and policy analysis.	Suitable for system design, process reengineering and enterprise integration.
Aims at developing models to assist the understanding of a behavior of system at an aggregate level and thereby helps reduce and address the dynamic complexity.	Assists in the understanding of the system elements and their interactions at different levels of abstraction and thereby helps reduce and address the structural complexity

The System Diagram provides a static image of a state of the system. Enterprise models capture a detailed representation of system in terms of the system elements and their interactions to provide a means of understanding or communicating of the enterprise. The modeler can decompose the enterprise to a consistent set of modules and hence gain a better understanding of and manage the system complexity. The System Diagram in this study has been augmented with notational elements to capture information and material flows in an enterprise and the environment in which it is embedded. In Table 1, we compare the Stock and Flow diagram in System Dynamics with the System Diagram in SEAM.

System Dynamics provides a rigorous basis for modeling the problems in which reside the choice situations as well as developing and comparing various choice scenarios to one another. However, an enterprise may have to reconfigure itself or eliminate the redundant activities in order to be able to achieve the outcomes associated with a desired scenario. By modeling various aspects of an enterprise such as information flows, functions, processes and etc. at different abstraction levels, the System Diagram provides a blue print for an enterprise to migrate from an as-is to a to-be situation yielding the desired outcomes. Moreover, the System Diagram can serve as a good starting point for building a Stock and Flow diagram. A System Diagram provides a rigorous and consistent abstraction of the reality as perceived by the modeler based on which a Stock and Flow diagram can be developed. The System Model accompanying the Stock and Flow diagram can help communicate the context and the focus of the problem and make the model more understandable.

The rest of the paper is structured as follows. In Section 2, we present the proposed six-step process for integrating the System Diagram in SEAM with the Stock and Flow diagram in SD. In order to illustrate the applicability of our proposed approach, in Section 3, we apply it to an example of a choice situation in a manufacturing company. In this example the manufacturing company needs to make a tradeoff between price and delivery lead-time in responding to a request for quotation (RFQ). Finally, in Section 4 we present our conclusions and future work.

2. The Proposed Six-Step Approach

Figure 1 illustrates an overview of the proposed process for integrating the System Diagram in SEAM with the Stock and Flow Diagram in SD. Throughout the process we refer to the System Diagrams as SEAM models. The process consists of six steps. In the first step, we conceptualize the as-is architecture and develop the SEAM models. Then, the Stock and Flow diagram is constructed. We show how the SEAM model of the as-is architecture in an enterprise can help us in building and understanding the Stock and Flow diagram. Next, we develop scenarios that can capture the choice situation. Scenarios are then simulated by means of the Stock and Flow diagram.

In the second step, we check whether the simulation results of the scenarios have led us to the identification of the problem residing in the as-is architecture. If a problem is identified we proceed to the third step, otherwise we are facing one of the following situations:

1) the current model (i.e. as-is architecture, the Stock and Flow and the scenarios) does not capture the existing problem. In this case, the model needs to be re-scoped which means perhaps we need to go to a higher or lower level of abstraction.

2) no problem exists and the model reflects the right abstraction of the reality as perceived by the modeler. In this case, the process terminates, otherwise we proceed to the third step.

The third step comprises two activities: 1) solution scanning, that involves generating all the alternatives that can serve as a solution to the identified existing problem, and 2) selection of a solution that has the potential to address the identified problem. Similar to step 2, if a solution cannot be found we probably need to re-scope the model.

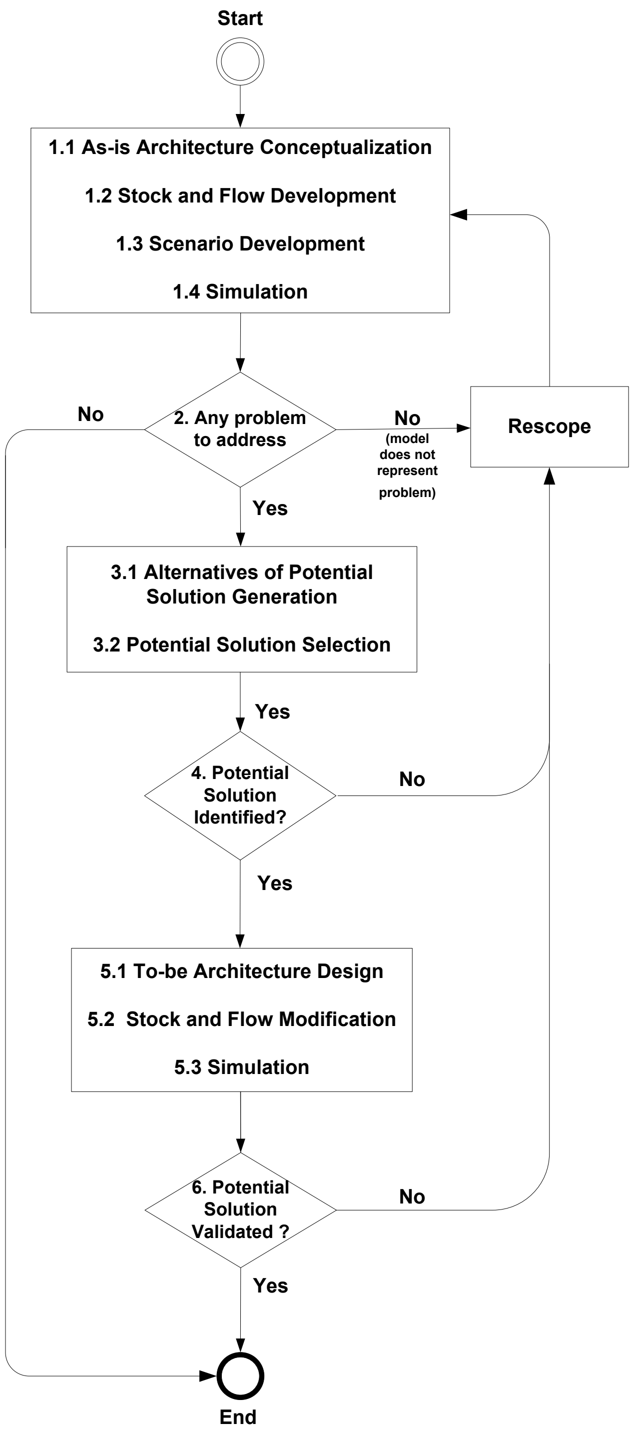


Figure 1: The proposed six-step process for integrating SEAM with SD

In the fifth step, we design a to-be architecture based on the potential solution identified, modify the Stock and Flow diagram and re-run the simulation. Finally, we check whether or not the to-be architecture is validated (i.e. the problems in the as-is architecture are tackled). If so, the process is terminated, otherwise we need to re-scope the model.

3. Integrating SEAM and SD: the Example of BE Co.

To illustrate the applicability of our proposed approach and provide practical insights into how SEAM can be integrated with SD we apply the six-step approach as presented in Section 1 to the example of a choice situation in a manufacturing company called BE Co. This example is based on a case inspired by a real company.

BE Co. (Best Engine Company) is specialized in designing, manufacturing and servicing diesel engines for light aircraft. NewPlane SA which is one of the most promising plane manufacturer companies in the aeronautic business has decided to buy 240 units of aircraft diesel engines over a two-year period. NewPlane SA has sent a request for quotation (RFQ) to BE Co. and its all time competitor QEng Co. (Quality Engine Company). BE Co. has had a number of experiences taking part in the tenders organized by NewPlane SA and it also has a good knowledge of the market in particular its competitor QEng Co. On this basis, BE Co. holds the following assumptions:

- NewPlane SA always chooses to source its demand from at least two suppliers.
- Diesel engines for light aircrafts are also supplied by QEng Co. Hence, the demand for 240 units of engines is going to be split between the two companies.
- As there is not considerable quality difference between the engines it manufactures and the ones manufactured by QEng Co., NewPlane SA makes its choice on the basis of delivery lead-time and price.
- QEng Co.'s price can range from 120 to 140 K USD for each unit of engine and the delivery lead-time is between 3 to 5 months.

BE Co. has to procure the engine parts from the suppliers. For the sake of simplicity we assume that only two types of parts are required for engine manufacturing: a kit and a mount. BE Co. has to figure out the right tradeoff between the lead-time and price to get the maximum number of orders at a competitive price and lead-time while ensuring profitability.

3.1 Step 1

This step comprises of the following activities: conceptualization of the as-is architecture, constructing the stock and flow diagram and finally, development and simulation of scenarios.

3.1.1 As-is Architecture Conceptualization

In this step we apply SEAM to conceptualize the as-is architecture of BE Co. Before explaining the as-is architecture, we briefly present a number of modeling principles used to develop the as-is architecture.

In SEAM block arrows represent systems. When modeling a business context we represent a company and its value network as systems. A value network is a group of companies that collaborate and pursue a common commercial objective. Systems can be represented as a whole (black box view of a system) denoted by [w] or as a composite (white box view of a system) denoted by [c]. Modeling a system as a whole, the system components and their interactions are abstracted. Instead, the system's emergent actions and properties that conceptualize the overall behavior of the system are observed. On the other hand, when a system is modeled as a composite, its structure, component systems and their interactions are viewed.

Figure 2 is a representation of the as-is architecture of BE Co. value network as composite. Modeling a value network as a composite, we capture the interactions between the companies inside the value network to gain a better understanding of how the companies cooperate to deliver a product or service to the customer. In Figure 2, inside the value network we have modeled BE Co., Mount Supplier X and Kit Supplier Y as wholes, thereby showing their emergent processes and abstracting the details of the processes and the departments inside each company. In SEAM, a process is represented by an ellipse. As shown in Figure 2, BE Co. has the core process of "Engine design, manufacturing and sales" and the "Order setting" processes that recur for kits and mounts. Since, BE Co. is within the scope of our analysis we have modeled the processes of the other entities within BE Co. value network to the extent that fits our purpose of analysis.

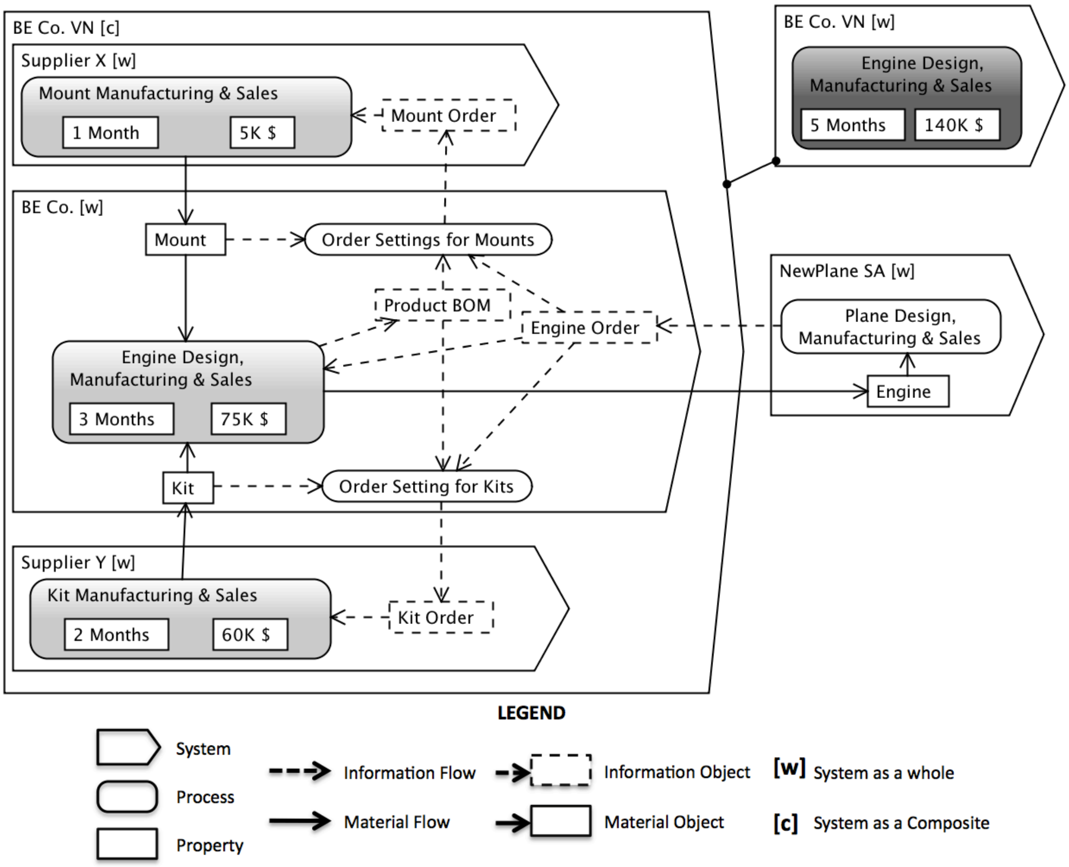


Figure 2: BE Co. Value Network as a composite (as-is architecture)

Modeling a system as a whole we can also represent its emergent properties. Emergent properties can be material and/or information that are output and/input of processes. Inspired by the work of (Dori 2002), material or information properties are respectively denoted by double line and single line rectangles. In Figure 2, an "Engine Order" is an information property that is inputted to the "Engine design, manufacturing and sales" process within Be Co. This process, in turn, outputs the "Product BOM" as an information property which triggers the "Order Setting" process for mounts and kits. Similarly the orders placed by BE Co. (i.e. information property) serve as the inputs that trigger the "Manufacturing" process within Supplier X and Supplier Y company which output “Kit” and “Mount” as material properties. Other sections of the model can be interpreted the same way.

The inflow and outflow of material and information properties are captured by dashed and dotted lines respectively. The dotted line from “Engine order” information property and “Kit” and “Mount” material properties to the “Order setting” processes imply that the “Order setting process” operates on the basis of the information inputs from these entities.

Processes also have emergent properties. In the case of the companies within BE Co. value network such emergent properties are the delivery lead-time and price. The overall performance of the companies within the value network is also captured as a process when the value network is viewed as a whole (black-box). As it can be seen in the model in Figure 2, with the current lineup of suppliers, BE Co. can deliver the engine at the price of 140 in a 4-month period. When modeling a value network, we also represent the customer. In Figure 2, we can see the flow of orders and engines between NewPlanes SA and BE Co.

3.1.2 Stock and Flow Development

At this step we develop the Stock and Flow diagram. Figure 3 exhibits the Stock and Flow diagram of BE Co. supply chain. As mentioned earlier, the SEAM model can provide useful insights into developing the SD model. More precisely, the *processes* in the SEAM models correspond to the *rates* in the stock. In addition, the *information* and *material properties* can be mapped onto the *stocks*. Further, the flow structure is almost similar in both Stock and Flow diagram and the enterprise model. As an instance to clarify this similarity, “Kit order rate” in the Stock and Flow diagram corresponds to the “order setting for kits” process in the enterprise model and the “Kits ordered by BE Co.” stock can be mapped onto the “Kit Order” information property in the enterprise model. The mapping between “Kit manufacturing and delivery” rate in the Stock and Flow diagram and “Kit manufacturing and sales” process in the enterprise model can be interpreted the same way. As it can be seen in Figure 3, we have structured the Stock and Flow diagram in such way that the commonalities can be easily identified.

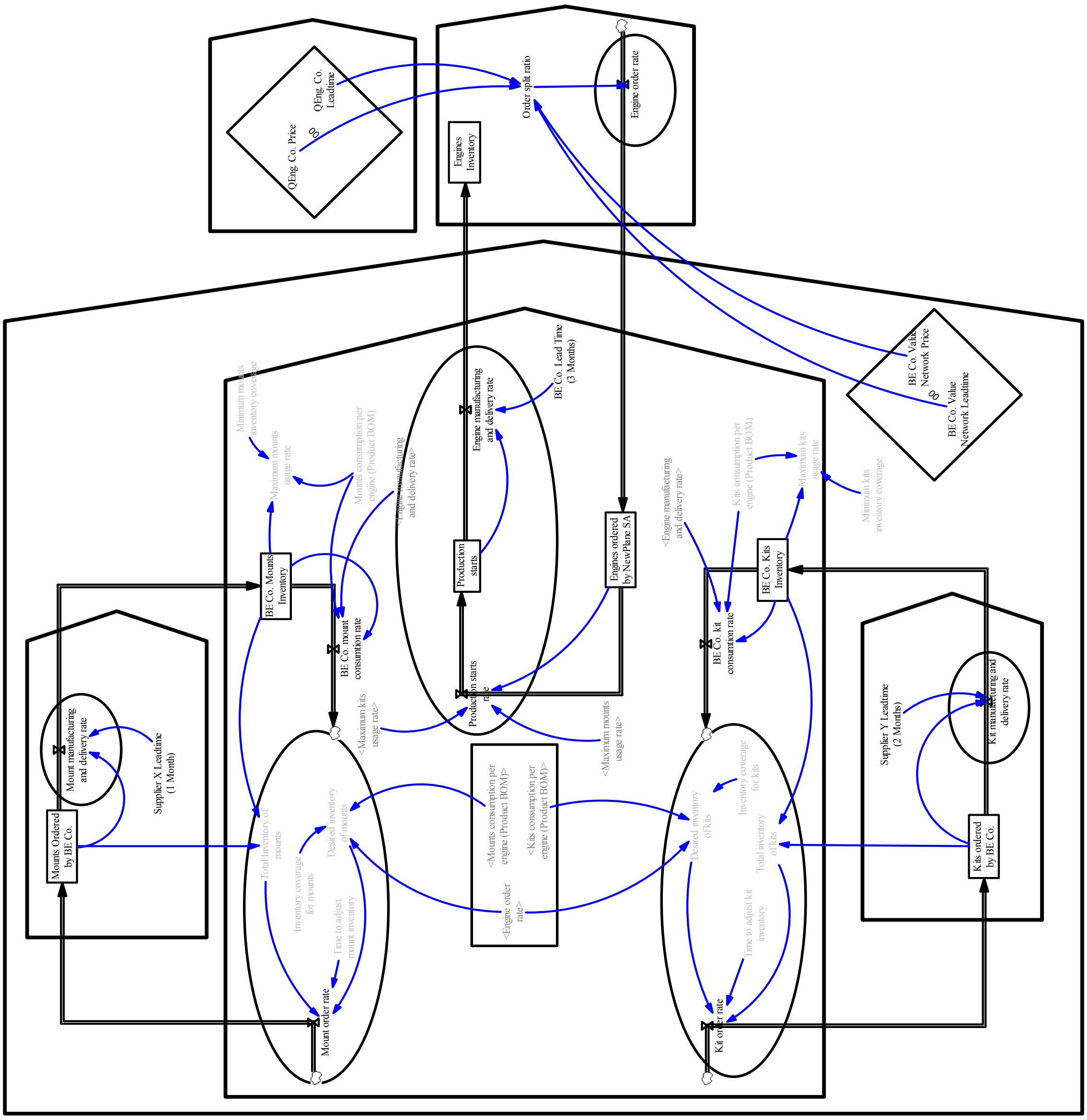


Figure 3: BE Co. Value Network as a composite - Stock and Flow diagram capturing the production aspects

We use the Stock and Flow diagram in Figure 4 to model the cash inflow and outflow in BE Co. In this model, by OpEx we refer to the operating expenses. The operating expenses for the production of each engine is 50 K USD. We have also assumed that the engine manufacturer pays the suppliers when its engines are sold to NewPlanes SA.

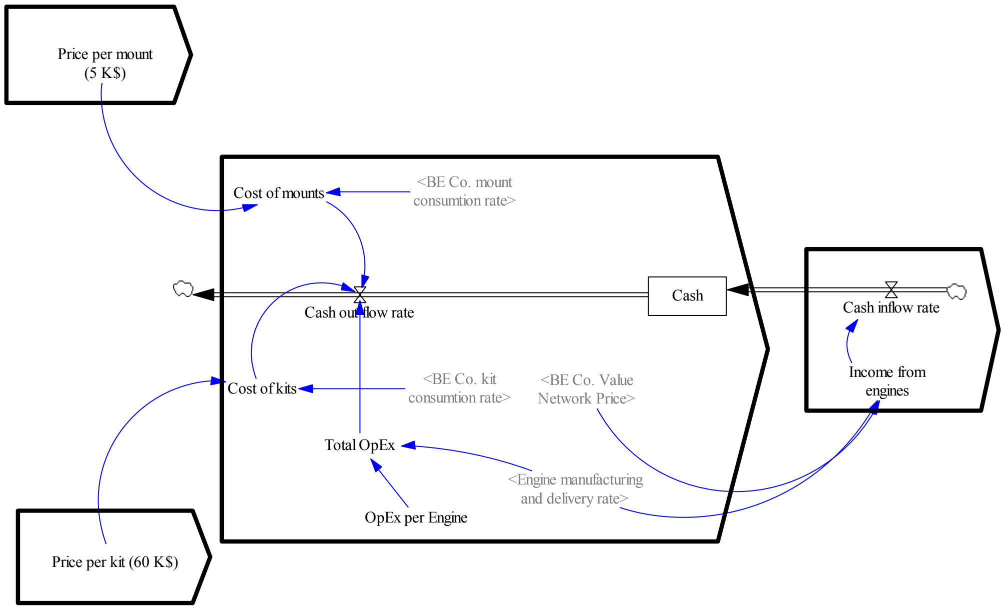


Figure 4: BE Co Value Network as a composite - Stock and Flow diagram capturing the financial aspects

3.1.3 Scenario Development

As mentioned earlier, BE Co. knows that the orders it can win from NewPlanes SA is a function of its lead-time and price relative to the lead-time and the price of QEng Co. Hence, to develop the scenarios inspired by the work of (Kim 1998), a nonlinear demand split function that can estimate order quantities for BE Co. and QEng Co. is used. By being nonlinear, the impact of the price and lead-time factors of a company on the orders won becomes disproportionate. Thereby, a slightly better lead-time or price can lead to a considerable increase proportion of the demand. The non-linear function we applied in our model is a power function. We have formulated the order split ratio for BE Co. as follows:

$$\text{BE Co.'s Order Ratio} = \frac{(\text{QEng. Co. Leadtime} * \text{QEng. Co. Price})^2}{(\text{BE Co. Lead} - \text{time} * \text{ BE Co. Price})^2 + (\text{QEng. Co. Leadtime} * \text{QEng. Co. Price})^2}$$

Based on the assumptions, QEng Co.'s price ranges between 120- 140 K USD with the delivery lead-time of 3 to 5 months for each unit of engine. On this basis we have developed two scenarios for BE Co. with the as-is price of 140 K USD and the delivery lead-time of 5 months. Table 2 summarizes these scenarios.

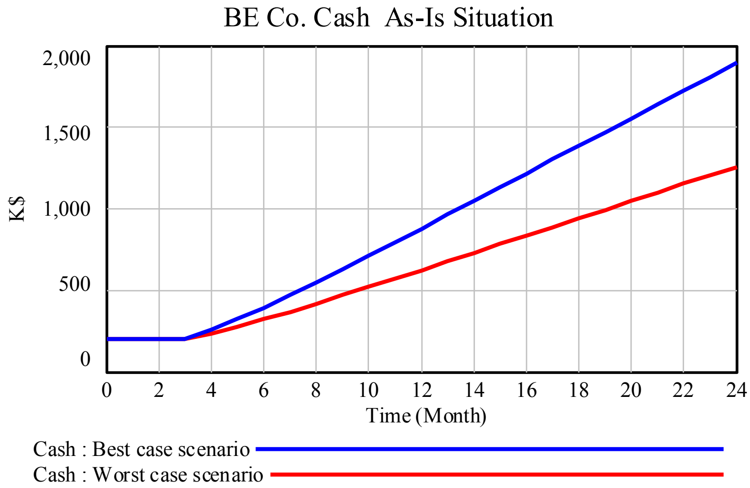
In Table 2, best case scenario means that if QEng Co.'s lead-time and price is 5 months and 120K USD respectively, the best case has occurred for BE Co. In that case, BE Co. can get a higher demand split ratio. It should be noted that since there is a tradeoff between price and lead-time it is not possible to decrease the lead-time and price simultaneously.

Table 2: The two scenarios

Scenario \ QEng Co.	Lead-time (Months)	Price (K USD)
Best case scenario	5	120
Worst case scenario	3	140

3.1.4 Simulation

We have simulated the cash level at BE Co. over a 2 years (24 month) period of time for the two scenarios. The results of the simulation are illustrated in Figure 5.



Actual Cash Level BCS: 1800 K$
Actual Cash Level WCS: 1200 K$

Expected cash level (3000 K$)
is not reached → problem

Figure 5: BE Co.'s cash level over a two year period of time for the as-is situation

3.2 Step 2 Any Problem to Address?

With the as-is architecture, and in the best case scenario (BCS) BE Co. can only get around 80 orders (around 42 % of the total orders) and reach 1,800 K USD level of cash which is far below expected cash level of 3000 K$. The expected cash level if calculated considering the rest of the expenditures BE Co. has such as CapEx (Capital Expenditures) and etc. Hence, it is apparent that a problem has been identified.

3.3 Step 3

In this step we develop alternatives to the potential solution and select the solution to be implemented.

3.3.1 Alternatives of Potential Solution Generation

In Step 2 BE Co. realized that with its current lead-time and price it can not win enough engine orders to reach its expected cash level. Hence, it has to reduce its lead-time or price in order to be able to capture a larger proportion of NewPlanes SA orders and thereby raise its level of cash. For BE Co. it is evident that reducing the price is out of question as the price it is planning to quite is very competitive. Hence, based on the model so, BE Co. can pursue two different strategies that can serve as solution alternatives.

Table 3: Solution alternatives for BE Co.

Solution Alternatives	
1	Reduce the supply lead-time for kits (currently 2 months) – no need to change part lead-time as not in critical path
2	Reduce its manufacturing cycle time (currently 3 months)

Since BE Co. has been engaged in a long time partnership with its suppliers and has in fact invested in training programs in its supplier companies to enhance the quality of the parts supplied, changing suppliers will not be feasible at all. Hence, it has to reengineer its internal process to improve its as-is situation.

3.4 Re-scope

As the current model scope the (i.e. the as-is architecture, the Stock and Flow and the scenarios) does not capture the details of the internal processes at BE Co., we need to re-scope the model in order to be able to select a solution based on which the to-be architecture can be designed. Hence we move back to Step 1.To gain an insight into the internal processes within BE Co. and to find out whether or not any improvement can be made we conceptualize BE Co. as a composite. Figure 6 presents a SEAM model of BE Co. as a composite.

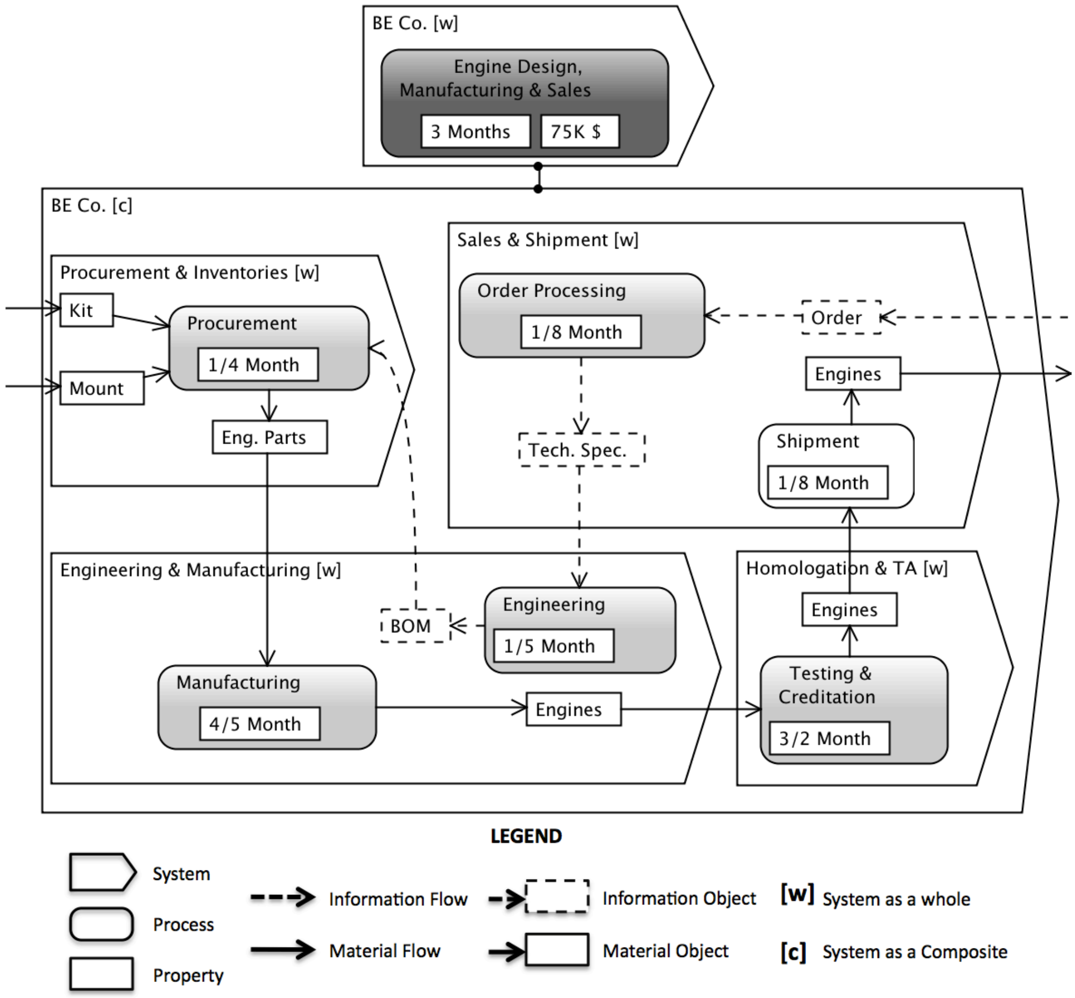


Figure 6: BE Co. as a composite

The composite view of BE Co. provides useful insights into the consituent sub-processes of “Engine design, manufacturing and sales” process which is the emergent process in the BE. Co as whole. As we can see the core emergent process of “Engine design, manufacturing and sales” is now decomposed to six sub-processes (i.e. Order Processing, Engineering, Procurement, Manufacturing, Testing and Accreditation and Shipment) carried out in four departments (Sales and Shipment, Engineering and Manufacturing, Procurement and Inventories, Homologation and Type Approval).

As this change in the as-is architecture does not precipitate any change in the structure of the Stock and Flow diagram, the previous Stock and Flow diagram can remain intact and no modification is required. In Step 2, we have the identified problem of long lead-time and high price. In step 3, we generate the potential solution alternatives based on the re-scoped model.

Table 4 summarizes the solution alternatives (2.1 to 2.4) that have the potential of addressing the problem no. 2 identified in step 2.

Table 4: Solution alternatives for BE Co. – Model re-scoped

Potential Solution Alternatives	
2.1	Reducing the 1 Month manufacturing lead-time
2.2	Reducing the 1/4 month Sales and Shipment lead-time
2.3	Reducing the 1/4 month Procurement lead-time
2.4	Reducing the 3/2 months Testing and Homologation lead-time

After scanning all possible solutions to the problem, we now evaluate the solution alternatives in order to come up with the solution that can meet an initial feasibility criteria.

Solution 2.1: Reducing the 1 Month Engineering and Manufacturing lead-time.

BE Co. has recently invested in manufacturing equipment such as automated guided vehicles (AGV) that led to a major reduction in its manufacturing cycle time. An effort to further decrease the manufacturing cycle time required an additional capital expenditure of 1,300 K USD to increase the automation level of the production line by employing a flexible manufacturing system (FMS). This will also require training courses for the engineering and manufacturing personnel. Altogether, BE Co.’s management is not willing to move towards this solution due to the high level of investment and the time required to move up the learning curve.

Solution 2.2: Reducing the 1/4 month Sales and Shipment lead-time.

Order processing involves a careful elicitation of the customer requirements and sending the technical specification requirements to the engineering department. The shipment process, on the other hand, involves the packaging and preparation of the required paper work for the product to be shipped to the customer. The one-week deadline has been achieved after years of experience in BE Co. and cannot be squeezed any further.

Solution 2.3: Reducing the 1/4 month Procurement lead-time.

The procurement process is composed of sending RFQs to the suppliers, receiving feedbacks and placing orders and takes almost a week in BE Co. It normally takes the suppliers a couple of working days to respond to the RFQs sent by BE Co. their quotations should then be analyzed by BE Co. and orders are then placed accordingly. Since a part of this one-week lead-time is geared to the response time by the suppliers, it is not possible for BE Co. to decrease it.

Solution2.4: Reducing the 3/2 months Testing and Homologation lead-time

Regulation plays an important role in the aeronautics business. Aircraft engine manufactures need to conduct a wide variety of tests on their engines to ensure that their engines conform to the safety standards and emission level requirements. The test results need to be accredited by a third party so that the engines can be homologated and type approved. Currently BE Co. carries out all the tests and sends the test results to an accreditor. BE Co. can reduce the testing time by one month if it outsources the testing as well as the homologation activities to a third party tester and accreditor.

3.5 Step 4 Potential Solution Identified?

As outsourcing the testing and homologation was selected as a potential we move on to the next step.

3.6. Step 5

In this step we design the to-be architecture and modify the Stock and Flow diagram accordingly.

3.6.1 To-be Architecture Design

As outsourcing the testing and accreditation was selected by BE Co. as a solution that can contribute to shortening the lead-time, the to-be architecture is designed accordingly. Figure 7 depicts the to-be architecture of BE Co.'s value network. As it can be seen Tester and Accreditor Co. is the new entity that is introduced in this model. BE Co. sends the manufactured engines to Tester and Accreditor Co. and the required homologation documentation is sent back to Be Co. in about two weeks. As it can be seen, this re-configuration leads to a month of reduction in lead-time and an increase of 15 K$ in the price.

3.6.2 Stock and Flow Modification

Be Co.'s price and lead-time in the to-be situation will respectively be 155 K USD and 4 Months. We modify the Stock and Flow accordingly.

3.6.3 Simulation

We run the simulation of the Stock and Flow Diagram that captures the to-be architecture to see whether the results lead to any improvement in terms of bridging the gap between the actual and the expected cash level.

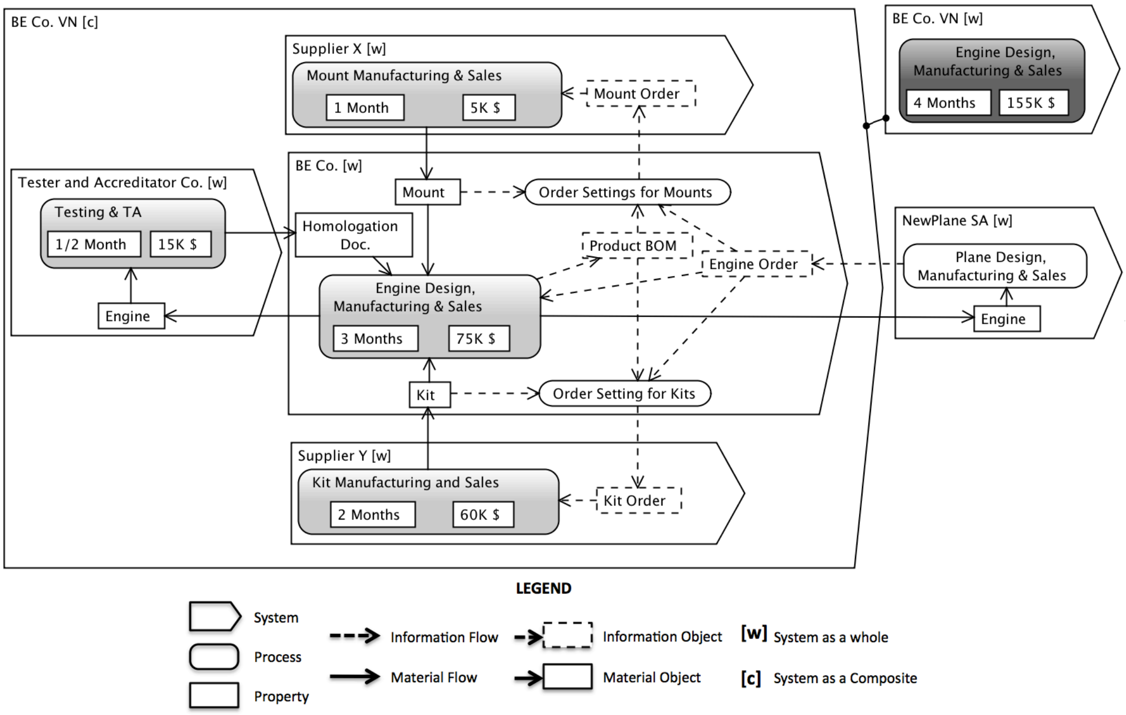
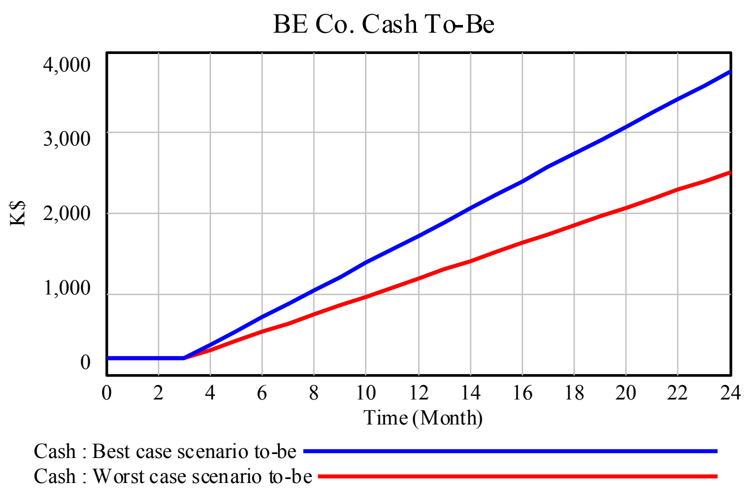


Figure 7: BE Co- Value Network (to-be architecture)

3.7 Potential Solution Validated?

Figure 8 compares the scenarios in Table 2 for the to-be architecture. As it can be noticed, the to-be scenario yields satisfactory results in terms of the cash level. Comparing the best case scenarios of the as-is and the to-be architectures, BE Co. can almost capture 50% of the orders placed by NewPlanes SA and double its stock of cash.



Actual Cash Level BCS: 3800 K$

Actual Cash Level WCS: 2500 K$

Expected Cash Level (3000 K$) achieved.

Figure 8: BE Co.'s cash level over a two year period of time for the to-be architecture

4. Conclusions

In this paper we presented an approach for dealing with structural and dynamic complexities in choice situations. Our approach consists of a six-step process in which we migrate from an as-is to a to-be architecture that incorporates a selected solution to an existing problem in the as-is architecture. We adopted the view of an enterprise as a system composed of subsystems (such as departments) which is in turn nested in a hierarchy of a larger systems such as value networks. This view enables a multi-scope analysis that can be conducted in order to address the various structural complexities. Such complexities can arise from the interactions between the entities within the enterprise as well as the interactions of the enterprise with the entities outside its boundary. Hence, identifying the problem in the as-is architecture and designing a to-be architecture that can address the problem an iterative re-scoping of the conceptualization should be done.

The System Diagram in Systemic Enterprise Architecture Methodology (SEAM) equips us with the ability to conceptualize and design the architectures at different levels of abstractions. SD on the other hand created the possibility of problem identification and solution validation through simulation of scenarios. The Models in this paper were developed by a computer-aided design (CAD) tool, SeamCAD. Figure 9 shows the user interface of SeamCAD.

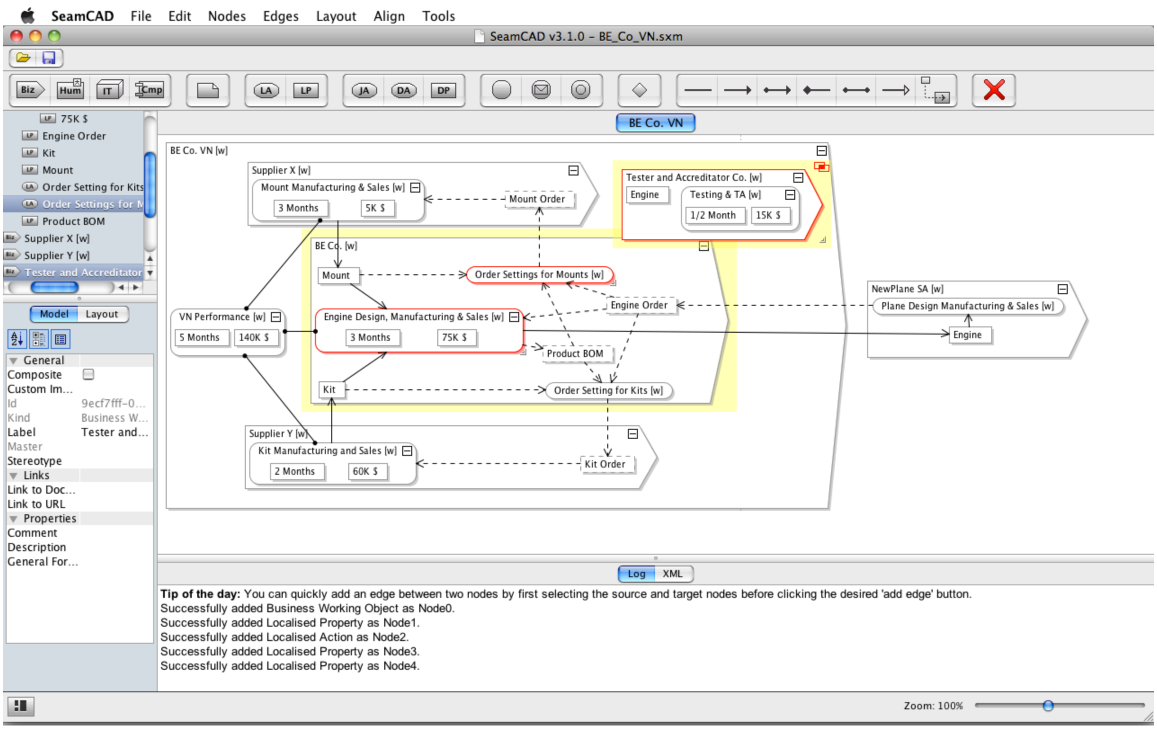


Figure 9. SEAM-CAD user interface

Our future work focuses on applying our approach to a prospective business case to check its applicability in real business settings. We will also examine how a better mapping between our enterprise modeling approach and SD can be made and how the two techniques can complement one another. Exploring the relationship between the modeling approaches can lead to significant insights into how the two methods can be integrated.

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Chapter 6: Integrating SEAM with the Analytic Hierarchy Process: A Pilot Study in a Large Swiss Bank

Abstract. *This chapter reports on a pilot study of the integration between the Systemic Enterprise Architecture Method (SEAM) and the Analytic Hierarchy Process (AHP) in a requirements engineering project. The objective of the project, conducted Credit Suisse, one of the major banks in Switzerland, was to select a common SOA tool that could satisfy the needs of two of the bank's main business units, investment and private banking. SEAM provided help in identifying stakeholders, eliciting their requirements, and analyzing these requirements. The resulting requirements were then grouped and translated into selection criteria for the alternative SOA tools. Based on these criteria, the stakeholders chose the tool to be purchased using AHP. We describe the project, the challenges we faced and the lessons learned. These relate to the nature and traceability of requirements, to the requirements elicitation process and to the relations between the bank's business units.*

1. Introduction

The project described in this chapter was done in Credit Suisse, a global bank headquartered in Zurich, Switzerland, hereafter referred to as the bank, from February to August 2011. The goal of the project was to select a Service Oriented Architecture (SOA) tool for the bank. The bank needed methodological support to insure that the SOA tool, to be selected, will fit the requirements of both the Investment Banking and Private Banking business units. We took this opportunity to propose a pilot study in the use of SEAM, the Enterprise Architecture Method (Wegmann, 2003; Wegmann et al., 2007a) developed by our research group, and AHP (Saaty, 1980) a well-known multi-criteria decision making method (MCDM). The application of AHP for requirements prioritization in requirements engineering dates back to 1990's, see for e.g. (Ryan & Karlssson, 1997). We have used SEAM in numerous projects in industry and have begun to use AHP as well but this project is the first time where we tried to integrate both methods.

To report on the process the results and the findings of the pilot study, we have organized our discussions in the following way. In Section 2 we provide some background information about the bank and the context of the pilot study. Section 3 describes the process of the pilot study conducted to select the SOA tool. We present our findings and recommendations in Section 4 and Section 5 includes our conclusions and proposed future steps. Please note that the contents of this chapter express the view of the authors and not of the bank.

2. The Context of the Pilot Study

The bank is a global organization with operations all over the globe, employing about 50,000 people. The project was conducted in its IT department in Switzerland. The IT department provides services to all the bank's departments, including two of its main business units, Private Banking and Investment Banking. Private Banking offers comprehensive advice and a broad range of financial solutions to private, corporate and institutional clients. Investment Banking provides a broad range of financial products and services, with a focus on businesses that are client-driven, flow-based and capital-efficient. The Investment Banking clients include corporations, governments, pension funds and institutions around the world.

To ensure agility and to achieve logical and operational decoupling, the bank implemented a component-based architecture in the late 1990's using CORBA (CORBA, 2013). This architecture was not homogeneously adopted by the Private Banking and Investment Banking business units. Whereas it was widely used in Private Banking, it was much less used in Investment Banking because Investment Banking believed that this architecture did not fit its needs. The Investment Banking culture is more oriented toward rapid implementation. CORBA was believed to induce lengthy development cycles, which are not compatible with the Investment Banking need for speed. On the technical side, CORBA was rapidly becoming obsolete being supplanted in most organizations by SOA.

To overcome these two problems, the bank started planning to roll out a global modern SOA implementation project connecting all its local and international branches, in order to serve clients across business units with integrated solutions via services. The bank had to choose a new technology fulfilling the requirements of both Private Banking and Investment Banking. The project was initiated in order to select a modern SOA tool to replace the older CORBA based solution.

One of the main components of SOA is known as the Web Services Description Language (WSDL) (WSDL, 2013). WSDL specifies a service and its interfaces. Recently, the web services concept was enhanced with the WSDL 2.0 standard, which addresses the "platform independent" aspects of SOA.

The initial assumption in the project was that adopting a WSDL 2.0 compliant tool will convince Investment Banking of the benefits of SOA via advanced web services. The aim of the project was therefore to select the SOA tool, preferably WSLD 2.0 compliant, that will fit the requirements of both Private and Investment Banking. To help with the methodological aspect of the project, we proposed to use SEAM and AHP. SEAM is an enterprise architecture method that enables modeling an organization from its position in a market segment down to the IT services and structure.

AHP is a Multicriteria Decision Making Method (MCDM) that aids in the ranking and evaluation of alternatives based on a given number of criteria. MCDM methods are characterized by the evaluation of a finite set of alternatives based on multiple criteria. The main objective of an MCDM method is to measure the overall preference values of the alternatives. In the AHP process, after identifying the criteria and the alternatives, the decision makers conduct pairwise comparisons of criteria. This way, the weight for each criterion is calculated. Next, the decision makers do pair-wise comparisons of the alternatives based on each criterion. For more on the algebraic calculations in the AHP process, refer to (Saaty, 1980).

In the context of this project, SEAM models contributed to the identification of the decision makers who do the pair-wise comparisons (i.e., the project stakeholders) and the decision criteria (i.e., the requirements of the stakeholders). Thus, the information captured by SEAM models served as an input to the AHP.

3. The SOA Tool Selection Process

Figure 1 depicts the steps taken in the project to define the selection criteria for the SOA tool.

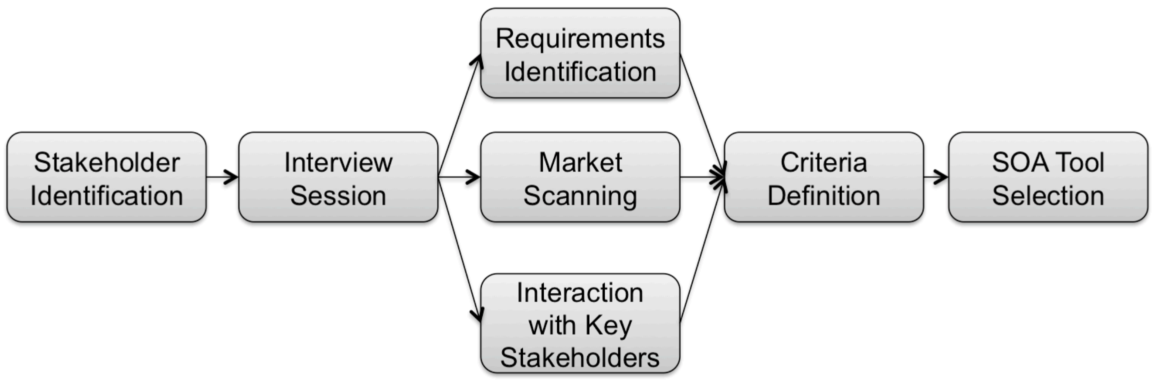

Figure 1. The SOA Tool Selection Process

3.1. Stakeholder Identification

As illustrated in Figure 1, the first step in the project was to identify the stakeholders. To this end, the IT systems of the Private Banking and the Investment Banking were modeled using the System Diagram (Rychkova et al., 2007; Wegmann et al., 2007b).

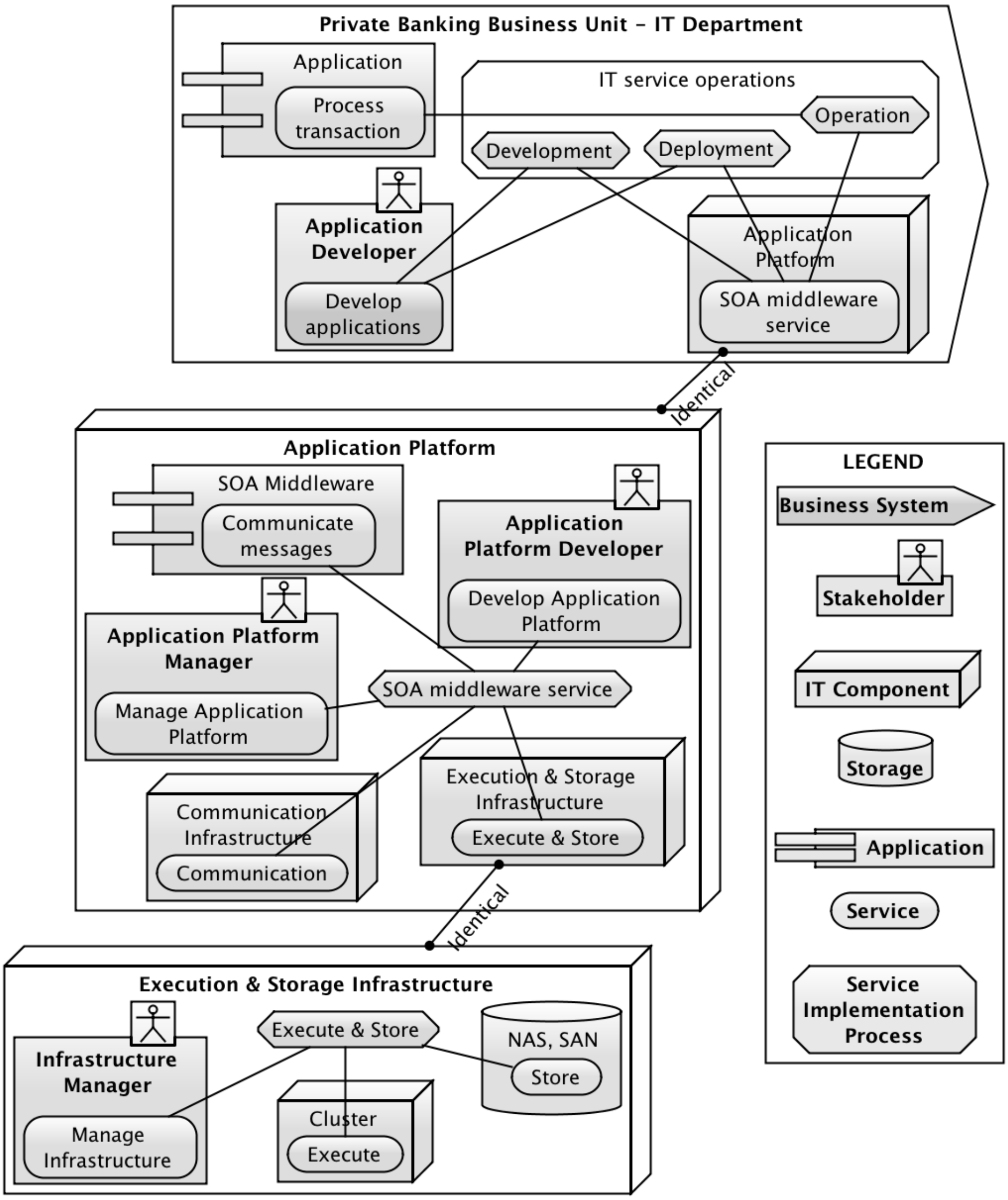

Figure 2. System Diagram of the Private Banking Business Unit IT Department

Figure 2 is a System Diagram of the Private Banking business unit IT department. As illustrated in this model, the IT service operations process is composed of three sub-services: development, deployment and operations. To implement these sub-services, the application developer develops applications on the application platform. The application platform runs on the execution and storage infrastructure. SOA middleware service is mainly related to the application platform and the execution and storage infrastructure. Thus, we modeled the constituent elements of these two IT components. This representation helped us to identify all the stakeholders in the Private Banking IT department: application developer, application platform developer, application platform manager and infrastructure manager. The stakeholders in the investment banking IT department were identified in the same way. Thirteen stakeholders were identified in total.

3.2. Interview Sessions

The thirteen stakeholders identified in the previous step were divided into three main groups as illustrated in Table 1.

Table 1. Stakeholder groups

Stakeholder Group	No.	Stake in the Project	Technical Knowledge
Key	4	High	High
Primary	4	Medium	Medium
Secondary	5	Low	Low -Medium

The key stakeholders had the highest stake in the project (i.e., directly affected by the project), a strong technical background in web services frameworks and were experienced in SOA implementation. They were also well informed about the technical developments in the field. The primary stakeholders were indirectly affected by the project. Their interest, influence and knowledge of the subject were limited compared to the key stakeholders. Even though they were not the target of the project, they needed to be kept informed and their views incorporated into the requirements. The secondary stakeholders were those with low familiarity with the technicalities involved in the project that were unlikely to be closely involved in the project. Special efforts were required to ensure that their needs were met and their participation was meaningful.

Semi-structured interviews were conducted with all stakeholders identified in the previous step. We adopted the seven-step interview design process (i.e., thematize, design, interview, transcribe, analyze, verify and report) in (Kvale & Brinkmann 2008). The questions were divided into five categories: platform independent level (i.e., the additional level of abstraction between the consuming application and the service provider); platform specific (i.e., interoperability with existing platforms, through language bindings.); transport level (i.e., routing, messaging, mediation and security services for runtime infrastructure); governance (i.e., defining, managing, monitoring and controlling services, registration and runtime endpoints), and product (vendors strategy for releasing, packaging and ease of initial product installation). For the stakeholders that were not based in Switzerland, the interviews were done over the phone. The level of the details discussed in the interviews depended on the group the stakeholder belonged to. The interview transcripts were sent to the interviewees for verification and getting their approvals.

3.3. Requirements Identification

We derived the beliefs and the goals of each stakeholder with respect to the prospective SOA tool from the verified interview transcripts. This was done by developing Goal-belief models of the stakeholders. In this modeling framework, goals are prescriptive statements that include a verb in imperative form to indicate a desirable or expected state, whereas beliefs are descriptive statements that reflects a stakeholder's understanding of itself and its environment. See (Regev & Wegmann, 2004) for more information. These models helped us in gaining a better understanding of the perspectives through which the stakeholder view and consider the prospective SOA tool. Figure 3 shows one of the goal and belief models of the stakeholders identified in the IT department of the private banking business unit. It shows their perspective about the security of the prospective solution. As illustrated, the application platform developer and the application platform manager believe that security depends on the platform. As illustrated, this belief is originated and communicated by the infrastructure manager. Moreover, the application platform manager holds the belief "altering message headers weakens security" and thus formulates the goal "to instruct the developer not to alter message headers". For the application developer, this goal is translated to the belief "I am not allowed to alter message headers" and thus he formulates the goal "The code to preserve message headers in the code". These security issues however exist independent of the SOA solution that will be chosen. To capture the impact of SOA implementation, we need to understand the goals and beliefs of the application platform developer.

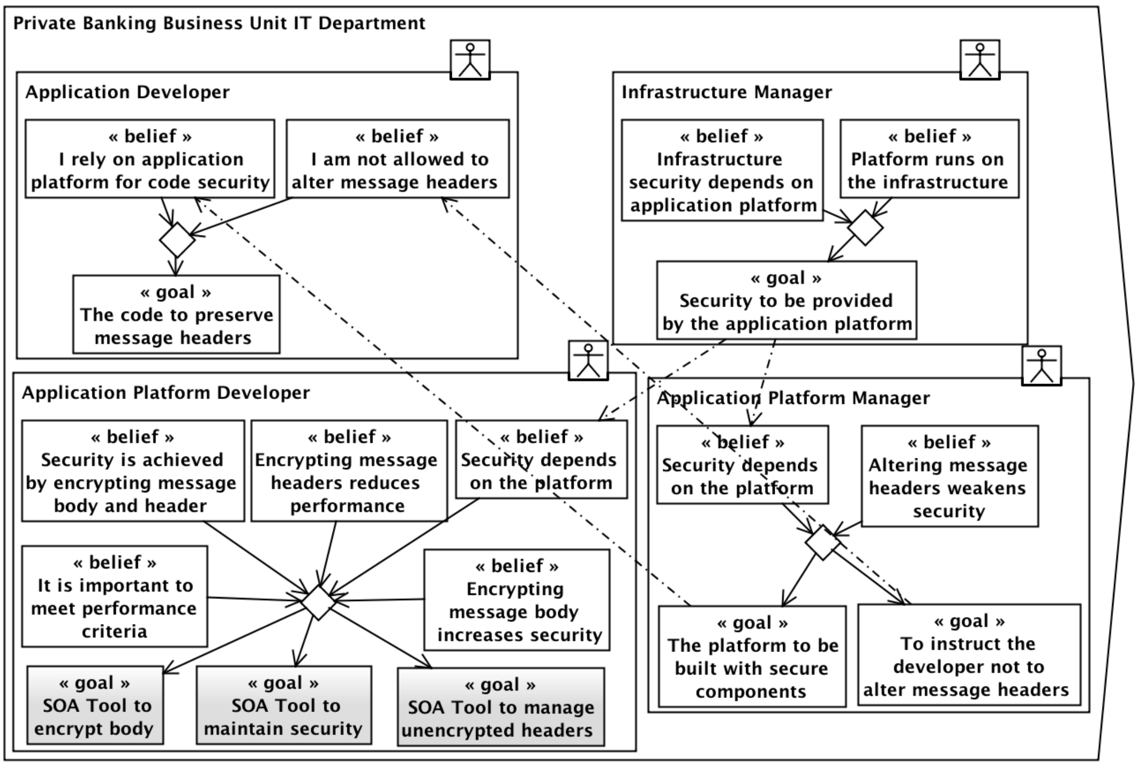

Figure 3. Goals and beliefs of the stakeholders in the Private Banking Business Unit

Similar to the application platform manager, the application platform developer believes security depends on the platform. When it comes to communicating messages he believes encrypting message body increases the security, whereas encrypting message headers reduces the performance of the application platform. As he has to meet the security and performance criteria, he formulates the following three goals as his requirements for the prospective SOA tool: “SOA tool to encrypt message body”, “SOA tool to manage unencrypted message headers”, “SOA tool to maintain security”.

This modeling procedure was followed iteratively to derive and cluster the goals and beliefs of all the stakeholders.

3.4. Market Scanning

A preliminary scanning of the market revealed seven tools to be potentially suitable for SOA implementation in the bank. Table 3 lists these tools and their key features.

Table 2. SOA Tools and their Key Features

	Tool	Key Features
1	AXIS 2	Implementation is available in C/C++ and Java
2	CXF	Development of web services using frontend programming APIs, like JAX-WS.
3	WSO2	Implementation is available in C, C++, PHP, PERL, RUBY, PYTHON, JAVA.
4	METRO	Offers development of Web Services by using Java Technology APIs and tools powered by SUN JAVA. It consists of JAX-WS, JAXB, and WSIT.
5	JBoss WS	It includes many specifications / standards implementations as well as tools to improve ease of use, endpoint management and monitoring.
6	Spring WS	Provides features such as configuration, transaction management, object-relational mapping, database abstraction, logging, etc.
7	WCF	It’s based on .NET framework, can be developed using languages such as Visual Basic, C/C++, C# and Java.

Other tools were also identified that allow generating web services such as: gSOAP(C++), NuSOAP, Pear SOAP (PHP), SOAP :Lite (Perl) and PySAOP (python). But as these tools do not offer functionalities broad enough with respect to the project scale, they were not considered as potential tools.

3.5. Interactions with Key Stakeholders

Reviewing the SOA tools in the market revealed a number of other potential requirements that were not initially thought of and thus not discussed during the interviews. As it was not possible to re-interview all the stakeholders, we discussed these additional requirements with the key stakeholders.

3.6. Criteria Definition

The requirements driven from the interviews and the follow up interaction the key stakeholders were categorized in ten main decision criteria and over 30 sub-criteria, as listed in Table 3.

Among the criteria listed, Service virtualization, Message and wiring, Protocols binding support and the details of Service stack coverage were added after the market scanning and the interaction with the key stakeholders.

Table 3. Criteria and sub-criteria

Service stack coverage - Java binding implementation of JAX-WS - .NET binding, compatibility with WCF C++ binding	**Name service lookup** - Group multiple endpoints against a single service instance - Look up capability of a physical endpoint - Service endpoint availability information
Service virtualization - Hiding the true location of services - Central or p2p functionality - Dynamic composition of endpoint address	**Protocols binding support** - SOAP over HTTPS - SOAP over JMS - SOAP over HTTP - COBRA
Decoupling of business - Physical endpoint lookup - Late transport and data binding	**Security** - Message body encryption - Managing unencrypted message headers
Routing and mediation - Bridge different transport technologies - Bridge different wire formats	**Service availability** - Notify of changes on availability - Metrics to measure the availability - Monitor active and inactive services
Message and wiring - Comma delimited wire encoding - JSON wire encoding - Non-SOAP XML encoding	**Service management** - Transport and context properties in metadata - Logging and auditing - Policy and SLA in metadata

3.7. SOA Tool Selection

Considering the decision criteria, we shortlisted the tools listed in Table 2 from eight to three. For confidentiality purposes, we refer to these tools as solutions 1-3. We then proceeded with the evaluation of the alternatives applying AHP. As mentioned earlier the first step is to compare the decision criteria based on their relative importance. The alternatives will then be evaluated based on the criteria.

The stakeholders were given instructions on how to compare the criteria. Judgment is the key ingredient for stakeholders when evaluating the relative importance of one criterion over another. This subjective judgment is then translated into a numerical value, using a scale of 1-9 where 1 and 9 respectively denote equal and the highest degree of importance (Saaty, 1980). Table 4 illustrates the relation between the preferences, their corresponding value and the explanation.

In the pairwise comparisons, the underlying assumption is that if criterion 1 is absolutely more important that criterion 2, criterion 1 is rated 9. Thus criterion 2 must be absolutely less important and is thereby valued 1/9. The pairwise comparisons were carried out for all the criteria and sub-criteria outlined in Table 3.

Table 4. Preferences, values and explanations in AHP

Preference	Value	Explanation
Equal	1	Two criteria contribute equally to the objective.
Weak	3	Experience and judgment might favor one over the other.
Strong	5	Experience and judgment slightly favor one over the other.
Very Strong	7	Experience and judgment very strongly favor one over the other. Its importance is demonstrated in practice.
Extreme	9	The evidence favoring one over the other is of highest possible validity.

Figure. 4 presents the results for the criteria evaluation. As shown, the key and primary stakeholders participated in ranking the selection criteria.

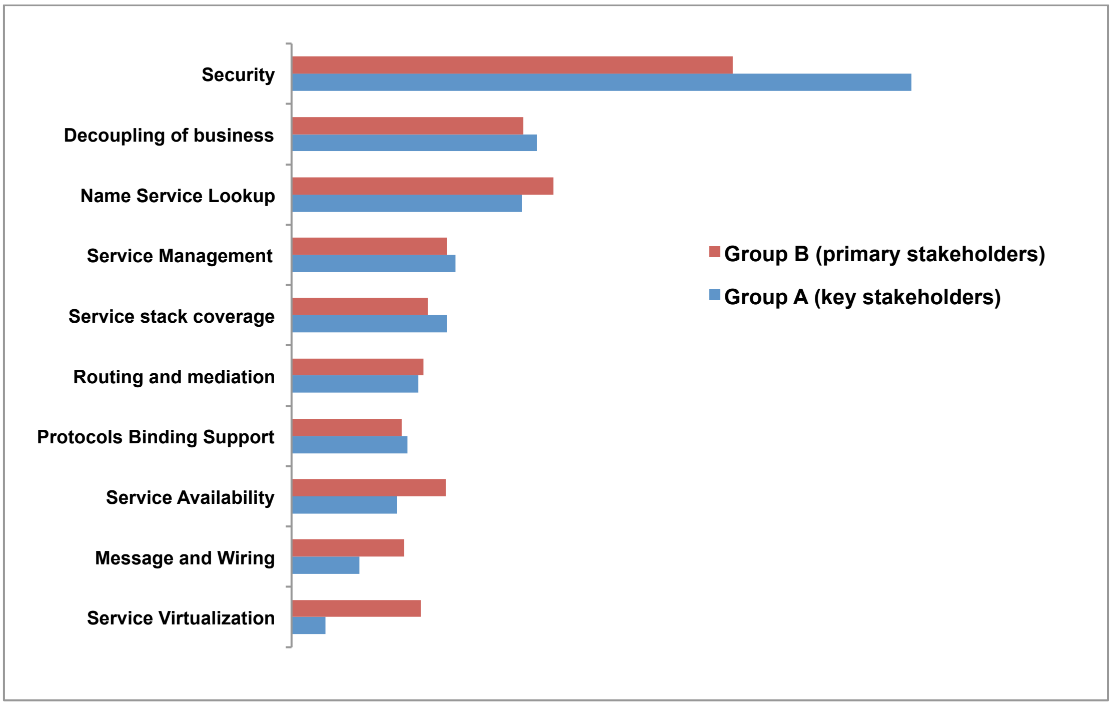

Figure 4. Results of the stakeholders' comparison of criteria importance

Finally, the evaluation of the three SOA tools was done by the key stakeholders as they had the highest level of familiarity with the technical aspects of the tools. In Figure 5, we present the AHP results, comparing the performance of each solution based on the criteria outlined in section 4.1. As it can be seen Solution 2 was ranked first on the basis of meeting the ten decision criteria. This solution is not WSDL 2.0 compliant, despite the initial assumption that WSDL 2.0 compliance was an essential requirement of the future SOA tool. The reason for dropping the WSDL 2.0 compliance was the emergence of another criteria that entailed the choice of a tool that implemented an industry standard. There was no prospect for WSDL 2.0 support in the market.

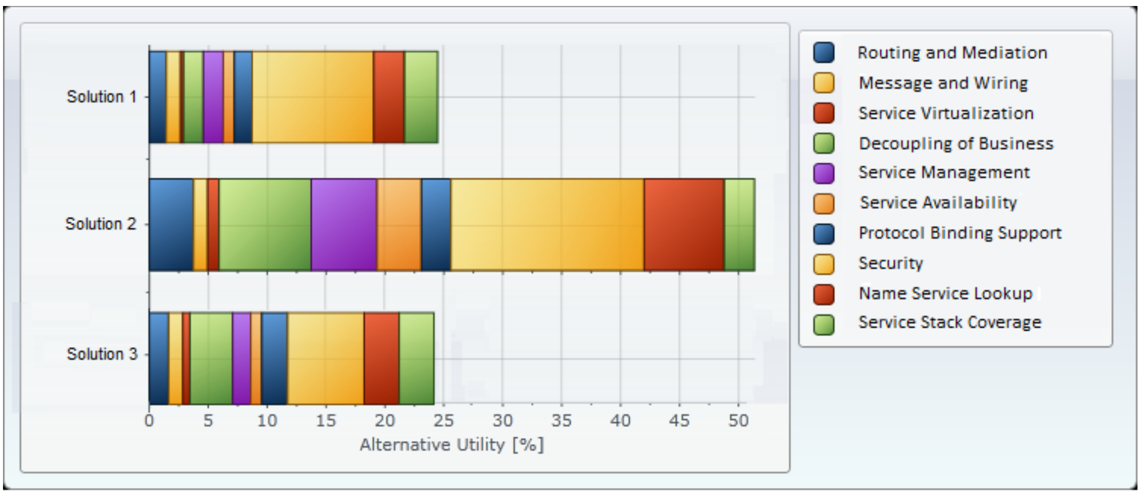

Figure 5. AHP Results: ranking of the alternatives based on the criteria

4. Finding and Recommendations

The findings of the pilot study relate to the selection process, the modeling, the use of AHP and the main objective of the project and the selected tool.

4.1. Amendments to the tool selection process

In retrospect, it became apparent that the tool selection process shown in Figure 2 was too simple to insure the traceability between requirements and criteria. Some of the detailed technical criteria that were used in the evaluation phase did not come from stakeholders requirements expressed in interviews. They came from an in-depth understanding of the features provided by the alternative tools in the phase we call "Market Scanning." It would have been very valuable to have this understanding before the interviews but at the same time simply experimenting with the alternative tools without interacting with the stakeholders would not produce an in-depth understanding either. We propose an iterative process where several phases of understanding the alternative tools are interleaved with stakeholder interviews. In Figure 6, we show an example process with two-phase market scanning and stakeholders interviews. We believe that by following such a process, a better traceability will be maintained between requirements and selection criteria.

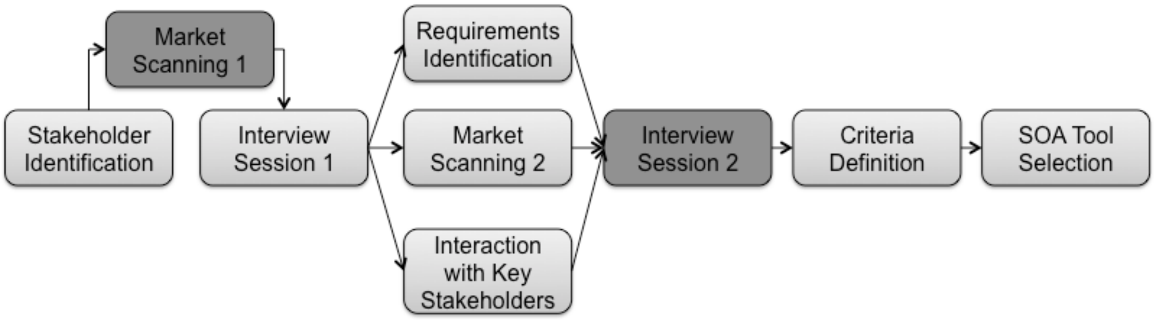

Figure 6. The amended selection process

The selection process followed in the project can also be mapped onto the decision making process outlined in (Van Gigch, 1991). As illustrated in Figure 1, the decision making process is composed of three interrelated phases: (1) policy making, (2) evaluation, and (3) action-implementation. In the project we undertook, we only completed phases 1 and 2. So, the action-implementation phase falls out of the scope of this paper.

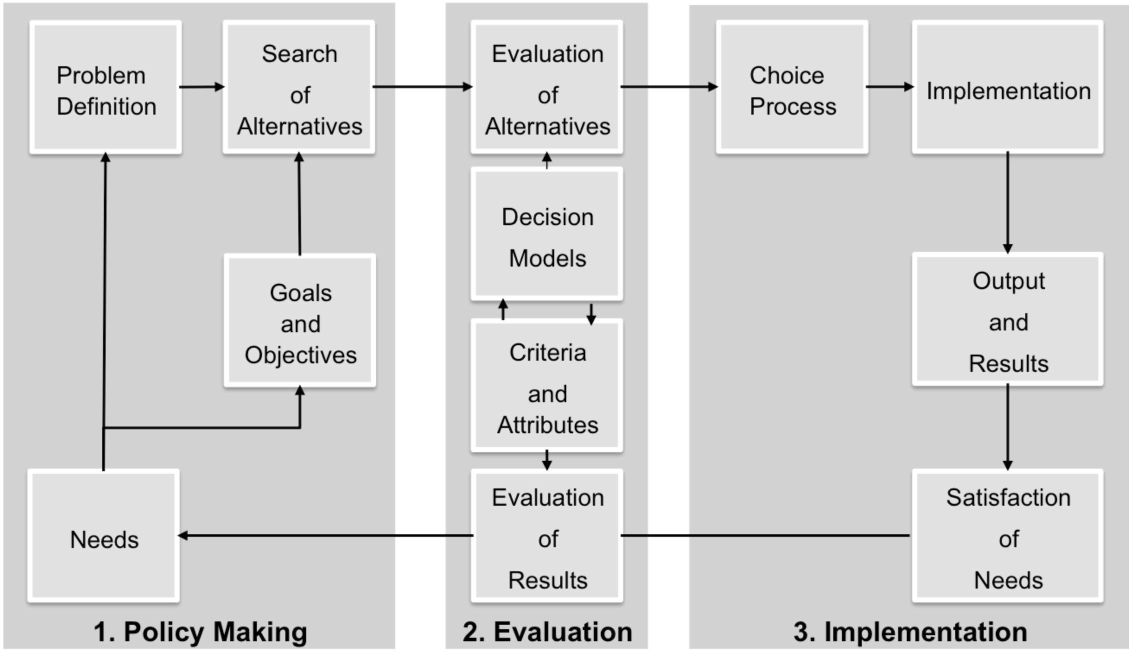

Figure 7. The decision making process (Van Gigch, 1991)

The policy making phase involves defining and analyzing the needs that initiate the decision. Defining the stimulus that initiates the decision is a crucial step upon which the whole decision making or problem solving initiative rests. Decisions do not present themselves to the decision makers. Rather, the decision makers need to identify the situations in which resides the decision to be made. A problem, an opportunity or a crisis can determine the stimuli that initiate the need for a decision to be made. Opportunity decisions are initiated voluntarily to improve an already secure situation. In crisis decisions, organizations have to respond to intense pressures that demand immediate action. If opportunity and crisis decisions are considered as the two ends of the spectrum, problem decisions are then defined as those that fall in between that are initiated by pressures that are milder in nature when compared to crisis. The need for making a decision on the basis of each of the three stimuli is often expressed as a difference between an actual and an expected situation (Mintzberg, et al., 1976).

In the evaluation phase, the decision criteria are formulated and the alternatives are ranked on the basis of the developed criteria.

4.2. The Use of Models

The models made during the project were mostly done on paper, see Figure 8 for example. Some of them have been transformed into electronic form. These models only partly adhered to the SEAM specifications. They were approximately correct models, but they were nevertheless useful to the stakeholders, not because they were correct but because the stakeholders could verify their understanding of the project with the help of the models. It is therefore important to note that we cannot expect industry people to do the same models that researchers do in the lab. Once the model is good enough for the stakeholders, it is a waste of time to make it "more correct."

Figure 8. Models with stakeholders

4.3. The Merits of the Goal-belief Models

Goal-belief Models reflect the opinions that stakeholders express in interviews. These opinions are often very personal. It is quite difficult to put them verbatim in presentations and reports. To publish these models, even internally in a company, it is necessary to make them impersonal by removing the names of the stakeholders and sometime toning down what they expressed. Surfacing these opinions in the form of beliefs requires deep listening skills as well as attention to the social context.

One of the added values of the models is for the requirements engineer to acquire a better understanding of the stakeholders. Each model corresponding to an interview can be validated one on one with the stakeholder. So even though the models are not presentable as-is, they can still be useful. We have noticed this aspect in many other projects.

To the best of our knowledge, traditional requirements and software engineering methods do not provide the means for modeling stakeholders' beliefs. As a result, people's deeply held but often unstated preoccupations are not sufficiently surfaced.

4.4. The Use of AHP

We had previously applied the Analytic Hierarchy Process (AHP) in a project with a watch manufacturing company that involved selection of a workflow engine from the solutions available in the market. Our experience in this project showed that it is necessary to identify where the criteria used in AHP come from and to trace these criteria back to the stakeholders and their requirements. The SEAM model helped us in identification of the stakeholders and their requirements and thereby served as an intermediary layer that linked the stakeholders and their requirements to the AHP criteria.

To aggregate the stakeholder's views and judgments in the evaluation and prioritization of alternatives by AHP, we calculated the geometric mean of the individual stakeholder's judgments and preference values. An alternative method for applying AHP in the group decision making process is that the stakeholders reach consensus on the importance of the criteria and the pair-wise comparisons of the alternatives. These two methods are the most well-established methods for applying AHP with groups (Lai et al., 2002). This requires the simultaneous presence of all the stakeholders in the selection of the alternative. More importantly, in cases of conflict that are inherent in the organizational decision making process, the stakeholders have to compromise on their perception of the importance of a criteria or an alternative and thus their views may not be adequately reflected and incorporated in the selection process. We recommend the geometric mean as a better means of involving the stakeholders in the selection process in large-scale projects with multiple stakeholders that are geographically dispersed. We intended to utilize a web-based decision making software called MakeItRational (MakeItRational, 2013) to gather the stakeholder's values for the pairwise comparisons and to do the AHP calculations online. However, as the computers in the bank did not support a certain application framework, the stakeholders were not able to open the link prepared for gathering their preference values. Thus the information was gathered by mailing Excel sheets to the stakeholders and the data was then entered manually in the Makeitrational web-based tool. A recommendation for future application of such web-based tools is to check the technical requirements and the compatibility with the existing applications within the organization.

4.5. The Main Goal and the Selected Tool

Recall that the main assumption of the project was that selecting a WSDL 2.0 compliant tool would convince Investment Banking of the benefits of SOA. The main goal was therefore to select a WSDL 2.0 compliant tool. As we described above, the final tool that was selected is not WSDL 2.0 compliant. Investment Banking was nevertheless convinced of the benefits of SOA. The reason is thought to be the involvement of Investment Banking in the project, more than the selection of WSDL 2.0. This shows that a project can be successful even if its basic assumption and therefore its main goal are not met, mainly because the necessary stakeholders are involved.

5. Related Work

The methods developed for business and IT alignment do not provide the means for representing and modeling the organization and the decision makers' mental models to support the design of IT systems. In most cases, such cognitive standpoints are treated as a given and therefore the means for eliciting, surfacing and understanding the underpinnings of the IT system requirements are not included in such methodologies. Business and IT alignment is mainly researched in enterprise architecture (EA) and requirements engineering (RE).

Zachman founded the Enterprise Architecture (EA) field with his seminal paper (Zachman, 1987). The initial focus of the so-called Zachman Framework was the information system architecture. This focus was quite quickly enlarged to encompass the whole organization (not only its information systems) and was renamed the Enterprise Architecture Framework (Sowa & Zachman, 1992). In the intervening 20 years many EA frameworks and methods have been proposed, e.g. TOGAF (TOGAF 9.1, 2013), DODAF Architecture Framework Version 2.02 (DODAF, 2013), ArchiMate (Archimate, 2013). Despite the name enterprise architecture, the roots of the field in information systems are still very apparent. All the EA frameworks ultimately seek to create an information system architecture. The enterprise (i.e. the organization) and the organizational participants receive little attention. In particular, the goals of the organizational participants are almost always considered as a given, an input to the enterprise architecture. TOGAF 9, the most mature of the EA frameworks, considers that: "Normally, key elements of the Architecture Vision — such as the enterprise mission, vision, strategy, and goals — have been documented as part of some wider business strategy or enterprise planning activity that has its own lifecycle within the enterprise." TOGAF 9 acknowledges that this may not always be the case, but provides little support in defining an organizational goals and requirements. ArchiMate, the leading EA method also considers that business goals have been previously defined, and therefore begins with the modeling of a business process.

In requirements engineering (RE) the link with organizational goals is essentially done in goal-oriented (Van Lamsweerde, 2001) and value-based (Gordijn & Akkermans, 2003) methods. Goal-oriented requirements engineering methods attempt to elevate the analysis of stakeholders' needs by asking why and how rather than what questions. Why questions reveal higher-level goals of stakeholders whereas how questions reveal lower level goals. The most prominent of these methods is i* (Yu, 1997). Stakeholders are modeled in i* as actors that have goals with clear-cut criteria for their achievement and soft-goals with unclear criteria for achievement. Actors also have resources, tasks and dependency relations with other actors. While indeed elevating the modeling level of requirements, i* does not adequately model organizational stakeholders and their requirements.

Value-based methods seek to link requirements engineering and business discourse. e3-value is a method designed to explore innovative e-commerce ideas (Gordijn &

Akkermans, 2003). It focuses on value exchange between actors in market segments. Even though e3-value extends requirements engineering practice with business and marketing concepts, this extension is limited. Because of its focus on a one to one value exchange between economic actors, e3value is limited in the kind of strategies it can model. With e3-value it is possible to model the "what" of the value exchange but not the "why" i.e., the business strategy (Weigand, et al., 2007). Weigand et al. (2007) propose an incremental extension to e3-value called c3-value that includes concepts such as competitors and complementors.

Most RE methods have a diagrammatic language that is not well understood by non-engineers (Moody, 2009). We assert that the application of most of the RE methods is hampered by the nature of the representations that are oftentimes cognitively inaccessible to people with a wide backgrounds. A lightweight diagrammatic representation facilitates the representation, communication and discussion of causal assumptions (Larkin & Simon, 1987; Vessey & Galletta, 1991; Zhang, 1997) without requiring special training, thereby, leading to a well-defined and common understanding of a situation (Lane, 2008; Larkin & Simon, 1987; Tufte, 1990). To ensure the cognitive effectiveness in generating and processing representations, the two modeling frameworks (i.e., the System Diagram and the Goal-belief Model) presented in this chapter, are designed to be lightweight diagrammatic methods for identification of the stakeholders of a choice situation and for eliciting their goals to derive the requirements.

6. Conclusions

It is often quite difficult to transfer research methods from the laboratory to industry. The case reported in this chapter is one where several aspects were not conducted as straightforward as the theory suggests. The process followed should have been more iterative. The models were not as clean as when they are done for a research project but still useful. The result was somewhat surprising because the stated objective was not achieved but the project was nevertheless successful. The tools that researchers often take for granted could not be used in practice.

The lessons learned throughout this pilot study contribute to a better understanding of the issues of applying research results in industry practice. Researchers and practitioners should accommodate the expectations of one another, because as we have seen in this project, often times it is impossible to directly apply the methods developed by a research lab in an industrial context. Likewise, practitioners need to believe in the value added of applying a method that is not industry grade. In the case of this pilot study, we combined a well-known decision making method implemented by an off-the-shelf tool with a requirements engineering method developed in our research lab. This combined application of multiple methodologies is referred to as multimethodology (Mingers & Brocklesby, 2013).

Our research is limited due to its case-based nature. To develop a better understanding of the potential merits of the multimethodology presented in this chapter, we should apply it in a number of other prospective organizational decision making projects and reflect on the lessons learned. This will also help us in identifying the improvement opportunities that can result in a more effective decision making process or a problem solving intervention. In our future work, we should also consider the application of other MCDM or group decision making techniques.

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Conclusions

In this section, we sum up the overall contribution of the thesis, the contribution of each chapter, the limitations of the chapters and the overall thesis. We also suggest how the thesis can serve as the basis for further research.

1. The Overall Contribution of the Thesis

Our research has four distinct categories of contributions: first to the work conducted by the Laboratory for Systemic Modeling (LAMS) at École Polytechnique Fédérale de Lausanne (EPFL) on the development of systemic enterprise architecture method (SEAM) modeling technique; second, to the organizational decision making and problem solving and, to the coopetition and service systems (i.e., the new business contexts in which SEAM was applied) and lastly to System Dynamics (SD) and Analytic Hierarchy Process (AHP) (i.e., the OR methods with which SEAM was integrated).

1.1 Contributions to SEAM

Our contributions to SEAM are two-fold. First, we contributed to SEAM by modifying and augmenting it with the requisite theoretical perspectives and notational elements to enable its use as a problem structuring method (PSM) in two new application contexts (i.e., strategic management and service science). Our work resulted in the creation of four SEAM-based PSMs: the Value Map, the Customer Value Model, the Viable Service System Model and the Value Network Model. These PSMs can be categorized based on the nature of the representations they embody (i.e., representing systems or value) and the context of their application (i.e., Service Science and Strategic Management).

The resulting PSMs were positioned relative to the related modeling frameworks or and other PSMs in the field and were validated empirically by means of surveys and application in problem solving interventions. Our second contribution to SEAM, was to complement SEAM's qualitative representations with quantitative aspects by integrating it with OR methods. SD and AHP were the two OR methods that were integrated with SEAM.

1.2 Contributions to organizational decision making and problem solving

Our research also contributes to the decision making and problem solving processes in organizations in three major ways: First, by providing theoretically grounded propositions on the nature of problem solving and decision making activities and the role of problem structuring methods. These propositions were empirically tested in a survey. Second, by providing qualitative models that decision makers can use to clarify ambiguities in the problem solving process and make decisions by identifying a mutually agreed upon framework for the problem that needs to be addressed. Finally, by making the quantitative OR methods more accessible through providing an intermediary layer for the decision makers to bridge the gap between the problem situation and the OR methods. This can pave the way for adoption and use of OR methods in decision making and problem solving processes in organizations.

1.3 Contributions to service systems and coopetition research

The first category of research (representations of value and systems) contributes to fields of service systems and coopetition research. In the service systems context for instance, we conducted a literature review that serves to discover the important concepts relevant to value creation and capture and explore the relationship among and these concepts. The literature review contributes to the field by providing a new perspective into the structure and the dynamics of value creation and capture in service systems. As another example, in the coopetition context, we develop a typology of coopetition between and within value networks that helps in understanding where and how coopetition appears in value networks.

1.4 Contributions to Systems Dynamics and Analytic Hierarchy Process

In the second category of our research work (i.e., forming multimethodologies), we contribute to the two OR methods i.e., SD and AHP. To be more exact, we contribute to the SD literature, by providing a theoretical framework for measuring the cognitive effectiveness of the PSMs that are applied by the community to conceptualize the problem situation. Our contribution to the AHP method providing an intermediary layer that enables the decision makers to trace the decision criteria based on which the alternatives are ranked to the requirements and the preferences of the decision makers.

In the next sections, we present role of each chapter in making the overall contribution of the research. We also highlight the limitations of the resarch and discuss the future work that can be conducted based on the limitations identified.

2. The Contribustions and Limitations of the Research Presented in Each Chapter

In the following sections we outline the contributions and the limitations of the research presented in each chapter. Broadly speaking, the limitations relate to the theortical and the empirical aspects of the research. The theoretical aspects pertain to the work included to build a theoretical framework based on which a PSM could be developed or the effectiveness of a multimethodology could be assessed. The emprical aspects concern the representativeness and the sample size of the particionts in the surveys and the exploratory laboratory study. Finally, we present the future work to be conducted to address these limitations.

2.1 Chapter 1: Problem Structuring and the Systemic Enterprise Architecture Method

In this chapter, we reviewed the literature on organizational decision making and explained its divergence from the theories of rational choice. We then described the nature of the problems managers face in organizations by invoking theoretical insights from systems thinking, highlighting the need for a new paradigm of analysis to accommodate the complexities residing in such problem situations. This led us to the origins of problem structuring methods (PSMs) as an alternative paradigm of analysis, their characteristics and the type of the problem situations for which they are deemed suitable. Next, a synthesis of renowned PSMs was provided and the role of PSMs in the problem solving and decision making process in an organizational setting was explored. Finally, as representing the structure of the problem situation is integral to the practice of problem structuring, a brief account of modeling was given and the nature of the models that are appropriate in the realm of problem structuring was explained. To provide some empirical evidence on the theoretical discussions, we derived five propositions from the literature review. To test the validity of the five propositions, we designed a questionnaire and conducted a survey among 30 executives and senior managers in Iran.

The literature review and the empirical study presented in this chapter suffer from a number of limitations. Firstly the articles based on which the literature review was conducted are not exhaustive. Despite the fact that we synthesized over 60 well-cited articles on organizational decision making and problem structuring that were to the best of our knowledge seminal to the field, some relevant work may still have not been included in the review of the literature. Inclusion of such articles can fine-tune or have a moderating effect on the theoretical propositions in the chapter. The second limitation of this research concerns the empirical study. The fact that all the participants in the survey were from Iran and the relatively small sample size limit the generalizability of the findings of our research. To tackle this limitation, the same study should be conducted among executives and managers from different countries. Since the respondents' knowledge of the research context positively contributes to their understanding of the concepts in the propositions and thereby enhances the quality of the responses we decided to hold workshops in which we familiarize the participants with the research context. Thus the major reason behind the small sample size is the way the data was gathered. Sending out the questionnaire along with the definitions of the concepts in the propositions could have increased the sample size at the price of compromising the respondents' understanding of the propositions and consequently the quality and accuracy of their responses. As a side note we also tried to gather data from participants that belonged to different industries. Therefore, the sample size although relatively small, featured representatives from various industries.

In our future work, we will focus on improving the literature review and the theoretical propositions by including other relevant work on organizational decision making and problem structuring. We will also gather more empirical evidence by holding workshops among managers and executives from different countries while maintaining the industry diversity of the participants.

2.2 Chapter 2: Value Map: Modeling Value Creation and Capture in Service-Oriented Business Models

In this chapter we have two main contributions: a conceptual model, derived from the literature, that captures the structure and the dynamics of value creation and capture, and a PSM referred to as the Value Map that embodies the conceptual model to represents value in service-oriented business models.

To develop the Value Map, we conducted a literature review that helped us discover the important concepts relevant to value creation and capture and explore the relationship among and these concepts in order to gain a new perspective into the structure and the dynamics of value creation and capture in service-oriented business models. As the correct selection of the published materials is a vital element of a literature review, we followed Baker (2000) and developed a number of criteria for selection of the work to be included in the literature review. Having identified the concepts and their relationships, we graphically represented them in form of a conceptual model made up of boxes (i.e., the concepts) and arrows (i.e., their relationships). According to Whetten (1989: 491), “box and arrow representations often clarify the author's thinking and increase the reader's comprehension”. Based this conceptual model, we then developed a PSM referred to as the Value Map to represent value creation and capture in service-oriented business models.

To evaluate the usefulness of the Value Map, we conducted an empirical study in which we also compared the Value Map with Business Model Canvas (Osterwalder & Pigneur, 2010), one of the most established methods in business model design. The results in general suggest that Value Map is a useful visualization tool that contributes to managerial decision making processes of business practitioners in the choice situations that entail value creation and capture in an organization’s business model. We learned that the Value Map complements and augments the Business Model Canvas by aiding the business practitioners in representing the necessary building blocks of business model of an organization and their inter-relations and interconnectedness. We also drew the conclusion that the Strategy Canvas can be used as an input to the Value Map in designing the value creation and capture processes in a business model.

This research suffers from a number of limitations. We used secondary data synthesized in a single case study to illustrate the applicability of the Value Map. Despite the fact that Amazon.com is well-studied company and there are plenty of secondary sources available that enable data triangulation, we believe the usage of primary data for business modeling in the Value Map can contribute to the practical relevance of the representations. Thus, in our future work we will develop our models based on primary data from prospective business cases. This will definitely result in a better evaluation of the applicability of the Value Map.

The second limitation of this research concerns the empirical study we conducted to evaluate the usefulness of the Value Map. The fact that all the participants in the survey were from Iran and the relatively small sample size limit the generalizability of the findings of our research. To tackle this limitation, the same study should be conducted among executives and managers from different countries. To ensure an accurate evaluation, the participants should have knowledge about the research context, the Value Map and Business Model Canvas, the alternative methodology with which we compared the Value Map. Thus, we believe the study should be conducted in form of workshops in which the participants are familiarized with the methodologies and attempt to apply them to develop a business model. In the empirical study we conducted, we included participants that belonged to different industries. Therefore, the sample size although relatively small, featured representatives from different industries. This participants heterogeneity positively contributes to generalizability of the results.

Lastly, the articles based on which the conceptualizations underlying the Value Map were developed are not exhaustive. Despite the fact that we synthesized over 30 well-cited articles on value creation and capture that were to the best of our knowledge seminal to the field, some relevant work may still have not been included in the review of the literature. Inclusion of such articles can bring in new modeling constructs in the Value Map or fine-tune and improve the existing constructs. Refining our conceptualizations based on the existing work that has not been included in the study will also be a part of our future work.

2.3 Chapter 3: The Viable Service System Model: Modeling and Analyzing Viability in Service Systems

Service science researchers have recently shown an increasing interest in studying the viability of service systems. Following systems inquiry, this body of research uses systems theory and cybernetics to understand the factors that can contribute to the viability of a service system, see for example (Barile et al., 2010; Saviano et al., 2010). Banathy and Jenlink (2004) proposed to conceptualize systems inquiry into three sub-parts: systems philosophy, systems theory and systems methodology. While most of the work conducted by the researchers in the field can be categorized as having systems theoretical contribution, we contribute to the service systems field by following a systems methodological approach. Systems methodology aims at the instrumentalization of systems theory and its application to a functional context (ibid). To this end, we augmented the System Diagram in SEAM with theoretical insights from the Viable System Model (VSM) (Beer, 1979, 1984) and developed the Viable Service System Model as a problem structuring method for analyzing the viability of a service system or for designing a viable service system.

Our research suffers from a number of limitations. First of all, the Viable Service System Model is developed based on the VSM. Other systemic conceptualizations alternative to the VSM should be taken into account and positioned relative to the VSM. This can definitely contribute to the academic rigor of the Viable Service System Model. Examples of such alternative methods include but are not limited to Robustness analysis (Rosenhead, 1980) Strategic Choice Approach (Friend & Hickling, 1987) Strategic Options development and analysis (Eden et al., 1983; Eden, 1989) Strategic assumption surfacing and testing (SAST) (Mason & Mitroff, 1981). Moreover, the case-based nature of the validation limits the generalizability of the results achieved through the application of the Viable Service System Model.

2.4 Chapter 4: The Customer Value and the Value Network Models: Modeling the Incentives and Design of Coopetitive Value Networks

In this chapter, we contribute to coopetition as a stream of research in strategic management by developing the Customer Value and the Value Network Models to represent the incentives and design of coopetitive Value Networks. We also conducted a case study to explore the potential advantages of coopetition-based business models.

Coopetition (i.e., collaboration between competing firms) (Brandenburger & Nalebuff, 1996) is a phenomenon that has recently captured a great deal of attention due to its increasing relevance to business practice. However, current research on coopetition is still short on providing tools that can aid organizations assess the potential merits of establishing a coopetitive relationship and explore the alternative designs of the value network structure capable of accommodating the complexities inherent in such a multi-faceted inter-organizational relationship. Doing so requires a shift from a positivistic / theory building approach that aims at describing various aspects of coopetitive interaction towards research focused on developing normative recommendations for initiating and sustaining coopetitive strategies and relations. Our research contributes to bridging this gap by developing the Customer Value Model and The Value Network Model. Both models incorporate important conceptualizations from the competence-based strategic management (CBSM) (Sanchez & Heene, 1997, 2003). CBSM theory provides precise and consistent definitions of the primitive entities that serve as the building blocks of its conceptual foundation for representing markets, organizations, and their cooperative and competitive interactions, etc. grounding our models in CBSM enabled the identification and analysis of the internal and external systems relationships and their interactions that are deemed indispensible for generating relevant representations of a coopetitive strategy. CBSM also enabled us to derive more broadly generalizable and more theoretically defensible findings from our models.

The Customer Value Model, contributes to our understanding of why companies engage in a coopetitive relationship. By applying the Customer Value Model, we analyze the value companies can create for the customers when they join forces with the competition. The Value Network Model, assists in exploring the alternative designs of value networks that can accommodate the complexities of coopetition as a multi-faceted inter-organizational relationship. The applicability of the models was demonstrated by means of case studies of coopetitive value networks with secondary data sources. The Customer Value Model was also applied to model and design the value for the customers in a project with an online social networking platform called Webdoc. We also position the Customer Value Model and the Value Network Model relative to the existing modeling frameworks in the strategic management.

Finally, in order to gain insights into the potential advantages of coopetition, we conducted a longitudinal, in-depth case study on the coopetition-based business models of Amazon.com. This case study provided the data required to demonstrate the applicability of the Value Network Model in this chapter. The case study itself has a number of contributions. We found evidence on three distinct coopetition-based business models of Amazon.com: (1) Amazon Marketplace, (2) Amazon Services and Web Services, and (3) the collaboration between Apple and Amazon.com on digital text platforms. The findings from the case study helped us to put forward several propositions on how the potential advantages of coopetition can be realized by involving competitors within a firm’s business model. As a whole, the results contributed to the current understanding of how firms—as well as their stakeholders—can better benefit from coopetition.

Concerning the Customer Value Model, the usefulness of the representations in the Customer Value Model was assessed in a project conducted with a social networking platform called Webdoc. Although the results from the project are promising, we cannot establish a warranted belief about the usefulness of the Customer Value Model. Thus, we need to apply it in a number of other projects and gather more evidence on its applicability and usefulness. In our future work, to make the Customer Value Model more prescriptive, the representations can be quantified using System Dynamics Stock and Flow simulations models so that the impact of various resource configurations on the net delivered customer value could be quantitatively assessed.

There are some other limitations related to our study that should be acknowledged. First, our approach simplifies coopetition settings into a four-cell typology, and real-life business situations may not clearly fall within one category only, or in extreme case in any of these categories. Thus, the reductionist approach adopted here certainly poses limitations for interpretation and analysis. While a limitation, we suggest that this can be taken into account in analyzing and modeling coopetition relationships. In addition, by initially acknowledging the different logics of coopetition separately, it is easier to start analyzing more complex value network settings. In any case, we suggest that research using deliberately more complex approaches is also needed to pinpoint the detailed scenarios which may take place in networked coopetition settings. In our future work, we will focus on holding workshops in which assess the usefulness and practicality of the Value Network Model in concrete business settings. We could assess other business cases in various industry settings including but not limited to coopetition.

2.5 Chapter 5: Comparing the Performance of Problem Structuring Methods in System Dynamics Modeling

In this chapter we contribute to the field of System Dynamics (Forrester & Wright, 1961) in two major ways. First, by suggesting the characteristics of a PSM that can result in a better representation of the problem situation by the organizational participants in group model building with System Dynamics, and secondly by measuring the cognitive effectiveness of four of the PSMs that are mainly used in the community and exploring the relationship between the cognitive effectiveness of the PSMs and the conceptualization of the problem situation.

Over the course of time, a number of PSMs were employed in the SD community to facilitate problem situation conceptualization. A key research question facing the SD community is how to usefully compare and assess the relative performance of these actual and other potential PSMs, given the facilitative role PSMs play in the establishment and increase of the quality of the communication within the participants and between the participants and the SD modelers (Akkermans & Vennix, 1997; Eden, 1994). This communication is indispensable to the effectiveness of the intervention.

We applied theoretical insights from cognitive science, in particular cognitive fit theory (Shaft & Vessey, 2006; Vessey, 1991), and visual notation analysis (Moody, 2009) to suggest the characteristics of a PSM that are likely to be cognitively effective in conceptualizing problem situations in building System Dynamics models. Then, we conducted an exploratory laboratory study to measure the cognitive effectiveness of the four PSMs that are widely used by the SD community: (i) Causal Loop Diagrams (CLDs) (Senge, 1994; Sterman, 2000), (ii) Influence Diagrams (ID) (Coyle, 1998, 2000), (iii) Cognitive Maps (Eden, 1989, 1994), and (iv) (Magnetic) Hexagons (Hodgson, 1992; Lane, 1993; Wong et al., 2011) as well as the Goal-belief Model from SEAM. In this study, we also explored whether cognitive effectiveness of a PSM results in a better conceptualization of the problem situation.

The research presented in this chapter is limited for a number of reasons. Firstly, the exploratory laboratory study was conducted with only twelve groups of participants who were Ph.D. or MSc students in the field of computer and communication sciences.

To increase the generalizability of the results the study should be done with more participants with a variety of backgrounds. Revisiting the work conducted on individual and group cognitive processes can provide insights into the way the cognitive effectiveness of different modeling frameworks can be measured. In our future work, we will plan to repeat the study with participants from industry and model real problem situations that are faced in the organizational setting. A part of our future work also focuses on investigating the technical requirements of a PSM that can result in cognitive fit, from the perspective of system dynamicist who constructs the Stock and Flow simulation model on the basis of the problem situation conceptualization captured by the PSM.

2.6 Chapter 6: Integrating SEAM with the Analytic Hierarchy Process: A Pilot Study in a Large Swiss Bank

In this chapter, we contributed to multi-criteria decision making methods in general and AHP (Saaty, 1980) in particular by showing how alternatives are developed and the decision criteria are defined in a group decision making process in an organizational setting. Most of the work in the application of AHP focus only on ranking of the alternatives with respect to a set of criteria and do not capture the decision processes that lead to the development of the alternatives and the definition of the criteria based on which the alternatives are ranked. We developed a multi-methodology by integrating the Goal-belief Model and the System Diagram in SEAM with AHP. The multimethodology was then applied in a requirements engineering project in Credit Suisse one of the major banks in Switzerland. The objective of the project was to select a common SOA tool that could satisfy the needs of two of the bank's main business units, investment and private banking. SEAM provided help in identifying stakeholders, eliciting their requirements, and analyzing these requirements. The resulting requirements were then grouped and translated into selection criteria for the alternative SOA tools. Based on these criteria, the stakeholders chose the SOA tool using AHP.

Our research is limited due to its case-based nature. To develop a better understanding of the potential merits of the multimethodology presented in this chapter, we should apply it in a number of other prospective organizational decision making projects and reflect on the lessons learned. This will also help us in identifying the improvement opportunities that can result in a more effective decision making process or a problem solving intervention. In our future work, we should also consider the application of other MCDM or group decision making techniques.

2.7 Summary

Table 1 summarizes the contrinutions and the limitations of the resaerch presented in each chapter.

Table 1. Summary of the contributions and the limitations of each chapter in the thesis

	Contributions	Limitations
Chapter 1 *Literature Review of Organizational Decision Making and Problem Solving*	- A literature review based on over 60 well-cited papers - Formulating and empirically testing the propositions derived from the literature review.	- More articles can be included in the literature review. - The empirical study should be done with a higher number of participants from different professional and cultural backgrounds.
Chapter 2 *The Value Map*	- A systematic literature review based on a total of over 30 papers. - A conceptual model, derived from the literature, capturing the structure and the dynamics of value creation and capture. - A PSM referred to as the Value Map that embodies the conceptual model to represents value in service-oriented business models.	- More articles can be included in the literature review. - The applicability of the Value Map was illustrated by a case study with secondary data. Primary data from prospective business cases should be used. - All the participants in the survey were from Iran and the relatively small sample size limit the generalizability of the findings. The empirical study should be conducted among executives and managers from different countries.
Chapter 3 *The Viable Service Systems Model*	- A simplified version of the Viable System Model (VSM). - A PSM referred to as Viable Service System Model to analyze the viability of a service system or for designing a viable service system.	- Related work such as Robustness analysis Strategic Choice Approach should be taken into account positioned relative to the Viable Service System Model. - The case-based nature of the validation limits the generalizability of the results achieved through the application of the Viable Service System Model.
Chapter 4 *The Customer Value and the Value Network Model*	- Customer Value Model a PSM that contributes to our understanding of why companies engage in a coopetitive relationship. - Value Network Model a PSM that assists in exploring the design of value networks that can accommodate the complexities of coopetition as a multi-faceted inter-organizational relationship. - Typology of coopetition in within and between value networks. - Longitudinal single case study of coopetition-based business models of Amazon.com.	- The applicability of the Value Network was illustrated by a case study with secondary data. Primary data from prospective business cases should be used. - Concerning the typology, our approach simplifies coopetition settings into a four-cell typology, and real-life business situations may not clearly fall within one category only, or in extreme case in any of these categories. - Other business cases in various industry settings including but not limited to coopetition should be studied.
Chapter 5 *Integrating SEAM with System Dynamics*	- Suggesting the characteristics of a PSM that can result in a better representation of the problem situation by the organizational participants in group model building with System Dynamics. - Measuring the cognitive effectiveness of four of the PSMs that are mainly used in the community and exploring the relationship between the cognitive effectiveness of the PSMs and the conceptualization of the problem situation.	- The exploratory laboratory study was limited by the number and the common background of the participants. - Revisiting the work conducted on individual and group cognitive processes can provide insights into the way the cognitive effectiveness of different modeling frameworks can be measured.
Chapter 6 *Integrating SEAM with Analytic Hierarchy Process*	- Showing how alternatives are developed and the decision criteria are defined in a group decision making process in an organizational setting.	- Case-based nature of the validation - The application of other MCDM or group decision making techniques should be considered.

3. Overall Limitations of the Thesis and Proposed Future Steps for Research

The research presented in this doctoral thesis was limited in a number of ways. First of all, this work was a continuation of the body of research conducted on the Systemic Enterprise Architecture Method (SEAM) by the Laboratory for Systemic Modeling (LAMS) at École Polytechnique Fédérale de Lausanne (EPFL). This presented both opportunities and challenges. The fact that the research had to contribute to SEAM limited the scope of the research activities that could be conducted. At the same time, over eight years of research on the development and application of SEAM had resulted in a number of interesting research topics and questions that could provide a good basis for research.

Moreover, our research resulted in the creation of four SEAM-based problem structuring methods (PSMs). These PSMs were applied to provide analytical assistance in the decision making process in the strategic management and service science contexts. We also explored the integration between SEAM and two operations research (OR) methods. The broad range of the topics and methods that were covered limited the depth of our research to some extent. In other words, we could have only focused on one of the four PSMs and one of the OR methods and instead, included more articles in the literature review, addressed more research questions in the field, provided more empirical evidence by repeating the surveys with more participants and analyzed more the related frameworks. Our future work will certainly focus on adding more depth to the breadth of research we have conducted so far in terms of theoretical grounding, method of validation, etc.

Our work can serve as a basis for future research in two major ways. Firstly, scholars can extend or expand the PSMs presented in this thesis by augmenting them with new theoretical perspectives or using them in new contexts of applications. Alternative PSMs can also be developed from ground up to address the problems identified in the contexts of the research. Secondly, research can be done on exploring the integration between the PSMs presented in this thesis and OR methods other than System Dynamics (SD) and Analytic Hierarchy Process (AHP) such as linear and dynamic programming, (non)linear optimization methods, network planning, etc.

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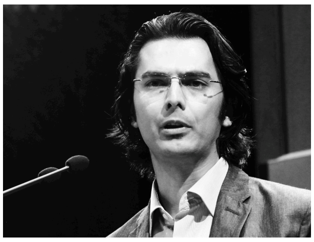

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