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A Quantitative Model for Decomposing and Assessing the Value for the Customer

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A Quantitative Model for Decomposing and Assessing the Value For the
Customer

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To Miguel, Gonçalo and José Carlos

Acknowledgments

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Table of Contents

1	Introduction	1
1.1	Motivation	1
1.2	Background and research context.....	1
1.3	Methodology and research questions	3
1.4	Conclusion.....	5
2	Published Papers	9
2.1	Paper I.....	9
2.2	Paper II – Poster /Extended Abstract	17
2.3	Paper III.....	23
2.4	Paper IV.....	69
2.5	Paper V	103
3	General Discussion	139
3.1	Introduction	139
3.2	Contribution to the Body of Knowledge	139
3.3	Limitations of the Study	142
4	Conclusion	143
5	References.....	145

Resumo

Este projeto de investigação desenvolve-se nas diferentes dimensões de análise e criação de valor. O objectivo fundamental desta investigação foi criar um modelo que permitisse às empresas modelar o valor, analisando a percepção do cliente e dos membros da organização relativamente à proposta de valor que a empresa oferece. Membros da organização percebem o valor da oferta da empresa de maneiras diferentes. Os clientes percebem os produtos / serviços de maneiras diferentes. O tempo tem um impacto direto no valor percebido, desde a pré-compra até à fase pós-compra. Neste contexto, surge o modelo conceptual resultante deste projeto de investigação o “*Conceptual Model Decomposing Value for the Customer*” (CMDVC) combinando três áreas: na área de marketing foi considerado o valor para o cliente, na área das redes colaborativas (ARCON) temos a perspectiva do ciclo de vida da empresa e os ativos endógenos e exógenos e na área do capital intelectual o conceito das redes de valor. Esta investigação propõe ainda um modelo quantitativo para o “*Value for the Customer*” com a utilização do método AHP fuzzy . O mérito desta abordagem tornou-se evidente pelas avaliações e validações das empresas, proporcionando um modelo estruturado para a compreensão das reais necessidades dos seus clientes e de que forma estão relacionadas com os ativos endógenos e exógenos. Com estes dados, é muito mais simples adequar a proposta de valor às exigências internas e externas, dotando-a de grande eficiência, orientando-a às necessidades do cliente ou diferenciando-a de outras organizações.

Assim, esperamos que esta investigação sobre valor para o cliente e com o desenvolvimento do CMDVC possa contribuir não só para ampliar e melhorar as bases de conhecimento existentes, mas também para a produção de valor significativo para as empresas, através da construção de uma ponte entre o “*Value for the Customer*”, a percepção de valor para o cliente e os ativos endógeno exógenos da empresa, quer este modelo seja aplicado no contexto da negociação ou no contexto da proposta de valor.

Keywords: Valor, Valor para o Cliente, Valor percebido, Ativos tangíveis e intangíveis, Redes de Valor, Redes Colaborativas, Fuzzy AHP

Abstract

The research in this dissertation builds on the different dimensions of the value creation analysis. Members of the organization may have different understanding of the perceived value of the enterprise offer. Customer's also perceive the products/services in different ways and time has definitely a direct impact in the perceived value, from the pre-purchase to the post-purchase phases. In this research, a Conceptual Model Decomposing Value for the Customer (CMDVC) was proposed, combining several concepts: from the marketing area we have the concept of Value for the Customer; from the collaborative networks area we have the perspective of the enterprise life cycle and the environment characteristics and from the intellectual capital area we have the concept of the value networks. This research further proposes a quantitative model for the Value for the Customer building on the Fuzzy AHP Method. The merits of this approach seem evident from the three case studies conducted along this research, providing a structured approach for the enterprises to know and understand the client/customer needs and how these relate to their endogenous and/or exogenous assets, therefore enabling them to improve their value proposition.

We thus hope that our research on Value for the Customer concerning the development of the CMDVC will contribute not only to extend and improve the existent knowledge foundations but also to produce significant value to the enterprises, by building the bridge between the Value for the Customer, customer perception of value and the enterprise endogenous and exogenous assets, whether it is applied to negotiation setting or in the context of the value proposition.

Keywords: Value, Value for the Customer, Perceived Value, Tangible and Intangible Assets, Value Networks, Collaborative Networks, Fuzzy AHP

1 Introduction

1.1 Motivation

At first glance, my personal motivation for embracing a PhD was to develop my professional and research skills. The PhD candidate works at an Engineering School, which requires full collaboration and team integration in different methodologies, perspectives and concepts. Multidisciplinary research was in fact in the horizon while being aware that this is the first step of a long journey of learning with the objectives of solving real-life and practical problems.

The specific motivation for the topic of this PhD dissertation emerged as the actual research unfolded, namely as a consequence of the early literature review that helped frame the research project objectives. The concept of Value, and of Perceived Value emerged very early in the process and the literature review led to the discovery that there was no quantitative model for describing the so-called “Value-for-the-Customer”. This realization allowed the combination of two streams in the author’s motivation. On the one hand the work on quantitative methods that build on the author’s mathematical background, on the other, the objective desire of developing models that would contribute to filling this gap in the literature.

1.2 Background and research context

Value for the Customer (Woodall, 2003) is one of the most important factors in the success of an organization, maybe it is the master key to overcome the boundless challenges of this global competitive market. This is recognized by (Teece, 2010 p172) when stating that “(...) The essence of a business model is in defining the manner by which the enterprise delivers value to customers (...)”. Moreover “knowledge on value is important in business market

management” (Sumantri and Lau, 2010), because as customers become more demanding, competition is always intensifying its pressure to overtake gains and influence, while economic and industrial growth slows down, and quality is not always an adequate source of competitive advantage. (Hassan, 2012 p68) says that “Loyal customers are the key factor of success in all organizations”. They spend money, they recommend to others and they repeat the acquisition from the same organization, as long as it delivers consistent value, also to new customers. Studying Value for the Customer (VC), it is more and more an indispensable tool to create new customer loyalties in all kind of markets, expand global sales and improve the organization efficiency in a customer/client oriented way. “Perhaps surprising then is that firms often do not know how to define value, or how to measure it” (Anderson and Narus, 1998 cited by Lindgreen 2005, p.2). This research relies on the definition proposed by Woodall (2003) for Value for the Customer:

“Value for the Customer is any demand-side, personal perception of advantage arising out of a customer’s association with an organisation’s offering, and can occur as reduction in sacrifice; presence of benefit (perceived as either attributes or outcomes); the resultant of any weighed combination of sacrifice and benefit; or an aggregation, over time, of any or all these”, (Woodall, 2003 p.2).

But the value derived by one individual is likely to be different from the value derived by another. So, we can say not only does each of us value the same things differently, we, individually, value different things at different times in different ways (Woodall, 2003). Value is a slippery concept which is very dependent on perception. The huge challenge many companies are facing “is to develop an offering that is both flexible and capable of being tailored to fit the specific requirements of customers” (Rahikka et al., 2011). To overcome this challenge, we have to understand how customers assess and perceive the actual product/service. But enterprises have a hard time defining value, measuring it, understanding how it is produced, delivered and perceived by the customer (Anderson et al., 2006, Lindgreen and Wynstra, 2005). In this context, for any business enterprise to anticipate the value for the customer, it must understand how the “dynamics of value conversion” go “beyond the asset view of intangibles to understand the function of intangibles as negotiable goods and as deliverables.” (Allee, 2008a p6). In this we agree with Allee in that value is “(...) an emergent property of the network, so, understanding the functioning of the network as a whole is essential to understand how and why value is created. (...)” (Allee, 2008a p12). This was the starting point of this research and led to a later focus on point of interaction between the enterprise and its client/customer in understanding how tangible and intangible assets, either endogenous or exogenous to the company, contributed to the perception of value. The perception would be built upon the assessment of the set of deliverables comprising the actual product/service composing the enterprise offering.

This research proposes a modeling framework, the so-called “Conceptual Model Decomposing Value for the Customer” (CMDVC) and a quantitative model that aims at enabling the supplier enterprise to better understand how customer’s perceive value and what are the key points to innovate or renovate the enterprise business to offer the customer an enhanced value proposition.

The proposed Conceptual Model for Decomposing Value for the Customer builds on a combination of the following concepts:

- 1) Forms of value and Value temporal positions (Woodall, 2003);
- 2) Value Network exchanged tangible and intangible deliverables, building on the enterprise tangible and intangible assets (Allee, 2000b, Allee, 2000a, Allee, 2002a), Allee, 2008a);
- 3) Enterprise Endogenous and Exogenous assets, concept extracted from ARCON, A Reference Model for Collaborative Network Organizations (Camarinha-Matos and Afasarmanesh, 2008c, Camarinha-Matos and H. Afasarmanesh, 2008a).

The proposed novel modeling framework and the underlying quantitative model fills a research gap in the literature and builds value for managers that are provided with the means to rationalize how their customers perceive the value of their deliverables (Product/Service) and how these relate to the enterprise endogenous and exogenous assets. This model comprises the understanding that time has direct impact in customer perceived value, because perceptions change from the pre-purchase phase to the post-purchase phase. In a longitudinal perspective and to reduce the scope of this research, we limited the analysis to an Ex-Ante phase, handling the beginning of the contract proposal and studying the customers' perceived value whenever they contemplate the purchase.

1.3 Methodology and research questions

This research project followed the “Design Science” approach proposed by Hevner, March et al “through the building and evaluation of artifacts designed to meet the identified business need” (Hevner et al, 2004 p7). This author further stresses that “design-science research requires the creation of an innovative, purposeful artifact for specified problem domain” (Hevner et al, 2004 p11). This approach provided the adequate setting for what we had in mind. In fact, we wanted to develop a new model (artifact), a “Conceptual Model Decomposing Value for the Customer” as well as an underlying quantitative model. In this sense, we extended and improved the “existing foundations in the design-science knowledge base” (Hevner et al, 2004 p19) in new and innovative way. The point we want to make is to determine how well our model work, using “information from the knowledge base (e.g. relevant research) to build a convincing argument for the artifact’s utility” (Hevner et al, 2004 p18).

The research validation combined the Case Study Approach as described by Dubé and Paré (2003) and “informed arguments” from the literature review that helped build the case of the results validation (Hevner et al, 2004 p18). The central notion to “use case studies as basis from which to develop a theory inductively” (Eisenhardt and Graebner, 2007 p25), is to recognize relationship among construct, replication logic and extension to the emergent theory (Eisenhardt and Graebner, 2007). Also, the “creative development of novel, appropriately evaluated model, constructs, (...), that extend and improve the existing foundations in the design-science knowledge base are also important contributions” (Hevner et al, 2004 p19).

Building on an Exploratory Case Study, and following the “design criterion in exploratory case research” (Dubé 2003, p 604), we first validated the proposed Conceptual Model for Decomposing Value for the Customer. It was in this context of looking at both the literature review and the business environment that the following research questions were tuned and designed:

1. How can the Value for the Customer be modelled?
 - 1.1 How is this value built on top of assets endogenous and exogenous to the organization?
 - 1.2 How do endogenous and exogenous assets influence the Value for the Customer?”
2. Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?

The “How” and “Why” questions lead to the usage of the Case Study approach aiming at an in-depth understanding of the phenomena and this really fitted our objectives. The next step was to understand how many case studies we would use in our research. Generally the analysis of multiple case studies has greater validity, but a question arises as to the number of the case studies among researchers. As examples we would refer: (Eisenhardt, 1989) suggests a range for a number of case studies; b) (Voss et al., 2002) suggests the fewer case studies the greater opportunity for depth observation; c) (Gerring, 2004) argues the number of the case studies according two types of case studies (type I temporal variation; type II no temporal variation); d) (Baxter and Jack, 2008) argues the importance for multiple case studies but doesn’t mention a number or even a range. Our decision on the number of case studies to use builds on the opinion of others authors said that a meticulous understanding requires the study of a small number of cases since every additional case reduces the time resources available (Miller and Salkind, 2002). Time was indeed a restriction and we reasoned that we would have an in-depth study of each of the case studies thus ensuring the validation of the results that would be further supported by the continuous literature review. We therefore defined that we would do a total of three case studies in companies that would be representative of a relevant segment of Portuguese companies.

The selection of the case studies was made based on the Eurostat (Eurostat, 2008) definition of small enterprises as having from 10 to 49 persons employed, and of medium-sized enterprises having from 50 to 249 persons employed. Eurostat further states that SMEs employ 37.7% of Europeans and are responsible for 36.8% of all value added. The remaining share of people employed is divided into 33.3% and 29%, respectively in large and small enterprises. Those companies are therefore representative of an important group for enterprises for the European economy.

We started the whole process with an exploratory Case Study conducted at a Small and Medium Enterprise (SME) called Centro Preventivo de Medicina do Trabalho (CPMT) in Porto, seeking the first validation of the proposed model. We were aware that, in this context, “although early identification of possible constructs can be helpful, it is equally important to recognize that it is tentative in theory building case research” (Dubé 2003, p 607). This articulates with Hevner, March et al. (2004) iterative approach with successive assessments and refinements in the theory building process. CPMT operates in the Occupational

Safety and Health Services sector. It has a permanent staff of 20 employees and 10 external regular collaborators.

The second Case study was conducted at a textile SME in the North of Portugal, Regina & Miguel Lda (REMI). REMI is a textile company with 20 employees and it is as well a good representative of an important industry sector in Portugal.

The third case study was conducted in a microenterprise called Pontechem, responsible for distributing raw material for the footwear industry. According to Eurostat, 5% percent of microenterprises in European Union (EU) are located in Portugal, where they represent 95.4 percent of the sector of Small and Medium Enterprises and employ 41% of the workers. According to data from the statistics office of the EU, the share of the sector of Small and Medium Enterprises (SMEs) in employment is in Portugal, 80.9 percent and 66.9 percent in the EU. "Microenterprises are much more dominant in the SME sector in Portugal than in almost all other Member States," reads the study on the essential contribution of microenterprises on job creation presented by the European Commission (EC) (Lusa, 2012). Also, according to the National Statistics Institute, in 2011, "84.7% of non-financial corporations were microenterprises, while medium-sized firms accounted for 2% and large companies were only 0.4% of the total" (Santos, 2014). In this context, we selected the third case study at the microenterprise Pontechem, which is also representative of an important enterprise group in European economy.

This research was conducted at each of the enterprises with personal interviews of enterprise members. We started with a recorded interview with open-ended questions, where they explained their routine and perceptions of how services unfold within the enterprise. The information gathered in the interview, the documents provided by the enterprise and the field observations during company visits offered the researcher multiple sources of evidence to support this work. This further enabled data triangulation, constructing, a stronger case study as well as evidences (Yin, 1999). Data collection and analysis was supported by the Business Narrative Modeling Language (BNML) approach (Oliveira and Pinto Ferreira, 2011). The narrative segmentation of the interview allows the construction of a direct relationship between each narrative text segment and a narrative pattern and, as a consequence, with all other items (Assets, deliverable value identification, Value temporal position, Forms of Value, Arcon Endogenous and Exogenous components) used as a coding scheme (Table 2 – paper IV) for the analysis. The resulting relationships are structured as a table in Microsoft Excel. Pivot tables are finally used to select the desired views on the data that is, finally, exported as a text file to Graphviz. This tool enables the visualization of graphs picturing the relationships among the keywords used in the coding scheme.

1.4 Conclusion

Figure 1 outlines the research path as a sequence of five original research papers. This approach was outlined from the very beginning, where each paper represents a milestone in the research project development.

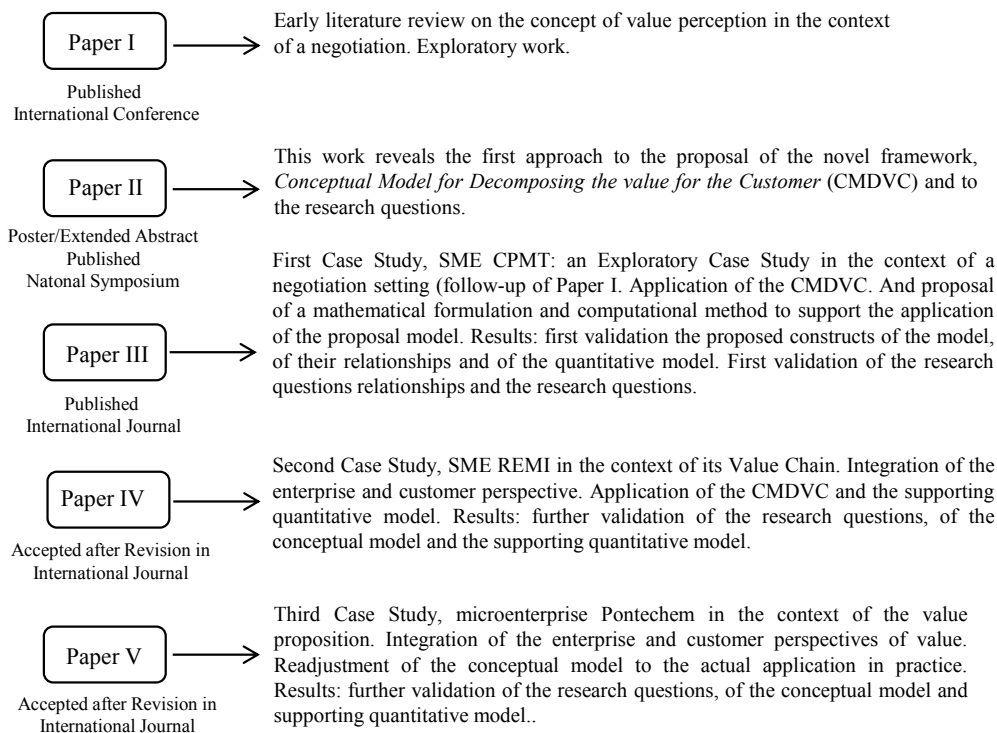


Figure 1 - A summary of the PhD research project involving a total of five papers.

The motivation for writing these papers was, respectively:

Paper I: (p9) This paper is the result of the early literature exploration on the concepts of value and value perception. At this point time we were looking at the negotiation setting where negotiators aim at a win-win situation and where the understanding of the other party perception of value is of particular relevance. This work was indeed the seed to a deeper understanding of the path that would be later followed in this research, to be reflected in the next papers.

Paper II: (p17) Paper I led the author to a further exploration of the concept of Value as well as an effort to understand the need to frame the context in which value is delivered and perceived. From this approach emerged the so-called “Conceptual Model for Decomposing the Value for the Customer” that is introduced here for the first time. This Model build on concepts stemming from: a) Value for the Customer (Woodall 2003); b) Collaborative Network Organizations, namely ARCON (Camarinha-Matos and Hamideh Afasarmanesh 2008); and c) Value Networks introduced by Allee (2008).

Paper III: (p23) This paper is the natural evolution of the work developed in Paper I and II. In fact, the model proposed in Paper II is further tuned and adjusted. A mathematical computational model is proposed using the Fuzzy AHP method. This means that we now support the proposed Conceptual Model with a quantitative model that aims at enabling the application in practice of the proposed concepts. This paper introduces

formally the Research Questions and uses the first exploratory case study to validate proposed constructs of the model and their relations at CPMT. This case study was of particular relevance for better grasping the whole concept and its quantitative application in a real business setting. The results were relevant as the testimonials from the enterprise confirm upon the discussion of the merit of the approach. This enabled the first validation of proposed answers to the research questions. Further validation was achieved through the continuous literature review that helped confirmation of the different research finds along the case study. As this paper refers to a negotiation setting from the enterprise perspective, the actual customer value perspective was not considered in this paper.

Paper IV:
(p69) Using “multiple case studies” provides a more precise assessment of relationships between connections and constructs, as well as the accuracy and appropriate level of the constructs (Eisenhardt and Graebner, 2007). We indeed aim at creating more robustness and a generalizable and testable CMDVC model applied in several case studies. With this objective in mind, we wanted a new case study where we would be able not only to validate the relationships between connections and constructs used in Paper III, but, as well, to bring in the customer perspective into the equation. It should be reminded that “interviews are a highly efficient way to gather rich, empirical data”, however, data collection bias is a problem widely recognized (Eisenhardt and Graebner, 2007). This issue was overcome by the natural combination of the interviews and the filling of pair-wise comparison tables used for Fuzzy AHP method and, again, new interviews for the discussion of the quantitative results. This approach allowed new issues (not mentioned during the first interviews) to emerge from the results of the quantitative Fuzzy AHP method. On its turn, the final interviews allowed the review/confirmation of the quantitative results and findings. The whole process was combined with the continuous literature review to further support the research findings.

Paper V:
(p105) In this document the author consolidates the research developed in two previous case studies by bringing a third case to the discussion. The paper builds on the experience acquired in the data collection process, analysis and final discussion with the company, and proposes a “three-steps approach” to decomposing and assessing the value for the customer. This is an important realization and enables the systematic application of the process for future projects. This paper brings its contribution to supporting the proposed answers to the research questions and concludes with the proposal of future developments to bring the results of this research into practice.

The organization of this document combines these papers organized chronologically in chapter two. The third chapter develops a general discussion of the developed research, results and limitations of the study. This discussion aims at integration the whole results achieved. The last chapter, the fourth, we have the conclusions and directions of future research.

2 Published Papers

2.1 Paper I

Nicola, S., Pinto Ferreira, E. & Pinto Ferreira, J. J. Value Model For Supporting Negotiation In Collaborative Networks. Published in the Proceedings of the IADIS International Conference e-Society 2010, 474-478. <http://www.iadis.org> .

Motivation

This paper is the result of the early literature exploration on the concepts of *value* and *value perception*. At this point time we were looking at the negotiation setting where negotiators aim at a win-win situation and where the understanding of the other party perception of value is of particular relevance.

This work was indeed the seed to a deeper understanding of the path that would be later followed in this research, to be reflected in the next papers.

VALUE MODEL FOR SUPPORTING NEGOTIATION IN COLLABORATIVE NETWORKS

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ABSTRACT

In this paper we describe a model for Supporting Negotiation in Collaborative Networks. Combining the research results of three areas: Collaborative Network Organizations, Value Network and Decision Support Systems, our objective is to provide enterprises and individuals whose activities unfold in the scope of collaborative networks, with models and tools to support their daily activities. This model presents the ARCON endogenous and exogenous elements integrated with the identification of tangible and intangible values and the assets (Allee 2008) at stake in the negotiation. In this model we apply Decision Support Systems to assist negotiation decision process and multi-criteria models that can help decision-makers in leading a process that creates value.

KEYWORDS

Collaborative Network, Value Network, Negotiation Support System, Negotiation.

1. INTRODUCTION

Any business activity is intrinsically about negotiation. It's about delivering some tangible and intangible good or service and having its value accepted and rewarded by your peer/customer/client, either inside your enterprise or collaborative network or outside. In this context, it is our objective to provide enterprises and individuals, whose activities unfold in the scope of collaborative networks, with models and tools to support their daily activities. To this end, this research work combines research results from three distinct areas: a) Collaborative Network Organizations, namely ARCON Reference Model for Collaborative Organizations Networks (Camarinha and Hamideh Afasarmanesh 2008); b) the "Value Network" concept introduced by (Allee 2000) whose purpose can be summarized, in her own words (Allee 2008), as "How do we convert intangible assets such as human knowledge, internal structures, ways of working, reputation, and business relationships into negotiable forms of value?"; c) the usage of Decision Support Systems to assist in the multi-criteria evaluation of alternative offers along the negotiation process. This paper is structured as follows. We present a background of collaborative networks and value network concept, followed by negotiation and negotiation support systems concepts (in section 2). We finally develop our proposal for supporting negotiation in a collaborative network (in section 3).

2. BACKGROUND

2.1 Collaborative Networks

A Collaborative Network (CN) is a network of autonomous entities that could be people or organizations, geographically distributed and heterogeneous that collaborates in order to better achieve common or compatible goals, whose interactions are supported by a computer network (Camarinha and Hamideh Afasarmanesh 2008). The concept of Collaborative Network Organization (CNO) refines the former

definition by introducing the existence of some form of organization in terms of membership structure, activities, definition of the participant's roles and governance principles and rules. Another possible specialization is the Ad-hoc Collaboration, where we have a form of spontaneous cooperation without an explicit structure or organization. The realization of CNOs may be motivated by long-term strategic alliances or to respond to well-defined objectives ("Goal-Oriented Networks").

Collaborative Networks are clearly a habitat for negotiation activities and this is the scenario where, in this paper, we visualize the unfolding of business activities.

2.2 Collaborative Networks

The topic of value networks has been an interesting field for researchers and practitioners (Biem and Caswell 2008),(Allee 2009), (Karl-Erik Sveiby 2001). In 1975, Verna Allee, introduced the idea in business networks. Value creation was notably a monetary measure, which focused more attention from the owners, shareholders, investors, and financial enterprises. Traditional business thinking was based on the exchange of goods, services and the generation of revenue - trading value chain. Allee proposed that these interactions were much more than material exchanges, depending upon the exchange of information and knowledge assets, allowing agreements to be reached without going into conflict. Indeed, these exchanges not only create value but are essential to the success of the company (Allee 2002). This led to the definition of value network (Allee 2002): "Any network of relationships that generate value tangible or intangible, through the dynamic interaction between two or more individuals, groups or organizations. The value chain is to understand "How to convert intangible assets such as human knowledge, internal structures, ways of work, reputation and business relationships into negotiable forms of value?", (Allee 2008). Intangible assets include the exchange of strategic information, planning knowledge, technical know-how, collaborative work, joint planning activities, competence of employees and policy development (Allee 2002). The tangible assets are defined as contractual transactions involving goods, services and income were not confined only to physical goods, services, government, and return receipts of orders, requirements for proposals, confirmations and payments. Knowledge of products and services that directly generate revenue, contract or paid as part of services or goods (eg reports). To determine whether a delivery is considered tangible or intangible is necessary to verify the nature of the contract and not the physical nature. The tangible assets are financial and other resources of social capital that are controlled by the firm.

Any organization can be understood as value network (Allee 2000). We can see a network as an organizational structure for the exchange of tangible and intangible value, i.e., in the form of a value network.

2.3 Negotiation

2.3.1 The Negotiation Concept

According to (Filzmoser and Vetschera 2008) "negotiations are dynamic processes in which the parties involved communicate to exchange offers, make concessions, raise threats, or otherwise influence each other in order to reach an agreement". The authors Aldo de Moor and Hans Weigand (De Moor and Weigand 2004) after analyzing several negotiation definitions stressed that those definitions shared common elements such as the fact that there are two or more participants, each of them with individual goals that may not be totally compatible. They also highlight that in a negotiation: there is usually a process involved; that there are alternatives to be investigated; and that there is a shared purpose to reach an agreement.

Every negotiator must negotiate to win, but there are two ways of winning: the first is to reach an agreement where involved parties' interests are met; the second is at the expense of the other party. The possible outcomes of a negotiation can be better understood as illustrated in Figure 1. According to (Carnevale and Pruitt 1992) there are four ways to reach a deal: a) There is no agreement (NA), b) the agreement favors only one of the parties with no compensation to the other party (1 or 5) c) Only one compromise (2,3,4), d) Agreement with a Win-Win Negotiating (6,7,8), are possible win-win solutions where x adds several improvements that benefit y more than the cost of x. The dashed/dotted lines for scenarios A, B and C give us the value limits tangible or intangible (eg, monetary value, business relationships, internal structures, human competence, environmental responsibility, social responsibility) that each party does not wish to exceed within a transaction.

These scenarios (A, B and C) give us the limits and difficulties that have to be overcome within a negotiation. These issues arise from multiple factors and problems involving the different parties' non-overlapping objectives as well as conflicting criteria to which we could further add risk perception, as well as behavioral (Vetschera 2007) and organizational environment issues (Swaab, Postmes et al. 2004). In his publication regarding the decision making perspective to negotiation, (Bazerman 2009) further refers to Raiffa's research mentioning that negotiators' behavior should not be considered as always acting rationally. Moreover, negotiators sometimes tend to aim at a particular objective such as getting a particular share of total deal, missing opportunities for mutually beneficial exchange. The point is that value is also perceived and therefore valued differently and failing to consider the opponent's perspective may lead to losing opportunities.

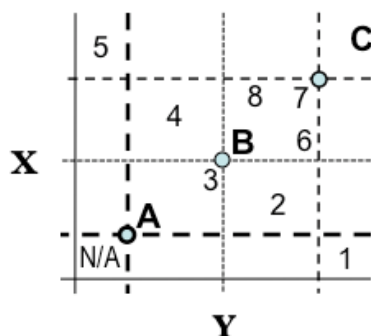


Figure 1. Negotiation scenarios, adapted from (Carnevale and Pruitt 1992)

Each negotiation process has its life cycle, depending on the negotiation model used (De Moor and Weigand 2004). The model of Gulliver defines 8 stages of negotiation: (1) identifying the scope of the negotiation; (2) structuring the process to be followed as well as working on definitions of the issues to be tackled in the negotiation; (3) producing early statements of demands and offers, in order to explore and identify the existing limits, and locate the differences that may exist between the parties involved; (4) examine ways to reduce existing differences and reach agreements on some issues; (5) preliminaries to final deal; (6) final deal; (7) mutual confirmation of the final negotiation outcome; and finally (8) deal implementation".

2.3.2 Negotiation Support System

A Negotiation Support Systems (NSS) (De Moor and Weigand 2004) can be defined as an assembly of computer techniques that support the different social or analytical aspects of the negotiation life-cycle. Moreover, NSS not only improve the quality of the negotiation results, but they are increasingly needed as more and more business are being conducted electronically. NSS are comprised typically by two parts, a Decision Support System (DSS) to assist the decision making process, and a Group Support System (GSS) and is responsible for ensuring the communication among the involved parties.

In this research project we aim at developing some of these functionalities, namely Negotiation Preparation and Evaluation Systems and Process Support Systems. In the context of Negotiation Preparation and Evaluation Systems we provide: 1) the (two or more) parties involved in the negotiation with the tools to build a proposal for negotiation and the means to weight both the actual value (proposal cost) and perceived value by the other party (how the proponent thinks the opponent values each item composing his proposal); 2) a framework to explicitly support the modeling of both the tangible and intangible value building in the Collaborative Network. In this context of Process Support Systems we provide a proprietary format, in the form of an excel worksheet, that should enable an easy interaction for the dialog between the two parties.

3. NEGOTIATION IN THE COLLABORATIVE NETWORK

In this paragraph we now relate the previous concepts into a structure that supports the process of explicitly handling the value exchange in a Collaborative Network. To this end, we looked into the ARCON Reference Model for Collaborative Networks (Camarinha and Afasarmanesh 2008).

ensure that the provided tools assist the negotiator in weighting among possible alternatives, combining their internal costs and perceived value, providing therefore different views and ways for evaluating the available scenarios.

As the negotiation modeling environment allows the modeling the tangible and intangible value of a broad range of issues, both endogenous and exogenous to the Collaborative network, this enables strategic issues to be reflected globally in the network and, therefore, made available to all negotiators in the CN. As an example we could mention the situation where a particular customer should have a particular favorable treatment because the CN has on-going negotiations and wants that company to join the collaborative network in a short term. In the NSSX, this intangible value would be reflected in the Market exogenous element where we would like highlight that this strategic customer is entitled to a special treatment as we want it to become a partner in the collaborative network.

REFERENCES

- Allee, V. (2000) "RECONFIGURING THE VALUE NETWORK." *Journal of Business Strategy* 21, 36-39 DOI: 10.1108/eb040103.
- Allee, V. (2000). "The value evolution: Addressing larger implications of an intellectual capital and intangibles perspective." *Journal of Intellectual Capital* 1(1): 17-32.
- Allee, V. (2002) "A Value Network Approach for Modeling and Measuring Intangibles."
- Allee, V. (2008). "Value network analysis and value conversion of tangible and intangible assets." *Journal of Intellectual Capital* 9(1): 5-24.
- Allee, V. (2009). "Building Value Networks Competencies."
- Bazerman, C.-J. T. a. M. H. (2009). "A Decision-Making Perspective to Negotiation: A Review of the Past and a Look into the Future." *Negotiation Journal* 25(4): 467 - 480
- Biem, A. and N. Caswell (2008). A Value Network Model for Strategic Analysis. Proceedings of the Proceedings of the 41st Annual Hawaii International Conference on System Sciences, IEEE Computer Society.
- Camarinha, L. and H. Afasarmanesh, Eds. (2008). Collaborative Networks: Reference Modeling.
- Camarinha, L. and Hamideh Afasarmanesh (2008). ARCON reference models for collaborative networks. Collaborative Networks: Reference Modeling: 83-112.
- Carnevale, P. J. and D. G. Pruitt (1992). "Negotiation and Mediation." *Annual Review of Psychology* 43(1): 531-582.
- De Moor, A. and H. Weigand (2004). "Business Negotiation Support: Theory and Practice." *International Negotiation* 9: 31-57.
- Filzmoser, M. and R. Vetschera (2008). "A Classification of Bargaining Steps and their Impact on Negotiation Outcomes." *Group Decision and Negotiation* 17(5): 421-443.
- Karl-Erik Sveiby, S. S. o. E. a. B. A., Helsinki, Finland (2001). "A knowledge-based theory of the firm to guide in strategy formulation." *Journal of Intellectual Capital* 2.
- Swaab, R., T. Postmes, et al. (2004). "Negotiation Support Systems: Communication and Information as Antecedents of Negotiation Settlement." *International Negotiation* 9: 59-78.
- Vetschera, R. (2007). "Preference structures and negotiator behavior in electronic negotiations." *Decis. Support Syst.* 44(1): 135-146.

ERRATA

- Pg 11,
Line 24
and 36 Presently reads: "...Camarinha and Hamideh Afasarmanesh..."
Change to: "...Camarinha-Matos and Afasarmanesh..."
- Pg 12,
Line 8 Presently reads: "Collaborative Networks"
Change to: "Value Networks"
- Pg 15,
Line 25
and 26 Change references to:

LM Camarinha-Matos & H. Afasarmanesh (2008). Collaborative Networks: Reference Modeling. Springer Science+Business Media, LCC
LM Camarinha-Matos & H. Afasarmanesh (2008). ARCON reference models for collaborative networks. Collaborative Networks: Reference Modeling: 83-112

2.2 Paper II – Poster /Extended Abstract

Nicola, S., Pinto Ferreira, E., Pinto Ferreira, J.J (2012), “Conceptual Model for Decomposing the Value for the Customer”, Porto, NW Portugal. In: IEMS '12. 3rd Industrial Engineering and Management Symposium; January 5th

Motivation

Paper I led the author to a further exploration of the concept of Value as well as an effort to understand the need to frame the context in which value is delivered and perceived. From this approach emerged the so-called “Conceptual Model for Decomposing the Value for the Customer” that is introduced here for the first time. This Model build on concepts stemming from: a) Value for the Customer (Woodall 2003); b) Collaborative Network Organizations, namely ARCON (Camarinha-Matos and Hamideh Afasarmanesh 2008); and c) Value Networks introduced by Allee (2008).

Conceptual Model for Decomposing the Value for the Customer

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Conceptual Model for Decomposing the Value for the Customer

Student: Susana Nicola
Supervisors: João José Pinto Ferreira & Eduarda Pinto Ferreira

Methodology

Design Science in Information Systems Research proposed by Hevner, A. R., S. T. March, et al. (2004), combined with the **Case Study Approach** as described by Dubé, L. and G. Paré (2003). The actual data collection and processing followed the **BNML** proposed by Oliveira & Ferreira (2011).

Research Results

Proposal and Validation of a novel “Conceptual Model for Decomposing the Value for the Customer” integrating the illustrated concepts. This validation was further achieved through the usage of the Fuzzy AHP Method that enabled the development of a formal mathematical model for the CMDVC.

IEMS'12

1 Introduction

Value has been defined in different theoretical contexts as need, desire, interest, standard /criteria, beliefs, attitudes, and preferences. The creation of value is key to any business, and any business activity is about exchanging some tangible and/or intangible good or service and having its value accepted and rewarded by customers or clients, either inside the enterprise or collaborative network or outside. “Perhaps surprising then is that firms often do not know how to define value, or how to measure it” (Anderson and Narus, 1998 cited by [1]). Woodruff echoed that we need “richer customer value theory” for providing an “important tool for locking onto the critical things that managers need to know”. In addition, he emphasized, “we need customer value theory that delves deeply into customer’s world of product use in their situations” [2]. In this sense, we proposed and validated a novel “Conceptual Model for Decomposing the Value for the Customer”. To this end, we were aware that time has a direct impact on customer perceived value, and the suppliers’ and customers’ perceptions change from the pre-purchase to the post-purchase phases, causing some uncertainty and doubts. We wanted to break down value into all its components, as well as

every built and used assets (both endogenous and/or exogenous perspectives). This component analysis was then transposed into a mathematical formulation using the Fuzzy Analytic Hierarchy Process (AHP), so that the uncertainty and vagueness of value perceptions could be embedded in this model that relates used and built assets in the tangible and intangible deliverable exchange among the involved parties, with their actual value perceptions.

2 Methodology

The structure of this research work follows the “Design Science” approach proposed by the Hevner, March et al. [3] that “seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artefacts”. This paper further builds on an Exploratory Case Study, following the “design criterion in exploratory case research” [4], as we seek the first validation of the proposed model. We were aware that, in this context, “although early identification of possible constructs can be helpful, it is equally important to recognize that it is tentative in theory building case research” [4]. This articulates with Hevner, March et al. [3] iterative approach with successive assessments and refinements in the theory building process.

3 Case Study Modeling and Analysis

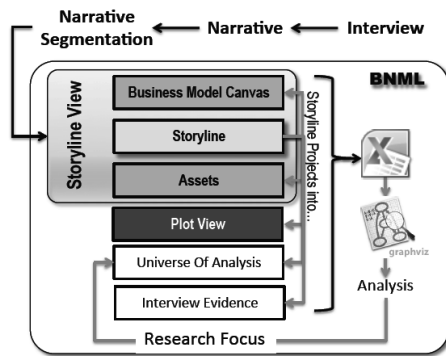
The Exploratory Case Study was conducted at a Small and Medium Enterprise (SME) in Porto along the second semester of 2010. Data analysis was supported by the so-called Business Narrative Modeling Language (BNML) proposed by Oliveira and Pinto Ferreira [5]. The BNML approach is illustrated in 1. As pictured, the story line is projected, onto the Universe of Analysis and onto the interview evidence. The coding scheme of Universe of Analysis was composed by combining keywords that define: a) the deliverable identification [6]; b) value temporal position [7]; c) forms of value [7]; d) and each deliverable projection onto the Reference Model for Collaborative Organizations Networks (ARCON) Endogenous and Exogenous components [8]. The interview segmentation into narrative patterns, pictured as deliverable exchange descriptions, allowed the construction of a Microsoft Excel table where each line establishes the relationship among all coding scheme terms and the interview evidence that provides the rationale for those relationships. Following the BNML approach, the Excel worksheet is then further processed using “pivot tables” in order to extract the desired perspectives onto the data model.

4 Conclusion

This research proposed and validated a novel “Conceptual Model for Decomposing the Value for the Customer” illustrated in 2 by relating the following concepts: a) Value for the Customer and the implied “Forms of Value” and “Value Temporal Positions” [7]; b) the “Endogenous” and “Exogenous” perspectives proposed by ARCON; c) the exchange of Tangible and Intangible Assets introduced by [6]. The validation was further achieved through the usage of the Fuzzy AHP Method that enabled the development of a formal mathematical model for the CMDVC that relates customer value (benefits/sacrifices) and the usage and construction of assets. As a result, managers will be able to identify and look into critical things, as wished by Woodruff [2].

References

- [1] A. Lindgreen and F. Wynstra, “Value in business markets: What do we know? where are we going?” *Industrial Marketing Management*, vol. 34, no. 7, pp. 732–748, 2005.
- [2] R. Woodruff, “Customer value: The next source for competitive advantage,” *Journal of the Academy of Marketing Science*, vol. 25, no. 2, pp. 139–153, 1997.



BNML Storyline View

- **Business Model Canvas:** Osterwalder [9]
- **Storyline:** Bjork and Holopainen's Game Patterns [10]; Uschold's Enterprise Ontology [11]; Allee's Value Exchange [6]
- **Assets:** Allee's Tangible and Intangible Assets [6]

Figure 1: BNML Approach

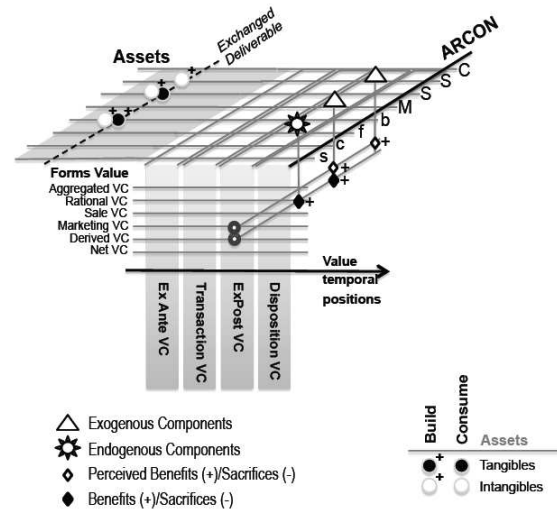


Figure 2: Conceptual Model for Decomposing the Value for the Customer (CMDVC)

- [3] A. R. Hevner, S. T. March, and et al, "Design Science in Information Systems Research." *MIS Quarterly*, vol. 28, no. 1, pp. 75–105, 2004.
- [4] L. Dubé and G. Paré, "Rigor in information systems positivist case research: Current practices, trends, and recommendations," *MIS Quarterly*, vol. 27, no. 4, pp. 597–636, 2003.
- [5] M. A.-Y. Oliveira and J. J. P. Ferreira, "Facilitating qualitative research in business studies: Using the business narrative to model value creation," *African Journal of Business Management*, vol. 5, no. 1, pp. 68–75, 2011.
- [6] V. Allee, "Value network analysis and value conversion of tangible and intangible assets." *Journal of Intellectual Capital*, vol. 9, no. 1, pp. 5–24, 2008.
- [7] T. Woodall, "Conceptualising value for the customer: an attributional, structural and dispositional analysis," *Academy of Marketing Science Review*, vol. 12, 2003.
- [8] L. Camarinha and H. Afasarmanesh, "ARCON reference models for collaborative networks," in *Collaborative Networks: Reference Modeling*. Springer Science+Business Media,LCC, 2005, pp. 83–112.
- [9] A. Osterwalder and Y. Pigneur, "Business models and their elements," in *Position Paper for the International Workshop on Business Models*, Lausanne, Switzerland,2002.
- [10] S. Bjork and J. Holopainen, *Patterns in game design*. Hingham MA,USA: Charles River Media, 2005.
- [11] M. Uschold, M. Uschold, M. King, and et al., "The enterprise ontology," *The Knowledge Engineering Review*, vol. 13, pp. 31–89, 1998.

2.3 Paper III

Susana Nicola, Eduarda Pinto Ferreira, J. J Pinto Ferreira, " A Novel Framework for Negotiation Decision Support in Collaborative Networks", Accepted 12th March 2012 in International Journal of information technology & Decision Making. Global Institute For Scientific Information (Gisi) - Journal Impact Factor (2012) - 5.3681.

Motivation

This paper is the natural evolution of the work developed in Paper I and II. In fact, the model proposed in Paper II is further tuned and adjusted. A mathematical computational model is proposed using the Fuzzy AHP method. This means that we now support the proposed Conceptual Model with a quantitative model that aims at enabling the application in practice of the proposed concepts.

This paper introduces formally the Research Questions and uses the first exploratory case study to validate proposed constructs of the model and their relations at CPMT. This case study was of particular relevance for better grasping the whole concept and its quantitative application in a real business setting. The results were relevant as the testimonials from the enterprise confirm upon the discussion of the merit of the approach. This enabled the first validation of proposed answers to the research questions. Further validation was achieved through the continuous literature review that helped confirmation of the different research finds along the case study. As this paper refers to a negotiation setting from the enterprise perspective, the actual customer value perspective was not considered in this paper.

A NOVEL FRAMEWORK FOR MODELING VALUE FOR THE CUSTOMER, AN ESSAY ON NEGOTIATION

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This paper proposes a novel framework for modeling the Value for the Customer, the so-called Conceptual Model for Decomposing Value for the Customer (CMDVC). This conceptual model is first validated through an exploratory case study where the authors validate both the proposed constructs of the model and their relations. In a second step the authors propose a mathematical formulation for the CMDVC as well as a computational method. This has enabled the final quantitative discussion of how the CMDVC can be applied and used in the enterprise environment, and the final validation by the people in the enterprise. Along this research, we were able to confirm that the results of this novel quantitative approach to model the Value for the Customer is consistent with the company's empirical experience. The paper further discusses the merits and limitations of this approach, proposing that the model is likely to bring value to support not only the contract preparation at an Ex-Ante Negotiation Phase, as demonstrated, but also along the actual negotiation process, as finally confirmed by an enterprise testimonial.

Keywords: Customer perceived value; modeling value; collaborative network; value network; negotiation.

1. Introduction

Any business activity is intrinsically about value exchange. It is about delivering some tangible and intangible good or service and having its value accepted and rewarded by one's peer/customer, either within or outside one's company. Value has been defined in different theoretical contexts as need, desire, interest, standard/criteria, beliefs, attitudes, and preferences. Value is, therefore, very dependent on perception. Many researchers have studied customer perceived value from different perspectives. Some have studied the influence of customer perceived value on loyalty¹;

others have studied the influence of perceived value on customer satisfaction¹⁴; still others follow Zeithaml's approach,² in line with Lapierre,³ who studied customer perceived value in an industrial context, dividing this into benefits and sacrifices.

In this context, it is our objective to provide firms with a model that builds the bridge between Value for the Customer,⁴ customer perception of value and enterprise usage and building of both tangible and/or intangible assets that can be either internal or external to business unit under analysis.

This model comprises the understanding that time has a direct impact on customer perceived value, and that the suppliers' and customers' perceptions change from the pre-purchase to the post-purchase phases.⁴ We therefore break down every value component, as well as every built-and-used asset, into their endogenous and exogenous perspectives along different time positions.

The research presented in this paper combines results from three distinct areas areas: (a) from the Marketing area, the concept of Value for the Customer⁴; (b) from the collaborative networks area, the ARCON Reference Model for Collaborative Organizations Networks⁵; (c) from the Intellectual Capital area, the concept of "Value Network", introduced by Ref. 6 whose purpose can be summarized in her own words,^{7,8} as "How do we convert intangible assets such as human knowledge, internal structures, ways of working, reputation, and business relationships into negotiable forms of value?" In this context, this paper derives the so-called Conceptual Model for Decomposing Value for the Customer (CMDVC) and its mathematical formulation in the context of an exploratory case study.⁹ The paper further illustrates the usage of this Conceptual Model in the preparation of a contract in a pre-negotiation setting. It concludes with the application of the formal mathematical model of the CMDVC using the Fuzzy AHP (analytical hierarchical process) method in the context of the case study and the final discussion of the results.

2. A Novel Framework for Modeling Value

2.1. Literature review

Customer Perceived Value

Long lasting relationships can help supplier and customer in the process of creating higher value that can be mutually beneficial. In business markets, few firms have the knowledge to assess value, and therefore need to understand how this is decomposed into its components and "what drivers create value for the customer" (see Ref. 3, p. 122) in order to obtain an equitable return for the value they deliver to the customer. Moreover, customers' "purchase decisions are often guided by a careful assessment of what benefits they obtain in exchange" (see Ref. 3, p. 123) such as expenses in acquiring and consuming products/services and costs of ownership.

From the point of view both of customer and supplier, it is essential to know how to create and deliver value in the relationship, "particularly as the product itself may end up becoming a commodity (see Ref. 10, p. 594).

Value creation is a concept that is difficult to achieve, understand, model and/or conceptualize. Some authors consider value creation a trade-off between benefits and sacrifices perceived by customers during a supplier's offering.¹¹ Lindgreen and Wynstra¹² consider creating and delivering customer value as a concept and illustrate its complexity. They consider it important to distinguish between two major research streams: (i) the value of goods and services; and (ii) the value of buyer–seller relationships, also mentioned in Allee's research as an exchange of tangible and intangible assets.¹³ Goods and services or buyer–seller relationships can be related to as benefits and sacrifices, in the exchange of either tangible or intangible assets.

In marketing literature, the term “customer value” is used to illustrate a scenario derived by the customer from the supplier, and also by the supplier from the customer. Different customers perceive different value for the same products/services. In addition, organizations involved in the purchasing process can have different perceptions of customers' value delivery.¹⁴ Lindgreen and Wynstra¹² further stress this statement by saying that value, as perceived by the producer, means something different from the value perceived by the user, i.e., the producer is less sensitive to price, whereas the consumer is more sensitive to the product quality. It is therefore necessary to establish models to support buyer–seller relationships where emphasis can be placed on improving supplier performance with a view to its effect on perceived value for the customer.¹⁴ As result, there is a clear need for a balance between the proposed value of product/service and the actual value perceived by the customer or end-user.

Zeithmal² has suggested that “perceived value is the consumer's overall assessment of the utility of a product based on perceptions of what is received and what is given”. This complexity and multidimensional nature of the conceptualization of perceived value can be seen in Ref. 15.

Subsequently Woodruff¹⁶ defines customer perceived value as: “(..) preference for and evaluation of those products attributes, attribute performances, and consequences arising from use that facilitate (block) achieving the customer's goals and purposes in use situations”.

Customer perceived value normally focuses on a buyer's evaluation at the time of a product purchase. From a longitudinal perspective, Huber *et al.*,¹⁷ Parasuraman⁵⁴ and Woodall⁴ state that customers are not able reliably to predict what they will value in the future and different types of value are experienced by the customer from the pre-purchase phase to a later post-purchase phase. To understand how customers determine/perceive value in a sequential activity of a value proposition, Woodall⁴ divides Value for the Customer (VC) into four value temporal positions:

- Pre-purchase — a phase of trying to predict how people perceive their services,¹⁷
- At the point of trade — which implies a sense of VC experienced at the point of trade; e.g., Acquisition Value plus Exchange Value,
- Post-Purchase — a phase that delivers results of experiments based on customers'/suppliers' choices; e.g., Use value; Received Value,¹⁷

- After/use experience — a phase that reflects the point of disposal/sale.
- Furthermore, but linked to the above, Woodall classified Value for the Customer into different forms of value,
- Net VC — “balance of benefits and sacrifices” to provide the best or the worst VC,
- Marketing VC — “perceived products attributes”,
- Sale VC — primarily concerned with the price,
- Rational VC — “difference from the objective price”,
- Derived VC — users’ experiences.

Measuring value for the customer and predicting how customer and supplier will perceive a value proposition is a strategic tool for clarifying a company’s propositions to its customer and creating a value offer superior to that of its competitors.

The perspectives “Value for the Customer” and “Perceived Value” were explored in depth in Refs. 4 and 15, but the decomposition of value is not dissected and broken down into its components, namely the firm assets used and build in the construction of the exchanged value, whether internal or external to the company or organization. For this reason we seek the integration of the above definitions with concepts that stem from research areas such as value networks and collaborative networks.

Value Networks

The topic of value networks has been an interesting field for researchers and practitioners.^{18–20} In the eighties Sveiby introduced the concept of intangible assets and in 1997 he stated that: “People are the only true agents in business. All assets and structures — whether tangible or intangible — are the result of human actions. All depend ultimately on people for their continued existence.” Allee¹³ further stresses that “intangibles are at the heart of all human activity, especially socio-economic activity,” and goes on to argue that “intangibles go to market as negotiable in economic exchanges” and that “intangibles act as deliverables in key transactions that take place in any given business model.” The understanding of intangible value and how it is exchanged is, therefore, of the utmost importance in a discussion of how value is exchanged and perceived and, ultimately, in the construction of the product/service Value Proposition.

Collaborative Networks

A Collaborative Network (CN) is a network of autonomous entities that might be either people or organizations, geographically distributed and heterogeneous, which collaborate in order to better achieve common or compatible goals, whose interactions are supported by a computer network.⁵ CNs are complex systems whose understanding encompasses several scientific areas ranging from engineering to social sciences such as management and law. As CNs “focus on the structure, behavior, and evolving dynamics of networks of autonomous entities that collaborate to better achieve common or compatible goals,”²¹ the density of the whole concept has to be modeled in order to reduce complexity and allow for the adequate handling of

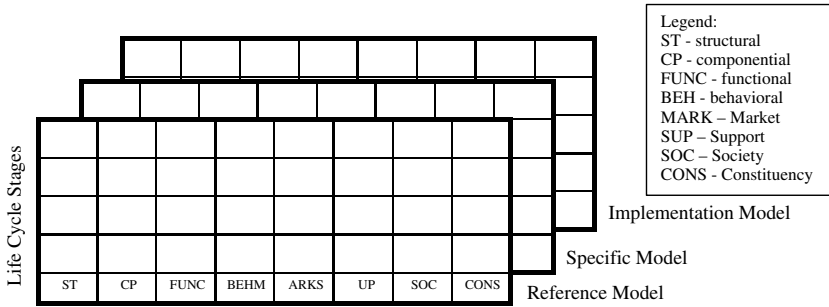


Fig. 1. ARCON through the perspectives of Value Network.

consistent subsets of the whole problem domain. To this end, Camarinha and Afasarmanesh⁵ proposed the ARCON modeling framework.

The Reference Model for Collaborative Network Organizations (ARCON)^{5,22} provides a generic and abstract representation that enables the understanding of all involved entities and the relationships between all of them. This model comprises three perspectives (Fig. 1): (1) the life cycle perspective, illustrating from the lowest row the CN phases (Creation, Operation, Evolution, Metamorphosis and Dissolution), (2) the modeling intent (general representation, specific model and implementation model), and (3) the endogenous and exogenous components of each of the phases.

Within the scope of our research we focus on the collaborative network daily activities that comprise both the operation and the evolution phases. Figure 1 also illustrates the so-called endogenous elements that capture and represent Collaborative Network Organizations (CNOs), under the following four dimensions: Structural (ST), Componential (CP), Functional (FUNC) and Behavioral (BEH). On the other hand, the outside perspective is captured by the exogenous elements that reveal the interaction with the surrounding environment and are divided into four dimensions: Market (MARK), Support (SUP), Societal (SOC), and Constituency (CONS).

2.2. Research question & methodology

The structure of this research work follows the “Design Science” approach proposed by Hevner *et al.*²³ that “seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artefacts”. This paper further builds on an Exploratory Case Study, following the “design criterion in exploratory case research” (see Ref. 9, p. 604), as we seek the first validation of the proposed Conceptual model for Decomposing Value for the Customer. It was in this context of looking at both the literature review and the business environment that the following research question was tuned and designed:

1. *How can the Value for the Customer be modeled?*

1.1 *How is this value built on top of assets endogenous and exogenous to the organization?*

1.2 *How do endogenous and exogenous assets influence the Value for the Customer*

2. *Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?*

As we conduct our research we are aware that, in this context, “although early identification of possible constructs can be helpful, it is equally important to recognize that it is tentative in theory building case research” (see Ref. 9, p. 607). In this context and in order to validate a proposal model constructs and their relationships, an Exploratory Case Study was conducted at a Small and Medium Enterprise (SME). According to Ref. 55, small enterprises have from 10 to 49 persons employed, whereas medium-sized enterprises have 50–249 persons employed. The selected company operates in the Occupational Safety and Health Services sector. It has a permanent staff of 20 employees and 10 external regular collaborators. Reference 55 further states that SMEs employ 37.7% of Europeans and are responsible for 36.8% of all value added. The remaining share of persons employed is divided into 33.3% and 29% respectively in large and small enterprises. This company is therefore representative of an important group for enterprises for the European economy. This was the main drive to select Centro Preventivo de Medicina do Trabalho (CPMT) to be our Unit of Analysis⁹ for our exploratory Case Study.

2.3. *Proposed conceptual model for decomposing the value for the customer*

It is our objective to understand how Value for the Customer could be broken down into component elements or simpler constituents integrating the value perceived by both suppliers and customers. To this end we derived the model in Fig. 2, which illustrates how to project the Value for the Customer of each exchanged deliverable⁸ on to the following dimensions:

- The Forms of Value and Temporal Positions. The diagram maps the Forms of Value within their temporal positions, because “not only does each of us value the same things differently, we individually value different things, and at different times in different ways” (see Ref. 4, p. 4),
- The ARCON Endogenous and Exogenous perspectives²² in the operation phase of the collaborative network life cycle,
- The usage and construction of tangible and/or intangible assets,^{7,8} which are going to be projected across the collaborative networks’ endogenous and exogenous perspectives.
- The Perceived Benefits (PB) and Perceived Sacrifices (PS), both by the enterprise itself and by the Customer — as seen by the people in the enterprise pictured and as a white diamond — are pictured in the illustration. These PB and PS will

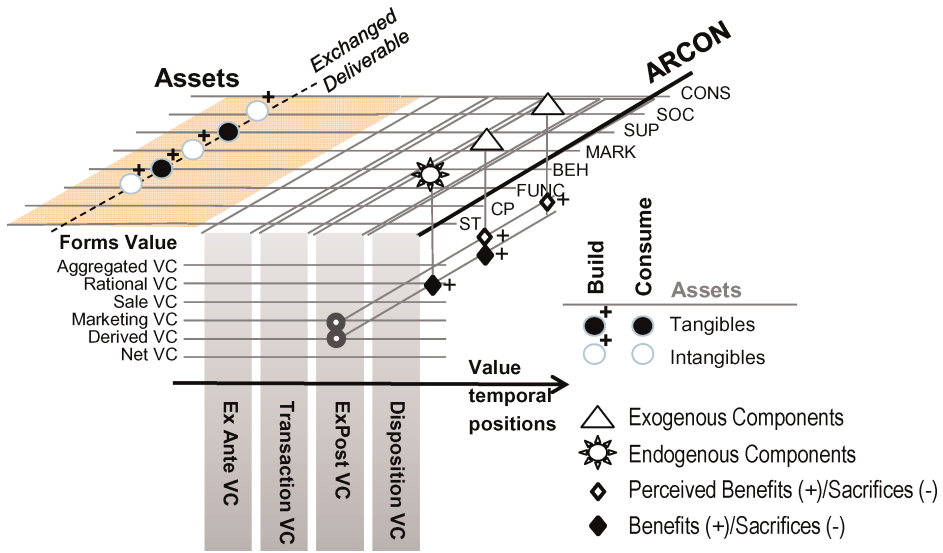


Fig. 2. Conceptual Model for decomposing the Value for the Customer.

provide the means to derive the relative value of each asset and, as a consequence, the relative value of each tangible of intangible exchanged deliverable.

3. Case Study

3.1. Unit of analysis

The present Case Study was conducted at CPMT in Porto along the second semester of 2010. Figure 2 illustrates the CPMT value network.^{6-8,13,19,24} The roles picture real people in the network, who perform different activities within CPMT. This study will focus on two roles, the Safety Service Manager and the Service Provider Manager and in their interaction with the customer company. As illustrated in the Value Network, transactions begin in one participant and end in another. Solid lines depict the exchange of tangible assets (e.g., process changes to improve safety), and dashed lines the exchange of intangible assets (e.g., improve worker health and happiness). The arrows express the direction of the exchange between two roles. The deliverables are the tangible or intangible assets that move from one participant to another.⁷

Using the information gathered in the interview and following the Business Narrative Modeling Language (BNML) approach, proposed by Oliveira and Pinto Ferreira,²⁵ the exchange of the deliverables between the CPMT and its customers were modeled and analyzed. In our approach we aimed at understanding how a Service Proposal from CPMT to one of its customers is decomposed as a finite set of deliverables. This analysis resulted in decomposing a Service Proposal into 19 deliverables provided from the CPMT to its customer at the “point-of-analysis” pictured in Fig. 3.

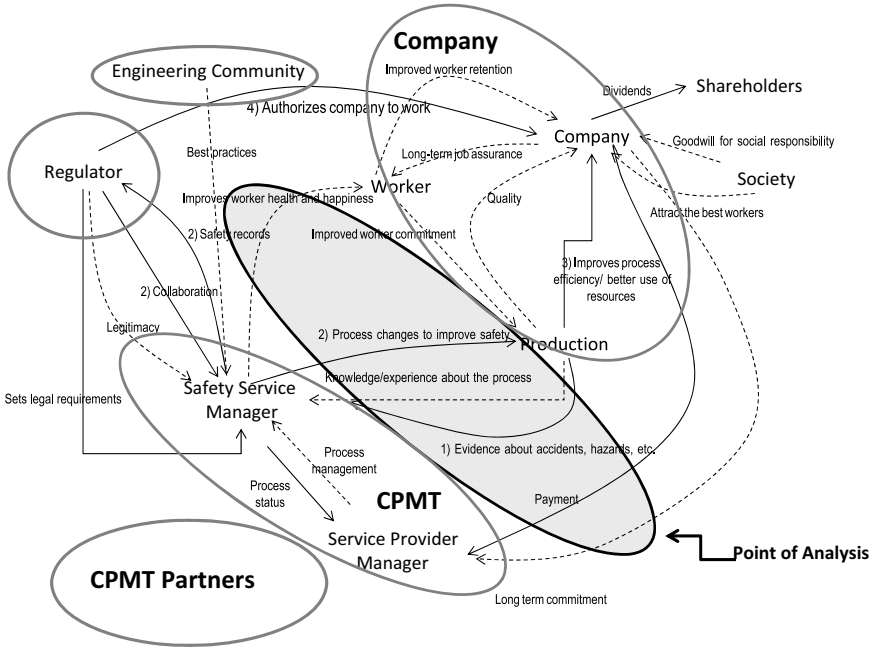


Fig. 3. Value Network for CPMT.

3.2. Data collection methodology

This case study was conducted at the company through the personal interview of two enterprise members. We started the process with a recorded interview with open-ended questions to the managers of the “Safety and Industrial Hygiene Services” and “Quality” departments. For the first phase the goal was to have an informal conversation, where they explained their routine and perception of how services unfold within the enterprise. With the support of the interviewee, we could investigate “a phenomenon within a specific natural setting” and using “multiple sources of evidence”²⁶ to gain experience and perceive certain issues which we aimed to extract in detail. In a second interview round, the interviewees were asked to give a very detailed description of all deliverables exchanges across the point-of-analysis (Fig. 3). These interviews combined with documents provided by the enterprise allowed the triangulation of the collected information.

3.3. Deliverable exchange at the point of analysis

We were able to identify three deliverables areas: the one related with the Customer Requirements, the ones that cover to whole value offered by the CPMT to customer companies, under the Value Proposition, and, finally, those related with the actual Service operations. For each of these areas and in the course of the interview, we were

able to identify several deliverables. Their identification and final validation was made in collaboration with both interviewees.

The Requirements area comprises the following deliverables: Customer Company Legal Requirements (DL_1 — Legal Requirements Customer); CPMT Legal Requirements (DL_2 — Legal Requirements CPMT), CPMT legitimacy (DL_3 — CPMT legitimacy); and Best Practices (DL_4 — Best Practices). The DL_1 is, in fact, the reason for the existence of CPMT. Companies need this Health and Safety Audits to get their operating license. The other deliverables are detailed in the context of the following interview excerpts.

Interview excerpts:

Regarding the legal requirements needed for the CPMT (DL_2) the interviewee referred that “(...) *to provide an occupational health service, as well as good safety and hygiene standards, the company must be legally empowered to do so. There is a set of statutes stating that companies must be legally qualified to provide a service.*” “*The terms of the contract may be adjusted at the very beginning of the service and while it is being carried out.*” It was further mentioned that CPMT has to fulfil legal requirements that define “(...) *how [CPMT] should operate. There is a regulation that lays down a mechanism for accreditation. Companies have to be legally accredited to be able to provide this service.*”

Regarding the CPMT legitimacy (DL_3) the interviewee referred: “(...) *in the same way, the CPMT must have a legal entitlement to operate.*” That is “*companies must be legally qualified in order to provide the service.*”

In a most relevant remark, it was stated that “(...) *the rules do not define everything, there are good practices in business*”. As an example “(...) *we have the best practices that we use and that are not specified by law: related with the medical records; Medical Exams Protocols recommended by the Medical Association (“Ordem dos Médicos”); and other practices such as several protocols for some types of exams, that we use and that are common practice in Spain.*” This means that the Best Practices (DL_4) provided by the CPMT is a most relevant deliverable.

The Value Proposition area comprises the following deliverables: Improvement in Worker Health and Happiness (DL_6), Improve Worker Commitment (DL_7), Health and Safety Audits (DL_8). The Value Proposition (DL_5) was considered itself a deliverable as it allows the instantiation, as a whole, of actual customer value perception of the CPMT service. Value Proposition as defined by Osterwalder and Pigneur²⁷ is “the bundle of products and services that create value for a specific Customer Segment.”

Interview excerpts:

According to the interviewee the Value Proposition (DL_5) “(...) *is evaluated by the customer at the beginning of the negotiation, as soon as the contract is entered into*”. It is also evaluated in another phases, because sometimes it could suffer

some adjustment, as “(...) other additional activities, which will be contracted as they appear.”

When talking about the Worker Health and Happiness (DL_6) the interviewee referred that: “(...) we can identify the point of view of the customer gains in service safety and hygiene, including: legal requirements; improved working conditions; improved productivity; contribution to quality improvement as well as worker satisfaction.”

About Improving Worker Commitment (DL_7), it was mentioned that “(...) it is an objective of the enterprise improve the worker commitment” also “(...) sometimes the CPMT team must be prepared to change the objectives to which they originally proposed. Must face some adversity to get new resources to safety improve.” As an illustration of this dynamic adjustment, CPMT promotes flexibility by allowing the worker check-ups to be made at the best convenience of the actual worker. This becomes very convenient for the customer company workers that travel and are often away from the company headquarters.

Finally, regarding to Health and Safety Audits (DL_8) the interviewee referred that “(...) usually there is a productive process during which audits are carried out, and the company also provides information about that process.” “(...) by assessing the state of the customer facilities, e.g., noise levels, the service provider can make a pre-analysis of working conditions.”

The Service area comprises the following deliverables: Process Changes to Improve Safety (DL_9), Process Changes Implementation (DL_{10}), Knowledge/Experience about the Process (DL_{11}), Payment (DL_{12}), Long-term Commitment (DL_{13}), Evidence about Accidents and Hazards (DL_{14}), Service Quality (DL_{15}).

Interview excerpts:

The deliverable Process Changes to Improve Safety (DL_9) is related to the needed flexibility to adjust the service to the customer’s company needs. This could involve, as in DL_7 , the service provision in another location. This could further involve having particular exams made in particular points in time, or need, the next for unforeseen exam requirements. These changes are made “(...) to improve safety and hygiene that has effects on [the customer] production”.

The CPMT has to face with some Changes in the Process Implementation (DL_{10}) because “(...) there are companies that want to make their workers check-ups outside the seasonal production peaks in order to avoid affecting the productivity.” “When faced with a situation that is not covered in the original contract, we have two situations: (1) we propose to provide the service ourselves; (2) but we always give our customers the chance to subcontract that service in another company, we have this attitude for the sake of transparency, and, if requested, we help in selecting the service provider.”

Knowledge/Experience about the Process (DL_{11}) was implicitly acquired by CPMT along its many years of successful operation in Portugal. This was

accomplished through the systematic gathering of information regarding “(...) *evidence about accidents and about on the products used (...)*” and by keeping abreast with the state-of-the-art in this area.

The Long-term Commitment (DL_{13}) results in having “(...) *customers renew[ing] their contract*”. This also relates with CPMT knowledge about the process that adds value to the whole Value Proposition to the customer.

Evidence about Accidents and Hazards (DL_{14}) is related with the: “(...) *information and evidence about accidents on the products used and on assessments made about levels of noise and fumes (...)*”. In face of Evidence about Accidents and Hazards, there are “(...) *legal requirements to be met and there might be accidents that may affect the actual production process that may have to be changed and improved.*”

The interviewee has further referred to the CPMT Service Quality (DL_{15}). This customer perception improves “(...) *once working conditions improve, the quality of work increases (...)*”. For example “(...) *by reducing the noise level and avoiding accidents, the quality of work [at the customer company] increases.*” On the other hand, “(...) *if we ensure that the check-ups and exams are performed in less and X hours, this becomes a competitive advantage for the customer company*”. At this point we would add that CPMT is certified ISO9001:2000.

3.4. Data analysis methodology

Data analysis was supported by the so-called BNML proposed by Oliveira and Pinto Ferreira²⁵ outlined in Fig. 4.

The coding for this research was centered in the following views on the collected data for each Deliverable (DL_i) exchanged in the point-of-analysis (Fig. 3):

- Business Model Canvas (Storyline view),
- DL_i projection onto the used and build assets (Storyline view),
- Universe of Analysis
 - Deliverable identification,^{7,8}
 - Deliverable Value Exchange (perception),^{7,8}
 - Value Temporal Position of DL_i ,⁴
 - Forms of Value related to DL_i ,⁴
 - DL_i projection onto the ARCON Endogenous and Exogenous components,²²
 - DL_i projection onto the Enterprise Ontology.⁵⁶
- Interview evidence.

The interview segmentation into narrative patterns allows the construction of a Microsoft Excel table where each line establishes the relationship among the different coding scheme terms and the interview evidence that provides the rationale for those relationships. For this Case Study, the narrative pattern is, in fact, the actual

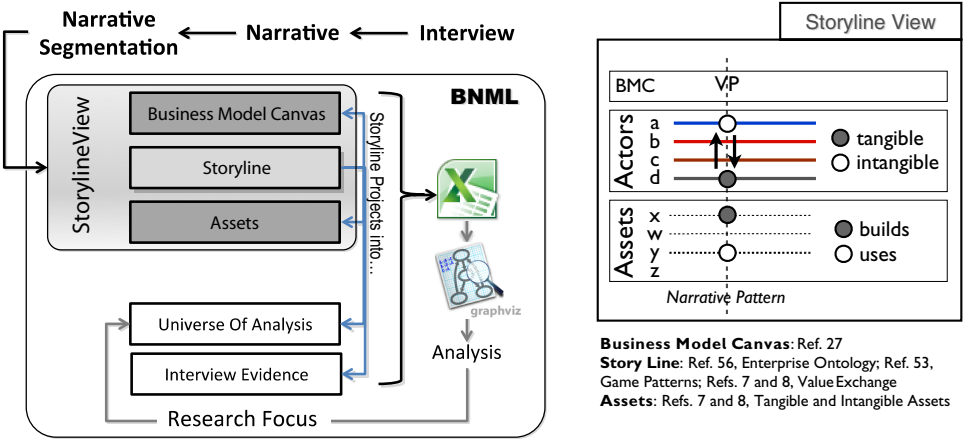


Fig. 4. Business Narrative Modeling Language.²⁵

detailed deliverable description. The Excel worksheet is then further processed using “pivot tables” in order to extract the desired perspectives onto the data model. For the sake to limiting the discussion of this Case Study in the context of this paper, we limited the analysis to the Ex-Ante time position, the Pre-purchase phase. In this context, we will be looking into a contract preparation phase and, therefore, at the set of foreseen deliverable exchange belonging to that contract.

4. Case Study Discussion

4.1. Perspective of analysis, pre-purchase phase

The analysis of the Pre-Purchase phase that corresponds to the period before the handing of the contract proposal to the CPMT customer seemed most interesting, as it relates to the perceived Value for the Customer “whenever they contemplate the purchase” (see Ref. 4, p. 10). This phase is related to “a guess about probability of uncertain future consequences,” and involves several decisions in order to measure the *Ex-Ante Time Position for the Value For Customer* (EXA_VC) in terms prior to consumption. This is a primary issue in adjusting of the Value Proposition of a product or service. From an Ex-Ante perspective this is fundamentally about whether we will decrease the error and increase relevant information for future funding decisions, by predicting the different scenarios. Since the future of the Value Proposition is unknown and highly uncertain, and the evaluation of the optimum is undetermined, the only objective data is the one collected along historical observations that enterprise (CPMT) has made at their customer’s. This phase is, therefore, a point in time for anticipating future predictable occurrences so that we can “make choices to maximize the ex-post happiness” (see Ref. 17, p. 325).

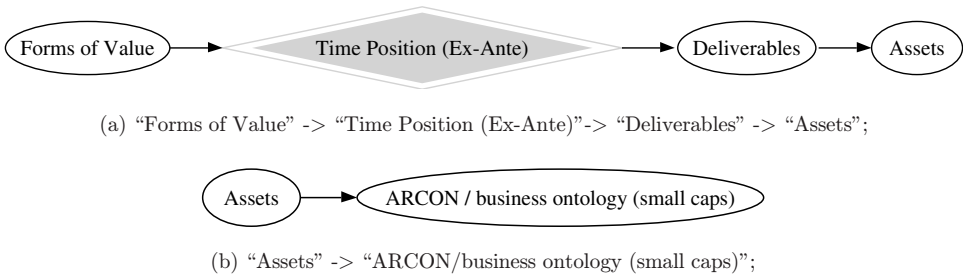


Fig. 5. Analysis Segments of the deliverables for the Ex-Ante Time Position.

4.2. Data analysis and discussion

The analysis to the Ex-Ante time position will be made by converting the excel data and implied connections into a graph using Graphviz. To this end, and for the sake to simplifying the discussion, we will break this temporal position view into two segments outlined in Figs. 5(a) and 5(b).

Forms of value, deliverables and assets

Figure 6 illustrates a graph that relates all different perspectives of analysis (for the segment (a) in Fig. 5) to the Pre-Purchase (Ex-Ante) time position. The graph in Fig. 6 illustrates the connections found for EXA_VC (Ex-Ante Time Position for the Value For Customer) relating "Forms of Value", "Deliverables" and "Assets". As explained before, this graph results from a filter applied using Excel "pivot tables" to the coded data. This filter makes the relations for the "EXA_VC" keyword explicit.

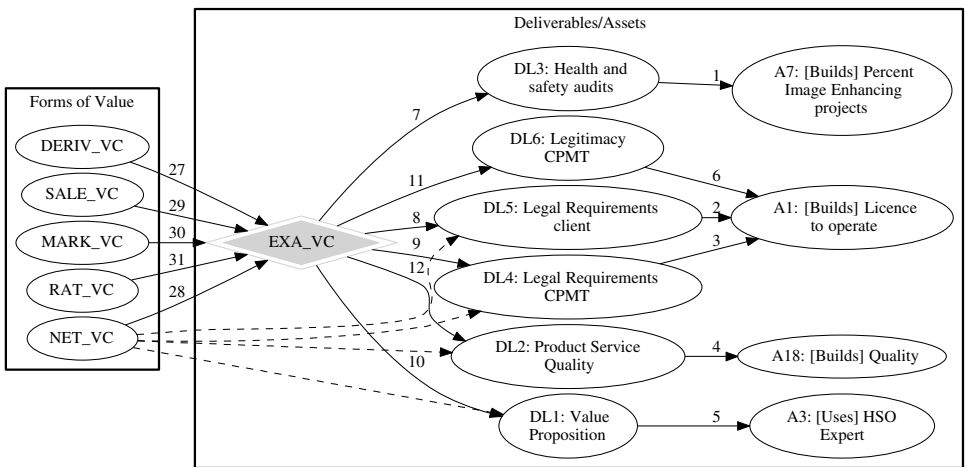


Fig. 6. Graph of the Value Temporal Position — Pre-Purchase (EX-VC) — Segment (a).

Forms of Value

All forms of value emerged from this phase - EXA_VC: the “Derived VC” (DERIV_VC – edge 27), “Net VC” (NET_VC – edge 28), “Sale VC” (SALE_VC – edge 29) “Marketing VC” (MARK_VC, edge 30) e “Rational VC” (RAT_VC, edge 31).

The “balance of benefits and sacrifices”, by equating the weight “and/or quantities of benefits and sacrifices” (see Ref. 4, p. 7) emerges at the so-called “Net VC” form of value. In this form of value we want to evaluate “how customers perceive the total value proposition (e.g., products, services, channels, ideas)” (see Ref. 3, p. 124). This form of value is related directly with the following deliverables (dashed lines): Legal Requirements for CPMT, Legal Requirements by the Customer; Product/Service Quality; and Value Proposition. The lines connecting the other Forms of Value and the Deliverables were not included in the illustration to avoid visual overload.

Marketing VC is linked with a “pre-experience zone and can best be associated with an Ex-Ante temporal perspective,” because “suppliers can never predict how each consumer will perceive and react to a specific service” (see Ref. 4, p. 17). We can say that this form of value is seen as a “perceived component”. It is also imminently linked to the product attributes and “concerned with the way that the organization goes to market”.⁴

Interview excerpts:

Some customers are more concerned with price whereas, in other cases, the CPMT would show that “*the service offers better value.*” For example, “*(...) to have very rapid response times when arranging appointments for temporarily employed workers in other companies.*” Going into further detail, the Marketing VC relates to the following deliverables: Value Proposition (edge 10); Legitimacy (edge 11); Product/Service Quality (edge 12).

Derived VC also appears at this phase, because it relates to expected “uses/experiences outcomes,” “derived from the consumption activity that associates the subject with individual social groups favored”,⁴ helping suppliers fulfil the customer’s needs. The Derived VC relates to the deliverables in edges 7 (Health and safety audits) 10 (Value Proposition) and 11 (Legitimacy).

Interview excerpts:

Expected outcomes demand that “*To provide a service whether for occupational health or safety and hygiene, the company must be legally qualified for the task.*” “*(...) In order to carry out the service, companies have to be legally qualified*” (edge 11, Legitimacy). “*The actual activity of work-based safety and hygiene is related to the legal framework, and is carried out within a complex of legislation which defines what the minimum requirements of safety and hygiene are in accordance with the type and extent of productive activity*” (edge 7, Health and safety audits).

On the other hand, the interviewee referred to the earlier audit preparation by saying that “*(...) when an audit is going to be undertaken there are some already prepared checklists and one must try to make full use of their stipulations, but*

(*this must take place*) while the service is being rendered” (edge 7, Health and safety audits).

Mind that “(...) *this is accomplished before contact with the consumer.*” (edge 10, Value Proposition).

Sale VC appears to be linked “primarily on price” and reduction of sacrifice, and is associated “purely upon units of exchange” (money, for example) “and will almost certainly influence perception on VC” at an Ex-Ante temporal position (see Ref. 4, p. 19). The Sale VC relates to the deliverable in edge 10 (Value Proposition).

Interview excerpts:

The interviewee referred that VC means low relative price “*The aim is to provide the service at lowest possible cost while complying with minimum requirements. We have this kind of customer for whom the cost is all that matters.*” On the other hand some customers are more associated with the reduction of sacrifice by saying that “(...) *the lowest total costs might not correspond with the lowest service cost.*”

The Rational VC combines the notions of exchange value with intrinsic value and, as Net VC, it is essentially utilitarian in nature. It is used “in a predictive context and may be seen as being represented primarily in the ex-ante zone” (see Ref. 4, p. 19). This is a phase in which the customer will predict within what acceptable range he is prepared to pay — either much more or much less — depending on what extra product/service features he requires. The Rational VC relates to the deliverable in edge 12 (Product Service Quality).

Interview excerpts:

The interviewee referred that the VC is a clear demand by the customers. Although suppliers can estimate what price difference the market tolerates for doing different exams, the customer makes an evaluation of “what a fair price might be in relation to the benchmark already established” (see Ref. 4, p. 8). In this context interviewee mentioned that “(...) *the customer could be interested in the exams being conducted in a specific place, in whether there are temporary facilities instead of the examinations being conducted on the main site. He can ask for more exams, besides those already specified by law. There’s a tendency for ever more companies to conduct ever fewer exams. They might need to contract additional services in order to conduct exams at certain times of year.*”

Net VC recalls a “utilitarian perspective on purchase and consumption,” considering an intuitive calculation in dividing benefits and sacrifices. The Net VC relates to the deliverables in edges 10 (Value Proposition), 11 (Legitimacy) and 12 (Service Quality).

Interview excerpts:

As an utilitarian perspective on purchase and consumption, the evaluation of the benefits and sacrifices “(...) *has to be done by the customer.*” However, the CPMT helps the customer balance the involved benefits and sacrifices. Quoting the interviewee “*If the work contributed to customers gains then they will hire CPMT*

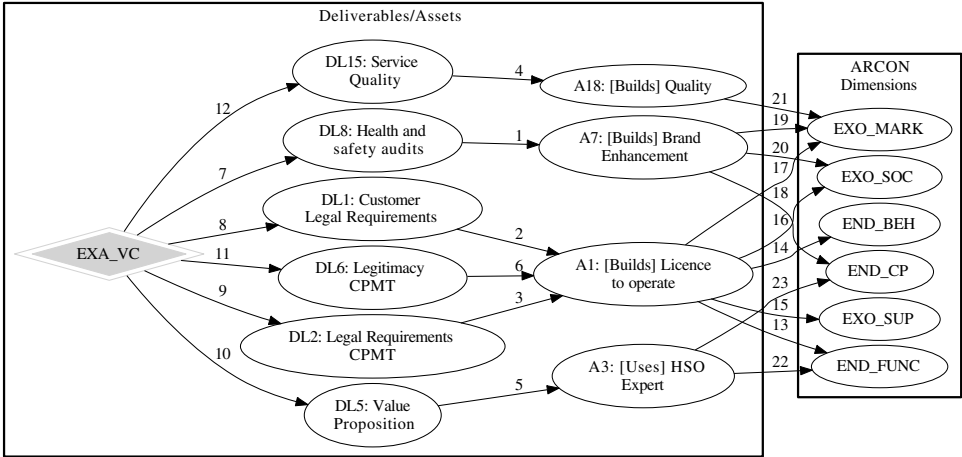


Fig. 7. Graph of the Value Temporal Position — Pre-Purchase (EX-VC) — Segment (b).

again. From the point of view of customer, we can advise some good services in safety and hygiene, including legal requirements, that can improve working conditions, improves productivity, contributing to quality improvement (reduction of costs of nonquality by accident) and worker satisfaction.”

Deliverables, Assets and ARCON Endogenous and Exogenous Perspectives

Figure 7 illustrates segment (b) of the Ex-Ante Time Position of the CPMT deliverables at the point of analysis. This discussion will be centered in the analysis of the assets used or built, and on their endogenous and exogenous composition. This approach will enable a better understanding of how each deliverable, and as a consequence, its perception of value, relates to components that are endogenous and exogenous to CPMT.

Asset A_1 – [Builds] License to Operate

The construction of this asset is related with deliverables DL_1 , DL_2 and DL_6 . The asset A_1 is projected through the ARCON at endogenous and exogenous components. Functional endogenous (END_FUNC – edge 13) “shall define the protocols to be followed as well as participants that shall be involved in each phase” (see Ref. 22, p. 96). This is related with how CPMT operates, either as an isolated company or as a collaborative network, whenever a partnership is used to geographically extend their services. In this context, they all have to fulfil the legal requirements to operate so that they become “(...) *legally empowered to provide a service (...)*”.

The behavioral endogenous (END_BEH – edge 14) dimension “prescribes normative guidelines or rules for the proper behavior of CNO” (see Ref. 22, p. 97). According to the interviewee the CPMT must be legally empowered to work and have the minimum rules to provide the service. This relates to the CPMT stance in relating all aspects regarding the enterprise operation, namely leadership, employee relations, as well as the relations with customers and business partners.

This asset, is linked to the exogenous Support dimension (EXO_SUP – edge 15) since “those entities are entitled to issue certificates of compliance with established regulations or norms” (see Ref. 22, p. 108). In the same way it is related with exogenous Society perspective (EXO_SOC – edge 16) because it “determines the laws that affect or regulate the existence and operation of the [network]” CPMT itself and of its network of partners (see Ref. 22, p. 108). This latter component gives the outside world an indication of what can be expected from the company.

The exogenous Market dimension (EXO_MARK – edge 17) “covers issues related with interactions to customers” (see Ref. 21, p. 11). It is intended for the target market, and offers a range of services, selecting the most relevant opportunities “for achieving its goals and sustainable competitive advantage,” including elements such as transactions and established commitment.²²

Asset A_3 – [Uses] HSO Expert

The usage of this asset is intimately related to the Value Proposition (DL_5) and relates to END_FUNC (edge 22) dimension as resulting from the “consolidation of knowledge acquired” (see Ref. 22, p. 94).

The endogenous Componential dimension (END_CP – edge 23) relates to the “set of documentation/information and assets which inherit from past collaboration cases” (see Ref. 22, p. 93), related therefore with expert acquired experience. On the other hand: “(...) *we have examples of customers, such as a Shoe producer, with special requirements that result from the usage of special components. This is a case that has to be tough and analyzed against best practices (...).*”

Asset A_7 – [Builds] Brand Enhancement

The construction of this asset is related to the Health and Safety Audits (DL_8). The asset is related to the endogenous Componential dimension (END_CP – edge 18) “in terms of their competencies, profile and potential roles they can perform” (see Ref. 22, p. 93). This means that the way the service is provided by all CPMT human resources, namely the way they use their competencies to perform their roles in the process, is critical to CPMT Brand Enhancement.

The EXO_MARK (edge 19) dimension relates to all “relevant past successful collaboration stories from customer, attesting the level of competence” (see Ref. 22, p. 105).

At EXO_SOC (edge 20) dimension relates “the contribution of CNO activities of benefit to the society in general” (see Ref. 22, p. 108). This gives the society an indication what can be expected from the service. In the case of proposed health and safety service, its mission is to “(...) *improve employee satisfaction, improve the image the company decreasing by the aspects related with workplace accidents.*”

Asset A_{18} – [Builds] Quality

This asset also related with the EXO_MARK (edge 21) perspective as it “refers to the actions devoted to deliver information about the competencies and products services in order to attract customers” (see Ref. 22, p. 106)

4.3. Case study conclusion

The graphs in Figs. 6 and 7, validated through the interviews and then revised with the interviewees, demonstrate the connections proposed in the Conceptual Model for Decomposing the Value for the Customer pictured in Fig. 2. We aimed, at this first step, to validate the rationale for the relationships among the different proposed constructs. These results provide the answer to the first research question “How can the Value for the Customer be modeled?” and also to its refinement in question 1.1 “How is this value built on top of assets endogenous and exogenous to the organization?” The detailed analysis of the exploratory case study demonstrated the proposed connections. It also confirmed the role of endogenous and exogenous assets and their relationships to the exchanged deliverables whose value will, ultimately, be perceived by the Customer.

The other two research questions (1.2 and 2) remain to be answered. To this end, we will go through the second step that corresponds to the mathematical formulation of this model that is discussed in the next section. In this section we will see how value perception, as Perceived Benefits and Perceived Sacrifices, are integrated into this model.

5. Deriving the Mathematical Formal Model for the CMDVC

In this section we derive the formal representation of the CMDVC, based on the “Formal Basis for Negotiation Support Systems Research” by Holsapple *et al.*²⁸ This author proposed that a negotiation activity can be described as having five variables:

$$N = (E, DL, RU, AR, t).$$

In N the:

- “ E ” stands for the entities participants,
- “ DL ” represents the set of exchanged deliverables,
- “ RU ” stands for the agreed negotiation rules,
- “ AR ” stands for the region of acceptance, and
- “ t ” stands for the time.

In a negotiation decision problem situation, one or more decision makers make a series of choices with interdependent outcomes. However, decisions that are at first glance unrelated to each other, such as DL_7 (Improved Worker Commitment) and DL_7 (Health and Safety Audits), may also be interdependent, casually related to and jointly affecting some common objectives, for example the building of A_{18} ([Builds] Quality) and A_5 ([Builds] Promotion of Long-term Employee Collaboration). The adaptation of this approach to our model does not impose any restrictions to our approach but extends our concepts by making them readily applicable to negotiation scenarios.

5.1. The deliverable concept

The work of Holsapple *et al.*²⁸ was developed in the context of negotiation. In this context, the notion of deliverable is a matter that is in dispute between two or more parties and can involve conflicts/disputes among entities or a cooperative effort to reach a common goal.

Every negotiation is related to a global Value Proposition and may include several deliverables. In the current context, one may define a deliverable (tangible or intangible) as being represented by the set DL_i :

$$DL_i = \{DL_1, DL_2, \dots, DL_n\},$$

where n is the number of deliverables at stake in the negotiation.

At this point we extend the Holsapple *et al.*²⁸ model by relating each DL_i with the assets used and/or built up in the context of providing that deliverable. This set is represented by the following formulation:

$$A(DL_i) = \{A_1, A_2, \dots, A_m\},$$

where m is the number of assets related to each deliverable. Still in this context, and for each asset, we will have to describe the related benefits and/or sacrifices. We have, therefore:

$B(A_i)$ as the set of benefits:

$$B(A_i) = \{PB_1, PB_2, \dots, PB_q\},$$

where q is the numbers of benefits associated with each asset A_i .

$S(A_i)$ as the set of sacrifices:

$$S(A_i) = \{PS_1, PS_2, \dots, PS_p\},$$

where p is the numbers of sacrifices associated with each asset A_i .

For example, for the asset A_7 – “[Builds] Brand Enhancement” the sets of benefits and sacrifices in the Componential endogenous dimension are:

$$B(A_7) = \{\text{Operational Benefits; Personal Benefits}\},$$

$$S(A_7) = \{\text{Price; Cost of Repair}\}.$$

5.2. The concept of entity

There is a set of entities that have influence on the negotiation of a Value Proposition. An entity can be a person, a group, a computer or a human–machine combination. We assume that entities will be the same during one transaction and use E to represent the set of all the entities:

$$E_i = \{E_1, E_2, \dots, E_p\},$$

where p is the number of entities involved in the negotiation.

In our case study, Fig. 3, we have five entities in the Value Network. However not all of them will be active during the negotiation:

$$E = \{\text{CPMT, Regulator, Company, Partner, Engineering Community}\}.$$

5.3. *The concept of acceptance region*

The acceptance region (AR) gives us the acceptable points within each deliverable. It can be different in all entities and in time (t) but the intersection for all entities (E) in an acceptance region will form a basis for reaching an agreement.

$$\forall_{E_i} \in E, \quad AR_{it} = AR(DL, E_i, RU, t).$$

The AR is composed by the different scenarios of negotiation. As the negotiation unfolds, according to the rules agreed by the parties involved (these rules can be implicit), the value of each dimension will change and therefore the issue value will change as well, as a result of the consolidation of those dimensions. This region will change as the entities involved in the negotiation modify their individual positions.

There should be an agreement area where all points within this zone are possible solutions, i.e., there must be a nonempty solution.

5.4. *The concept of negotiation rules*

The Negotiation Rules, designated by RU , allow all entities involved to act correctly, and are divided into some several categories:

$$RU(TC, RC, RES).$$

“ TC ” — Time Constraints, for instance, or the deadlines,

“ RC ” — Regulation for Coalition Formation,

“ RES ” — Rules for making Decisions.

5.5. *Conclusion*

This section illustrated how the Holsapple *et al.*²⁸ Formal Basis for Negotiation Support System Research was extended to comply with the proposed Conceptual Model for Decomposing the Value for Customer. This extension materialized as result of the need to relate Holsapple’s Deliverables with the endogenous and/or exogenous Enterprise Assets, used or built in the process of fulfilling that deliverable, and the benefits and sacrifices as perceived by the party being considered. This mathematical model of the CMDVC provides the first step answer towards the answer of research questions 1.2 and 2. The final answer is to be expected at the end of the next section where we will apply the proposed model to the case study and realized the first validation through the exploratory case study.

6. An Essay on a Pre-Negotiation Setting, Applying the Conceptual Model to the Case Study

6.1. Negotiation

According to Filzmoser and Vetschera,²⁹ “negotiations are dynamic processes in which the parties involved communicate to exchange offers, make concessions, raise threats, or otherwise influence each other in order to reach an agreement.” The authors De Moor and Weigand,³⁰ after analyzing several negotiation definitions, stressed that those definitions shared common elements such as the fact that there are two or more participants, each of them with individual goals that may not be totally compatible. They also highlight that in a negotiation: there is usually a process involved, there are alternatives to be investigated, and there is a shared purpose to reach an agreement. Moreover, each negotiation process has its life cycle, depending on the negotiation model used.³⁰

Every negotiator must negotiate to win, but there are two ways of winning, the first one being to reach an agreement where the interests of all the involved parties are met; the second being to win at all costs at the expense of the other parties. The possible outcomes of a negotiation can be better understood by studying Fig. 8 (lower-right corner) of a negotiation scenario, which depicts the acceptable ranges within benefits and sacrifices and where “-” indicates a weak negotiating position, while “+” indicates a stronger one. The bold lines represent the very lowest acceptable position for each of the negotiating parties and for each

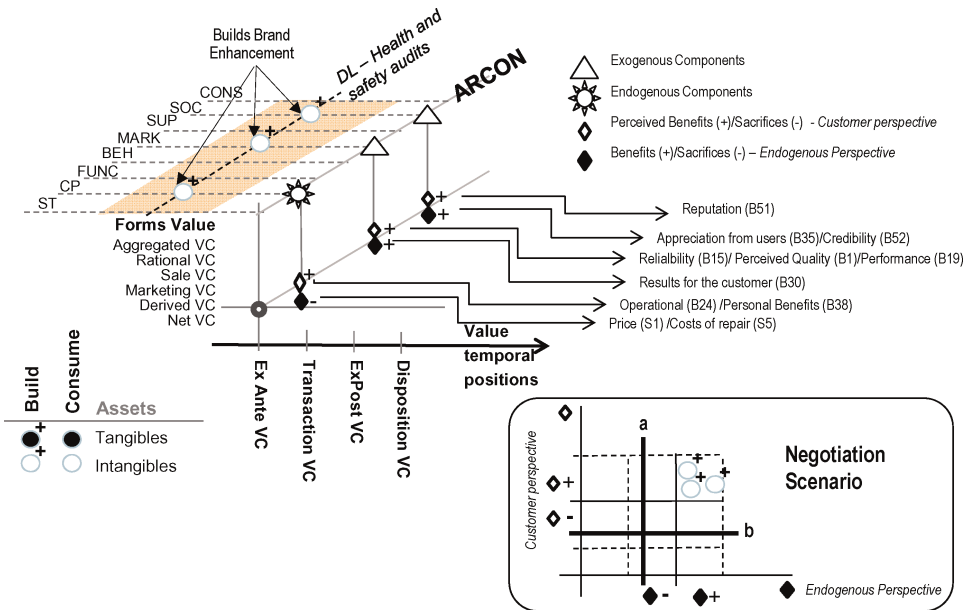


Fig. 8. Decomposing the Value for the Customer of specific DL in an Ex-Ante Phase.

particular deliverable. According to Carnevale and Pruitt (1992) there are four ways of reaching a deal: (a) There is no agreement; (b) the agreement favors only one of the parties with no compensation for the other; (c) only one compromises (meaning that only one is in a weak position); (d) there is agreement with a Win-Win result (both parties are in a favorable position “+”). The broken lines give us the tangible or intangible upper and lower value limits (e.g., monetary value, business relationships, internal structures, human competence, environmental responsibility, social responsibility) that each party does not wish to exceed within a transaction.

For each negotiation the overall real value and the perceived value should be positioned within an agreement area of the negotiation utility space,³¹ such that all players involved feel that they achieve an overall real benefit (win-win) from the negotiation. The two bold lines (a) and (b) give the value limits that each party does not wish to exceed in the value proposition. For example the line (a) could be the internal cost of a particular asset that the company does not wish to exceed and line (b) the cost that the company does wish to maintain in their customer relationships, as this could be an asset whose perceived value is comparatively high.

In this context, this section aims at illustrating the usage of the previously presented mathematical formulation of the CMDVC in the context of a negotiation. As mentioned earlier we will only look at the Ex-Ante phase, meaning, the preparation phase that happens before the contract proposal presentation to the customer and, therefore, before the actual negotiation. This is the point in time where the overall Value Proposition as well as the value of each foreseen deliverable set is weighted against the customer value perception. The mathematical formulation of the CMDVC will enable the fast evaluation of alternative scenarios and support decision making along the whole negotiation process.

6.2. Applying the CMDVC in an Ex-Ante negotiation scenario

This paragraph aims at illustrating the detailed instantiation of a deliverable into CMVDC, enabling therefore an easier understanding of the extension of the formal mathematical model and its application to the case study model at the point of analysis to be analyzed in depth in Sec. 6.3.

This section makes a detailed analysis of one of deliverables analyzed in Fig. 6. DL_8 – “Health and Safety Audits” decomposition in the Ex-Ante Temporal phase is illustrated in Fig. 8. This picture maps the connections featured in the graph of this deliverable presented in Figs. 6 and 7. Moreover, it features the involved benefits and sacrifices in the context of a negotiation scenario. The benefits and sacrifices now emerge as two projections of one sole perspective, the Enterprise Perspective, of: (1) the Endogenous benefits and sacrifices quantified by the enterprise, as they refer to itself; and (2) the Customer Perspective that materializes the enterprise belief of the actual customer perceived benefits or sacrifices. We would add that the error of

this latter quantification can be reduced by integrating the enterprise experience and close customer relationship.

Figure 8 shows DL_8 as building the asset “[Builds] Brand Enhancement” (see Ref. 6, p. 26 Table 2) and how this asset is projected into exogenous/endogenous components of the ARCON, forms of value and value temporal position. Zooming into the detail of DL_8 we can see that this asset is projected on two dimensions of the exogenous components, namely Market and Society, and also on to the endogenous Componential dimension.

Moreover, DL_8 is associated with the benefits and sacrifices for enterprise itself and to the customer perceived benefits/sacrifices, as also seen by the enterprise (CPMT). These benefits/sacrifices arise from multiple factors and problems involving the different parties’ nonoverlapping objectives, as well as conflicting criteria to which we could further add risk perception, along with behavioral³² and organizational environmental issues.³³ In his publication, regarding the decision-making perspective in negotiation, Tsay and Bazerman³⁴ further refers to Raiffa’s research, which mentions that negotiators’ behavior should not always be considered rational. Moreover, negotiators sometimes tend to aim at a particular objective, such as acquiring a particular share of the total deal, thus missing opportunities for mutually beneficial exchange. The point is that value is also perceived and therefore valued differently, and failing to consider the opponent’s perspective may lead to missed opportunities. As a result, contract proposal preparation should have in mind these most relevant issues.

In the example of Fig. 8, the asset is projected into the ARCON Market Dimension. This dimension looks at Customers, potential Beneficiaries and Competitors. This is, therefore about customers perceived benefits such as reliability (see Ref. 3, p. 125) and perceived quality and performance (see Ref. 4, p. 12 Table 2). On the other hand, from the company perspective we have the benefit “results for the customer” (see Ref. 4, p. 12 Table 2), as these results may induce new and more projects. The asset “Builds Brand Enhancement” is also projected onto the Society ARCON Dimension as reputation and credibility (see Ref. 4, p. 12 Table 2). This reputation and credibility builds on a good public image that is likely to be the evidence of technical competence in the provision of adequate solution to existent problems in customer companies.

6.3. Applying the CMDVC mathematical model — using the fuzzy AHP method in an Ex-Ante perspective on negotiation

6.3.1. The CMDVC mathematical model

The next few paragraphs build on the CPMT case study in a pre-negotiation scenario (Ex-Ante perspective on Negotiation), comprising the usage of set of deliverables belonging to a contract proposal to be exchanged at the Point-of-analysis. We will work with those Deliverables and related Assets and Benefits, from now on referred to as variables. In this example we intentionally excluded the Sacrifice quantification.

Table 1. Deliverables, assets and benefits in an Ex-Ante perspective.

Deliverables	Assets	Perceive benefits
DL_3 : Legal Requirements CPMT	A_1 : Builds License to operate	PB_{20} : Functional Benefits
DL_1 : Legal Requirements Customer	A_3 : Uses HSO Expert	PB_{24} : Operational Benefits
DL_2 : Legitimacy CPMT	A_7 : Builds Brand Enhancement	PB_{48} : Image
DL_8 : Healthy and Safety audits	A_{18} : Builds Quality	PB_{51} : Reputation
DL_5 : Value Proposition		
DL_{15} : Service Quality		

This does not impose any limitations on the results and makes the actual demonstration easier to understand.

Building on the variables listed in Table 1, we now outline the detailed Mathematical formal model for applying the Fuzzy AHP method to the CPMT Case Study.

In a value temporal position $t = \{\text{Ex_Ante}\}$ we have the following deliverables:

$$DL_i = \{DL_1; DL_2; DL_3; DL_5; DL_8; DL_{15}\}.$$

For each DL_i we have to describe the assets used/built, as:

$$\begin{aligned} A(DL_1) &= \{A_1\}; & A(DL_2) &= \{A_1\}; & A(DL_3) &= \{A_1\}; \\ A(DL_5) &= \{A_3\}; & A(DL_8) &= \{A_7\}; & A(DL_{15}) &= \{A_{18}\}. \end{aligned}$$

For each asset we will have the related benefits:

$$\begin{aligned} B(A_1) &= \{PB_{20}; PB_{24}\}; & B(A_3) &= \{PB_{20}; PB_{24}; PB_{48}; PB_{51}\}; \\ B(A_7) &= \{PB_1; PB_{15}; PB_{19}; PB_{20}; PB_{24}; PB_{51}\}; \\ B(A_{18}) &= \{PB_{20}; PB_{48}; PB_{51}\} \end{aligned}$$

and, also the sacrifices:

$$\begin{aligned} S(A_1) &= \{PS_1; PS_5\}; & S(A_3) &= \{PS_1; PS_{10}; PS_{11}; PS_{13}\}; \\ S(A_7) &= \{PS_7; PS_{10}; PS_{24}\}; & S(A_{18}) &= \{PS_5; PS_{13}; PS_{24}\} \end{aligned}$$

(As stated, the sacrifice quantification was excluded from this example.)

The entities involved at time t are:

$$\begin{aligned} E &= \{\text{CPMT}(E_1); \text{Regulator}(E_2); \text{Company}(E_3) \\ &= \text{Partner}(E_4); \text{Eng Commt}(E_5)\}. \end{aligned}$$

As expected, only E_1 will be active at the Ex-Ante time position. This is the point in time when the CPMT is preparing the contract proposal before the actual negotiation takes place.

The acceptance region is given by:

$$\forall_{E_j \in E}, AR_{it} = AR(DLi, E_j, RU, t), \quad j = 1, 2, 3, 4, 5; \quad i = 1, 2, 3, 4, 5, 6.$$

For example we have:

$$\begin{aligned} AR_{1Ex_Ante} &= AR(DL_5, E_1, RU, t) \\ AR_{2Ex_Ante} &= AR(DL_{15}, E_1, RU, t); \quad AR_{2Ex_Ante} = AR(DL_{15}, E_2, RU, t) \\ AR_{3Ex_Ante} &= AR(DL_8, E_1, RU, t); \\ AR_{4Ex_Ante} &= AR(DL_2, E_1, RU, t) \\ AR_{5Ex_Ante} &= AR(DL_1, E_1, RU, t); \quad AR_{5Ex_Ante} = AR(DL_1, E_3, RU, t) \\ AR_{6Ex_Ante} &= AR(DL_3, E_3, RU, t). \end{aligned}$$

As the negotiation rules are not relevant for the discussion of the proposed model they were not included in the demonstration.

6.3.2. Applying the fuzzy AHP method in the VC evaluation

In this section we want to understand the weight of each deliverable in the Value for the Customer and the role that it may play in the future negotiation with the CPMT customer. This value is related with the actual tangible and intangible assets that are used and/or built in the deliverable exchange, and how their value is perceived.⁷

The valuation and measurement of tangible and intangible assets is a difficult task, since it brings together qualitative and quantitative variables. We must weigh the “value-based drivers” (term set by Lapierre³) identified by benefits and sacrifices, of each assets in the enterprise. This involves multi-criteria decision analysis (MCDA), where we have several conflicting criteria in a setting where their importance is not easily determined.³⁵ In this sense, the AHP is a systematic decision-making tool which combines both qualitative and quantitative techniques. AHP has been eagerly developed for application in various areas over recent years.^{36–40}

However, this traditional AHP method “is problematic in that it uses an exact value to express decisions maker’s opinion in a comparison of alternatives” and this makes it unable to adequately handle the inherent uncertainty and imprecision in the pairwise comparison process.⁴¹

A theory proposed for Zadeh’s, in 1965 creates a fuzzy environment, which is used by decision makers to give interval judgments rather than fixed value judgments to measure relative weights for evaluating the critical factors.⁴² In this study we use Triangular Fuzzy Numbers (TFNs)^{43,44} for a pairwise comparison and use the “extent analysis method for the synthetic extent value”⁴⁵ for the fuzzy pairwise comparison of a fuzzy number in order to derive the weight vectors. The application of this AHP-Fuzzy method enabled the construction of a computational model for the mathematical formulation of the proposed CMDVC. The background concepts for this method are detailed in the annex.

As in the AHP method, the Fuzzy AHP also has: a set of p criteria; a set of n alternatives; a set composed by the perception of two decision makers and the perception of the customer (as seen by CPMT). In this context the decision maker defines the weights that relate criteria and alternatives by using the Saaty’s scale (see Table A.1 in the annex). We then cluster the data by using the TFNs for a pair wise comparison of fuzzy AHP. Then, using the “extent analysis method for the synthetic extend values” (Chang’s⁴⁵) (S_i) of the pairwise comparison and by applying the arithmetic operations on fuzzy numbers, we perform evaluations on the decision makers and the customer perception (as seen by CPMT), on the alternatives set with respect to each criteria. There are many applications for Fuzzy AHP in literature. For instance, Cebeci and Ruan⁴⁶ applied the Fuzzy AHP to compare the best consultant that provides the most customer satisfaction (Ref. 46, p. 191). A recent study by Nazari-Shirkouhi *et al.*⁴⁷ proposed the fuzzy AHP to find the priority and ranking of each information system project with seven criteria. Still others, presented a Fuzzy AHP in a wide variety of problems areas.^{48,49}

As illustrated in Fig. 9, the CMPT criteria correspond to the different Assets A_1, A_3, A_7 and A_{18} . The alternatives available for each criteria are the different possible combinations of Perceived Benefits (PB_q): Functional Benefits (PB_{20}), Operational Benefits (PB_{24}), Image (PB_{48}) and Reputation (PB_{51}). The list of perceived Benefits and Sacrifices used in the analysis was compiled from both Lapierre³ and Woodall.⁴ The quantification of that perception combines inputs from two CPMT decision makers (D_1, D_2), as well as their opinion on how the customer (C_3) perceives each PB_q . The outcome is the hierarchical structure pictured in Fig. 9. In this context, Table 2 outlines the perceived benefits associated with each asset. The Perceived Sacrifices are also presented although not used in the following

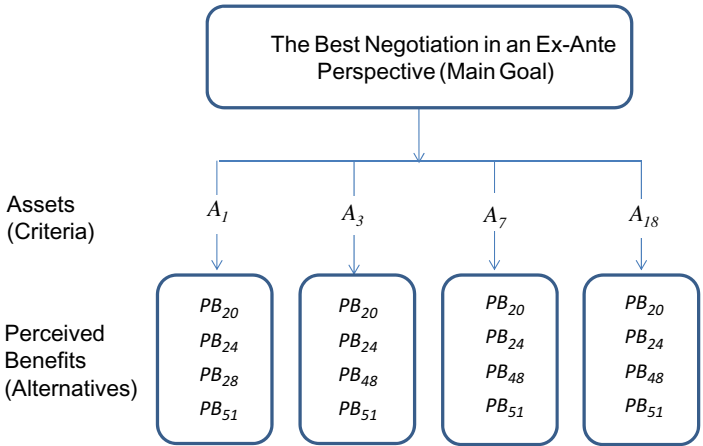


Fig. 9. Decomposition of the case study problem into criteria and alternatives.

Table 2. Benefits and Sacrifices associated to which asset.

	A_1	A_3	A_7	A_{18}
Perceived	PB ₂₀ — Functional Benefits	PB ₂₀ — Functional Benefits	PB ₁ — Perceived Quality	PB ₂₀ — Functional Benefits
Benefits(PB)	PB ₂₄ — Operational Benefits	PB ₂₄ — Operational Benefits PB ₄₈ — Image PB ₅₁ — Reputation	PB ₁₅ — Reliability PB ₁₉ — Performance PB ₂₀ — Functional Benefits PB ₂₄ — Operational Benefits PB ₅₁ — Reputation	PB ₄₈ — Image PB ₅₁ — Reputation
Perceived	PS ₁ — Price	PS ₁ — Price	PS ₇ — Perceive costs	PS ₅ — Costs
Sacrifices (PS)	PS ₅ — Costs	PS ₁₀ — Opportunity Costs PS ₁₁ — Delivery and installation costs PS ₁₃ — Training and mainten- ance costs	PS ₁₀ — Opportunity costs PS ₂₄ — Effort	PS ₁₃ — Training and mainten- ance costs PS ₂₄ — Effort

computations. Shaded in gray one finds the Perceived Benefits related with the Point of Analysis identified in Fig. 9.

6.3.3. Evaluation of the criteria

There are two (D_1, D_2) decision makers and C_3 , where C_3 handles the perception of the customer as seen by the CPMT. For each decision maker and customer (C_3), each criterion may have the same or a different importance in the context of the problem. This means that we need that each involved party individually performs the needed pairwise comparison by using Saaty’s scale 1-9 for all criteria as illustrated in Eq. (1).

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \quad i = 1, 2, \dots, n; \quad j = 1, 2, \dots, n. \quad (1)$$

The result of this pairwise comparison by using Saaty’s 1-9 scale.⁵⁰ for the four criteria made by D_1, D_2 and C_3 are presented in Fig. 10.

Then, a comprehensive pairwise comparison matrix (\tilde{D}_p) is built as in Table 4 by integrating the values of the evaluations made by D_1, D_2 and C_3 : \tilde{b}_{jep} through the

Pairwise comparisons for the four criteria

Evaluation of criteria

***D*₁ Managment CPMT**

<i>D</i> ₁	<i>A</i> ₁	<i>A</i> ₃	<i>A</i> ₇	<i>A</i> ₁₈
<i>A</i> ₁	1	5	1/7	1/9
<i>A</i> ₃	1/5	1	1/7	1/7
<i>A</i> ₇	7	7	1	1
<i>A</i> ₁₈	9	7	1	1

*A*₁ → *A*₃ *A*₁ it is 5 times more important than *A*₃
*A*₇ → *A*₁ *A*₇ it is 7 times more important than *A*₁
*A*₇ → *A*₃ *A*₇ it is 7 times more important than *A*₃
*A*₁₈ → *A*₁ *A*₁₈ it is 9 times more important than *A*₁
*A*₁₈ → *A*₃ *A*₁₈ it is 7 times more important than *A*₃

***D*₂ Technical CPMT**

<i>D</i> ₂	<i>A</i> ₁	<i>A</i> ₃	<i>A</i> ₇	<i>A</i> ₁₈
<i>A</i> ₁	1	9	7	1
<i>A</i> ₃	1/9	1	1/3	6
<i>A</i> ₇	1/7	3	1	1/7
<i>A</i> ₁₈	1	1/6	7	1

*A*₁ → *A*₃ *A*₁ it is 9 times more important than *A*₃
*A*₁ → *A*₇ *A*₁ it is 7 times more important than *A*₇
*A*₃ → *A*₁₈ *A*₃ it is 6 times more important than *A*₁₈
*A*₇ → *A*₃ *A*₇ it is 3 times more important than *A*₃
*A*₁₈ → *A*₇ *A*₁₈ it is 7 times more important than *A*₇

***C*₃ Perception of the client**

<i>C</i> ₃	<i>A</i> ₁	<i>A</i> ₃	<i>A</i> ₇	<i>A</i> ₁₈
<i>A</i> ₁	1	9	7	2
<i>A</i> ₃	1/9	1	1/3	5
<i>A</i> ₇	1/7	3	1	1/9
<i>A</i> ₁₈	1/2	1/5	9	1

*A*₁ → *A*₃ *A*₁ it is 9 times more important than *A*₃
*A*₁ → *A*₇ *A*₁ it is 7 times more important than *A*₇
*A*₁ → *A*₁₈ *A*₁ it is 2 times more important than *A*₁₈
*A*₃ → *A*₁₈ *A*₃ it is 5 times more important than *A*₁₈
*A*₇ → *A*₃ *A*₇ it is 3 times more important than *A*₃
*A*₁₈ → *A*₇ *A*₁₈ it is 9 times more important than *A*₇

Fig. 10. Evaluation of the criteria.

Eqs. (2)–(6).⁵¹

$$l_{je} = \min(b_{jep}), \quad p = 1, 2, \dots, t, \quad j = 1, 2, \dots, m, \quad e = 1, 2, \dots, m; \quad (2)$$

$$m_{je} = \frac{\sum_{p=1}^t (b_{jep})}{p}, \quad p = 1, 2, \dots, t, \quad j = 1, 2, \dots, m, \quad e = 1, 2, \dots, m; \quad (3)$$

$$\mu_{je} = \max(b_{jep}), \quad p = 1, 2, \dots, t, \quad j = 1, 2, \dots, m, \quad e = 1, 2, \dots, m; \quad (4)$$

$$\tilde{b}_{je} = \max(l_{je}; m_{je}; u_{je}), \quad j = 1, 2, \dots, m, \quad e = 1, 2, \dots, m; \quad (5)$$

where \tilde{b}_{je} represents the relative importance among each criterion with TFNs.

$$\tilde{D}_p = \begin{bmatrix} \tilde{b}_{11} & \tilde{b}_{12} & \dots & \tilde{b}_{1m} \\ \tilde{b}_{21} & \tilde{b}_{22} & \dots & \tilde{b}_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{b}_{m1} & \tilde{b}_{m2} & \dots & \tilde{b}_{mm} \end{bmatrix}. \quad (6)$$

By this way, the different perceptions pairwise comparison values are transformed into TFNs.

Table 3. The fuzzy evaluation matrix with respect to criteria.

TFN	A_1			A_3			A_7			A_{18}		
A_1	1	1	1	5	7.667	9	0.143	4.714	7	0.111	1.037	2
A_3	0.11	0.14	0.2	1	1	1	0.143	0.270	0.333	0.143	3.714	6
A_7	0.143	2.4286	7	3	5.667	7	1	1	1	0.111	0.418	1
A_{18}	0.5	3.5	9	0.167	2.456	7	1	5.667	9	1	1	1
Total	1.753	7.0686	17.2	9.167	16.789	24	2.286	11.651	17.333	1.365	6.169	10

From Table 3, and following the “extent analysis method for the synthetic extend values,” the next step, according to Chang,⁴⁵ is to perform the so-called extent analysis (annex — Eqs. (A.9)–(A.15)). After calculating the fuzzy extent synthetic values we have:

$$\begin{aligned}
 S_{A_1} &= (0.091; 0.346; 1.304), \\
 S_{A_3} &= (0.020; 0.123; 0.517), \\
 S_{A_7} &= (0.062; 0.228; 1.098), \\
 S_{A_{18}} &= (0.039; 0.303; 1.784).
 \end{aligned}$$

Using these fuzzy values, we can compare them by using Eq. (A.12) (see annex). As an example of comparing S_{A_1} and S_{A_3} we have $V(S_{A_1} \geq S_{A_3})$:

$$\begin{aligned}
 V(S_{A_1} \geq S_{A_3}) &= hgt(S_{A_3} \cap S_{A_1}) \\
 &= \mu_{A_1}(d) \begin{cases} 1, & \text{if } m_{A_1} \geq m_{A_3} \\ 0, & \text{if } l_{A_3} \geq u_{A_1} \\ \frac{l_{A_3} - u_{A_1}}{(m_{A_1} - u_{A_1}) - (m_{A_3} - l_{A_3})}, & \text{otherwise,} \end{cases}
 \end{aligned}$$

where d , the ordinate of the highest intersection is point D between μ_{A_3} and μ_{A_1} (see Fig. 11).

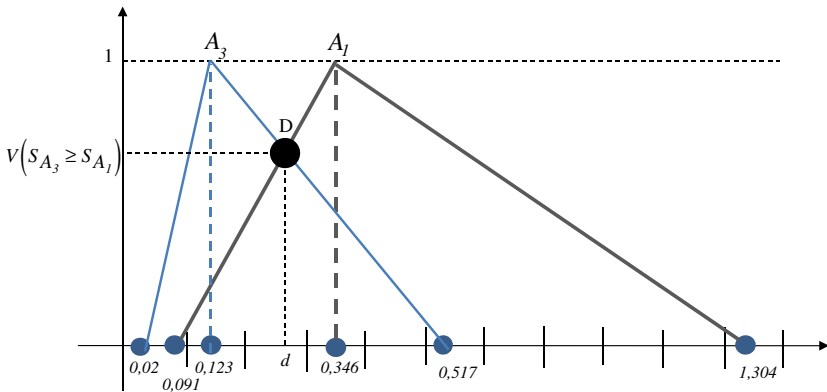


Fig. 11. Comparing both value A_1 and A_3 .

To compare A_1 and A_3 , we need the values of $V(S_{A_1} \geq S_{A_3})$ and $V(S_{A_3} \geq S_{A_1})$.

According to asset A_1 and Fig. 11, the value 0 is assigned to the membership function when it is lower than 0.091 and greater than 1.304, i.e., there is no possibility of occurrence of these values. Values between 0 and 1 are assigned to the membership function when they fall in the two intervals $[0.091; 0.346]$ and $[0.346; 1.304]$. Also for the asset A_3 , the value 0 is assigned to the membership function when it is lower than 0.02 and greater than 0.517. Values between 0 and 1 are assigned to the membership function when it is in the intervals $[0.02; 0.123]$ and $[0.123; 0.517]$. The comparison of these two fuzzy values is achieved using the $\min V(S_{A_1} \geq S_{A_3})$ and $V(S_{A_3} \geq S_{A_1})$. In this case the minimum between A_1 and A_3 is $V(S_{A_3} \geq S_{A_1}) = 0.656$.

The comparison of the all fuzzy values $S_{A_1}; S_{A_3}; S_{A_7}; S_{A_{18}}$ is as follows:

$$\begin{aligned} V(S_{A_1} \geq S_{A_3}) &= 1; & V(S_{A_1} \geq S_{A_7}) &= 1; & V(S_{A_1} \geq S_{A_{18}}) &= 1; \\ V(S_{A_3} \geq S_{A_1}) &= 0.656; & V(S_{A_3} \geq S_{A_7}) &= 0.812; & V(S_{A_3} \geq S_{A_{18}}) &= 0.727; \\ V(S_{A_7} \geq S_{A_1}) &= 0.895; & V(S_{A_7} \geq S_{A_3}) &= 1; & V(S_{A_7} \geq S_{A_{18}}) &= 0.934; \\ V(S_{A_{18}} \geq S_{A_1}) &= 0.975; & V(S_{A_{18}} \geq S_{A_3}) &= 1; & V(S_{A_{18}} \geq S_{A_7}) &= 1. \end{aligned}$$

Then the priority weights are calculated by using Eq. (A.13).

$$\begin{aligned} d'(A_i) &= \min V(S_{A_i} \geq S_{A_k}) \quad \text{for } k = 1, 2, \dots, n; k \neq i, \\ d'(A_1) &= \min(1; 1; 1) = 1, \\ d'(A_3) &= \min(0.656; 0.812; 0.727) = 0.656, \\ d'(A_7) &= \min(0.895; 1; 0.934) = 0.895, \\ d'(A_{18}) &= \min(0.975; 1; 1) = 0.975. \end{aligned}$$

Then the assets weight vector (W'_A) is given by the equation

$$\begin{aligned} W' &= (d'(A_1); d'(A_2); \dots; d'(A_n))^T, \\ W'_A &= (1; 0.656; 0.895; 0.975)^T. \end{aligned} \tag{7}$$

After the normalization of these values priority weight respect to main goal is calculated as by the equation

$$\begin{aligned} W &= (d(A_1); d(A_2); \dots; d(A_n))^T, \\ W_A &= (0.284; 0.186; 0.254; 0.277)^T. \end{aligned} \tag{8}$$

We now have to quantify the meaning of the linguistic values (see annex) using “membership function” (see annex — Eq. (A.2)). The μ function gives us the relationship between assets by quantifying the degree of certainty of that asset relevance being greater than the others. We can say, therefore, that:

- $\mu_{\bar{A}_1} = 0.284$ — Shows the degree of possibility for a fuzzy convex number to be greater than A_3, A_7, A_{18} is 0.284;

- $\mu_{\bar{A}_3} = 0.186$ — Shows the degree of possibility for a fuzzy convex number to be greater than A_1, A_7, A_{18} is 0.186;
- $\mu_{\bar{A}_7} = 0.254$ — Shows the degree of possibility for a fuzzy convex number to be greater than A_3, A_1, A_{18} is 0.254;
- $\mu_{\bar{A}_{18}} = 0.277$ — Shows the degree of possibility for a fuzzy convex number to be greater than A_3, A_7, A_1 is 0.277.

The criterion A_1 has the highest priority weight and is likely to be the most relevant asset. By ranking the order of the criteria with the fuzzy AHP method we have $A_1(0.284) > A_{18}(0.277) > A_7(0.254) > A_3(0.186)$. Now that we have the priority weights for each criteria, we have to calculate the priority weights for each alternatives and, as a result, the impact this has in the relative relevance of each Asset (criteria).

6.3.4. Evaluation of the alternatives

As in the criteria evaluation, the evaluation of alternatives by D_1, D_2 and C_3 is expressed, as before, through the Saaty’s scale. Each matrix of pairwise comparisons must follow the judgment matrix:

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \quad i = 1, 2, \dots, n; \quad j = 1, 2, \dots, n.$$

The pairwise comparisons (Fig. 12) of values are then transformed into TFNs on the fuzzy evaluation matrix (Eq. (6)). The results are presented in Tables 4–7.

The priority weights of the Perceived Benefits (alternatives) for each asset are determined by making the same calculations as for criteria.

The weight vector from Table 4 is calculated as W_{PBA_1}
 $= (0.341; 0.395; 0.263; 0)^T$,

The weight vector from Table 5 is calculated as W_{PBA_3}
 $= (0.407; 0.392; 0; 0.201)^T$,

The weight vector from Table 6 is calculated as W_{PBA_7}
 $= (0.264; 0.264; 0.253; 0.219)^T$,

The weight vector from Table 7 is calculated as $W_{PBA_{18}}$
 $= (0.253; 0.374; 0.211; 0.163)^T$.

The composite priorities of the alternatives will be determined by aggregating the weights throughout the hierarchy. The final score SC of alternatives can be calculated as follows:

$$SC = M_{PBA} \times W_A^T. \tag{9}$$

Pairwise comparisons for the four alternatives

Evaluation of alternatives

D₁ Managment CPMT

<i>A₁</i>	<i>PB₂₀</i>	<i>PB₂₄</i>	<i>PB₄₈</i>	<i>PB₅₁</i>
<i>PB₂₀</i>	1	1	7	3
<i>PB₂₄</i>	1	1	5	7
<i>PB₄₈</i>	1/7	1/5	1	1/7
<i>PB₅₁</i>	1/3	1/7	7	1

<i>PB₂₀ → PB₂₄</i>	<i>PB₂₀ and PB₂₄ are equally important</i>
<i>PB₂₀ → PB₄₈</i>	<i>PB₂₀ is 7 times more important than PB₄₈</i>
<i>PB₂₀ → PB₅₁</i>	<i>PB₂₀ is 3 times more important than PB₅₁</i>
<i>PB₂₄ → PB₄₈</i>	<i>PB₂₄ is 5 times more important than PB₄₈</i>
<i>PB₂₄ → PB₅₁</i>	<i>PB₂₄ is 7 times more important than PB₅₁</i>
<i>PB₅₁ → PB₄₈</i>	<i>PB₅₁ is 7 times more important than PB₄₈</i>

D₂ Technical CPMT

<i>A₁</i>	<i>PB₂₀</i>	<i>PB₂₄</i>	<i>PB₄₈</i>	<i>PB₅₁</i>
<i>PB₂₀</i>	1	1	9	9
<i>PB₂₄</i>	1	1	7	7
<i>PB₄₈</i>	1/9	1/7	1	9
<i>PB₅₁</i>	1/9	1/7	1/9	1

<i>P_{B20} → PB₂₄</i>	<i>PB₂₀ and PB₂₄ are equally important</i>
<i>PB₂₀ → PB₄₈</i>	<i>PB₂₀ is 9 times more important than PB₄₈</i>
<i>PB₂₀ → PB₅₁</i>	<i>PB₂₀ is 9 times more important than PB₅₁</i>
<i>PB₂₄ → PB₄₈</i>	<i>PB₂₄ is 7 times more important than PB₄₈</i>
<i>PB₂₄ → PB₅₁</i>	<i>PB₂₄ is 7 times more important than PB₅₁</i>
<i>PB₄₈ → PB₅₁</i>	<i>PB₄₈ is 9 times more important than PB₅₁</i>

C₃ Perception of the client

<i>A₁</i>	<i>PB₂₀</i>	<i>PB₂₄</i>	<i>PB₄₈</i>	<i>PB₅₁</i>
<i>PB₂₀</i>	1	1	1/2	1/4
<i>PB₂₄</i>	1	1	9	9
<i>PB₄₈</i>	2	1/9	1	1/3
<i>PB₅₁</i>	4	1/9	3	1

<i>P_{B20} → PB₂₄</i>	<i>PB₂₀ and PB₂₄ are equally important</i>
<i>PB₂₄ → PB₄₈</i>	<i>PB₂₄ is 9 times more important than PB₄₈</i>
<i>PB₂₄ → PB₅₁</i>	<i>PB₂₄ is 9 times more important than PB₅₁</i>
<i>PB₄₈ → PB₂₀</i>	<i>PB₄₈ is 2 times more important than PB₂₀</i>
<i>PB₅₁ → PB₂₀</i>	<i>PB₅₁ is 4 times more important than PB₂₀</i>
<i>PB₅₁ → PB₄₈</i>	<i>PB₅₁ is 3 times more important than PB₄₈</i>

Fig. 12. Evaluation of the alternatives.

The weight vector of priority weights (Eq. (8)) of the main criteria (assets) of the goal was

$$W_A = (0.284; 0.186; 0.254; 0.277)^T.$$

Table 4. The fuzzy evaluation matrix with respect to asset *A₁*.

TFN(<i>A₁</i>)	<i>PB₂₀</i>				<i>PB₂₄</i>			<i>PB₄₈</i>			<i>PB₅₁</i>		
<i>PB₂₀</i>	1	1	1	1	1	1	1	0.5	5.5	9	0.25	4.083	9
<i>PB₂₄</i>	1	1	1	1	1	1	1	5	7	9	7	7.667	9
<i>PB₄₈</i>	0.111	0.7503	2	0.111	0.151	0.2	1	1	1	0.143	3.159	9	
<i>PB₅₁</i>	0.111	1.4813	4	0.111	0.394	0.143	0.111	3.370	7	1	1	1	

Table 5. The fuzzy evaluation matrix with respect to asset *A₃*.

TFN (<i>A₃</i>)	<i>PB₂₀</i>			<i>PB₂₄</i>			<i>PB₄₈</i>			<i>PB₅₁</i>		
<i>PB₂₀</i>	1	1	1	1	3	7	4	5.667	9	4.00	6.667	9.00
<i>PB₂₄</i>	0.14	0.7143	1.00	1	1	1	5	6.333	9	5.00	7	9.00
<i>PB₄₈</i>	0.11	0.2037	0.25	0.111	0.170	0.2	1	1	1	0.14	0.770	2.00
<i>PB₅₁</i>	0.11	0.168	0.25	0.111	0.151	0.2	0.5	4.5	7	1.00	1	1.00

Table 6. The fuzzy evaluation matrix with respect to asset A_7 .

TFN (A_7)	PB_{20}			PB_{24}			PB_{48}			PB_{51}		
PB_{20}	1	1	1	1	1	1	0.11	6.037	9.00	0.14	6.048	9.00
PB_{24}	1.00	1	1.00	1	1	1	0.143	4.714	9	3.00	5.667	9.00
PB_{48}	0.11	6.037	9.00	0.111	2.437	7	1	1	1	1.00	1.333	2.00
PB_{51}	0.11	5.3704	9.00	0.111	0.215	0.333	0.5	0.833	1	1.00	1	1.00

Table 7. The fuzzy evaluation matrix with respect to asset A_{18} .

TFN (A_{18})	PB_{20}			PB_{24}			PB_{48}			PB_{51}		
PB_{20}	1	1	1	1	1	1	5.00	7.667	9.00	3.00	7	9.00
PB_{24}	1.00	1	1.00	1	1	1	3	6.333	9	5.00	36.333	99.00
PB_{48}	0.11	3.1037	9.00	0.111	0.196	0.333	1	1	1	1.00	4	6.00
PB_{51}	0.11	3.1481	9.00	0.010	0.137	0.2	0.167	0.456	1	1.00	1	1.00

The matrix of priority weights of the perceived benefits is M_{PBA} such as:

$$M_{PBA} = \begin{bmatrix} 0.341 & 0.407 & 0.264 & 0.253 \\ 0.395 & 0.392 & 0.264 & 0.374 \\ 0.263 & 0 & 0.253 & 0.211 \\ 0 & 0.201 & 0.219 & 0.163 \end{bmatrix}.$$

The evaluation criteria is obtained by multiplying the matrix M_{PBA} obtained by the weights of alternatives with respect to main criteria with the normalized vector obtained by the weights of the criteria W_A^T . We get the normalized ranks for the benefits.

$$SC = \begin{bmatrix} 0.307 \\ 0.353 \\ 0.197 \\ 0.136 \end{bmatrix}.$$

According to the obtained results in the fuzzy AHP method, the alternative PB_{24} , which has the highest priority weight, is selected as the most important benefit that the negotiator may take in account in the decision-making process for the CPMT in an Ex-Ante temporal phase. The ranking order of the alternatives with the fuzzy AHP method is $PB_{24} > PB_{20} > PB_{48} > PB_{51}$. Therefore, PB_{24} (Operational Benefits) would be considered the most relevant benefit in Ex-Ante phase.

6.3.5. Discussion

Table 8 summarizes the overall results: (1) the degree of possibility (relevance) of A_i and PB_i being related; (2) the relative importance of A_i — bottom row; and (3) the relative importance of PB_q right column.

Table 8. Results.

	A_1 Builds license to operate	A_3 Uses HSO expert	A_7 Builds brand enhancement	A_{18} Builds quality	WP vector of the PB
PB_{20} Functional Benefits	0.341 ^a	0.407 ^a	0.264 ^a	0.253 ^a	0.307
PB_{24} Operational Benefits	0.395 ^a	0.392 ^a	0.263 ^a	0.374 ^b	0.353
PB_{48} Image	0.263	0 ^a	0.253 ^b	0.211 ^a	0.197
PB_{51} Reputation	0 ^b	0.201 ^a	0.219 ^a	0.163 ^a	0.136
Weight priority (WP) vector of the assets	0.284	0.186	0.254	0.272	

^aBelongs to the asset. ^bDoes not belong to the asset.

This table and its meaning, featuring the quantitative representation of the CMDVC, was discussed with CPMT in an interview from which we would highlight the following comments: “(…) *The results are quite consistent with the company’s management perception of the market. The license to operate is clearly the key factor. Nevertheless, it was quite interesting that important factors overlooked in the interviews (e.g., image) did show up in the results and that quality (directly or by brand enhancement) were also important assets. This is most important, as often price-based competition is regarded as a suitable strategy in the fiercely competitive market the company operates (…)*.” This is explained by the need to rank alternatives using the Saaty’s Scale and lead a previously disregarded Perceived Benefit to emerge. This important result is confirmed by the interview testimonial. Moreover, the analysis of the above table combined with Fig. 13, further enables the understanding of how

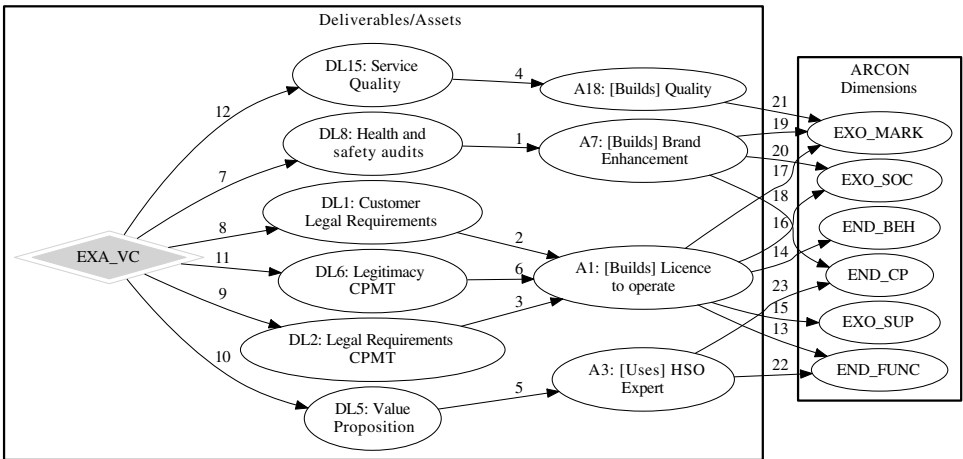


Fig. 13. Deliverables/assets/ARCON Dimensions.

these Perceived Benefits relate to the actual deliverables. In this case, we see that A_7 is also related with PB_{48} (Image), which means that DL_8 also builds CPMT image among its customers with a degree of possibility (relevance) that is comparable to the other PB_i in the same column (Table 8).

It is also interesting to see that A_1 ([Builds] License to Operate) is a very important asset. We could have expected that from the interviews. It was also confirmed that the Operational Benefits for the customer as seen by CPMT (PB_{24}) emerge as the PB_q with the higher degree of possibility. We should also realize that PB_{24} now emerges in A_{18} and was previously not there. In fact, PB_{24} , that was not mentioned in the interviews as related with A_{18} , is now the highest ranked for asset A_{18} ([Builds] Quality). As explained by CPMT, "(...) *The results are consistent with the company's empirical experience in the occupational health services market. Most clients favor the operational aspects of the service, like minimizing the time "lost" by employees in medical exams, over the actual service "quality". The impact of the latter in the client's bottom line usually takes years to be noticed and it is difficult to quantify.*"

The researchers were happy to hear a final comment by the CPMT interviewee regarding the value of this approach: "*This novel approach can be quite useful for CPMT to better manage its service offering and marketing approach, as it provides management qualitative data, instead of relying solely on hunches. (...)*"

We can finally confirm that the CMDVC formal model enabled the quantification of "How do endogenous and exogenous assets influence the Value for the Customer?" (Research Question 1.2). This influence emerges from the relations made explicit between the assets in Fig. 13 and ARCON dimensions, intersected with the results of Table 8 that map the relative value of each asset as the result of weighting perceived benefits. The Research Question number two, "Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?" is implicitly responded by the validation of the formal quantitative model upon its validation by the interviewees at CPMT.

As proposed by Dube and Pare⁹ we followed the exploratory case study approach as a "tentative in theory building case research." The constructs defined for the proposed model revealed both useful and adequate. In this context we would finally highlight the importance of two constructs that seem not to be directly used in the Quantitative CMDVC, the Forms of Value and the ARCON endogenous and exogenous dimensions. In fact, whereas the Forms of Value provide the model user with a comprehensive framework on the nature of the demand-side perceptions of value, the ARCON endogenous and exogenous dimensions make explicit the origin of each asset and, therefore, the level of influence the enterprise has over them.

7. Conclusion

This paper proposed a novel framework for modeling the Value for the Customer, the so-called Conceptual Model for Decomposing Value for the Customer (CMDVC). This conceptual model was first validated through an exploratory case study in

CPMT, and SME in Porto, Portugal, where we were able to both validate the proposed constructs of the model and their relations. In a second step the authors proposed a mathematical formulation for the CMDVC as well as a computational method. This has enabled the final quantitative discussion of how the CMDVC can be applied and used in the enterprise environment, and the final validation from the CPMT interviewees, where we were able to confirm that: *“This novel approach can be quite useful for CPMT to better manage its service offering and marketing approach (...).”*

Upon answering the Research Questions it is useful to reflect on the merits and applicability limits of the proposed model.

The merits of this approach seem evident from the contact with CPMT. The tool, tested on a contract preparation phase (Ex-Ante negotiation perspective), revealed itself useful by providing *“(...) results [that] are consistent with the company’s empirical experience (...)”*. Moreover, it enabled the discovery of previously disregarded connections between assets used and/or built in the foreseen exchange of deliverables and perceived benefits.

Along this paper the authors focused on the CMDVC validation and on the validation of the corresponding quantitative model and corresponding computational method. To this end, a pre-negotiation scenario consisting of a contract proposal preparation, was defined where a set of deliverables, belonging to contract proposal, were dissected in a very detailed analysis of the case study. This approach allowed the testing of the proposed model and the discussion of the obtained results. The imposed scenario aimed at limiting the scope of analysis. However, we believe that this does not impose any limits to the applicability of the proposed model, namely as a support tool along the negotiation process. In fact, we would argue that, from the moment the negotiation starts, people at CPMT would likely realize that some of their expectations regarding the customer perceived value may now be wrong and would have to be changed and adapted. This was confirmed by CPMT by stating: *“(...) when we send a contract proposal we always follow-up on the phone and try to feel the customers reaction and understand what is the most important thing for them. In fact, the strict economic context we now live in Portugal may very fast drive the customer stance from a service quality inclination to a severe cost-driven attitude. We try an early evaluation of all these issues in the first contact, but things actually change.”* In this context and along the negotiation process, the existence of a computational model that could rapidly give the new distribution of weights (Table 8) would be of utmost value, as it would help establishing the relationship of what is actually valued by the customer and what is being offered, enabling, therefore, the preparation of a new proposal that best meets the customer needs.

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Appendix A. Introduction to the Fuzzy AHP

The AHP, first proposed by Saaty,⁵⁰ is widely used multiple criteria decision-making tool. According to this author, “the most creative task in making a decision is to choose the factors that are important for that decision” (see Ref. 50, p. 9). AHP is based on the representation of a complex problem through a hierarchical structure, which consists in defining criteria, sub-criteria and alternatives in successive levels, and relating them with the goal criteria. The hierarchical sub-criteria are represented in Fig. A.1.

This structure provides “an overall view of the complex situation relationships inherent in the situation; and helps the decision maker assess whether the issues in each level are of the same order of magnitude, so he can compare such homogeneous elements accurately” (see Ref. 50, p. 9). Once the problem has been decomposed and the hierarchy constructed, the prioritization procedure starts and the comparison is used to form the matrix of pairwise comparisons called the judgment matrix A , using Saaty’s nine-point scale listed in Table A.1.

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \quad i = 1, 2, \dots, n; \quad j = 1, 2, \dots, n. \quad (A.1)$$

Each entry a_{ij} of the judgment’s matrix is governed by the three rules:

$$a_{ij} \geq 0; \quad a_{ij} = \frac{1}{a_{ji}}; \quad a_{ii} = 1 \quad \text{for all } i.$$

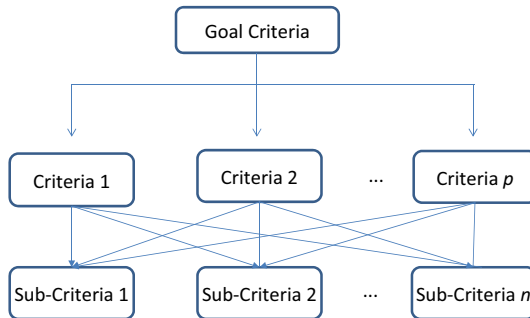


Fig. A.1. Decomposition of the problem in AHP method.

Table A.1. Saaty’s 1-9 scale for AHP.⁵⁰

Definition	Saaty’s scale	Description
Equal importance	1	Two criteria contribute equally to the objective in the immediate higher level
Moderate importance of one over another	3	Experience and judgment slightly favor one criterion over another
Essential or strong importance	5	Experience and judgment strongly favor one criterion over another
Demonstrated importance	7	A criterion is favored very strongly
Extreme importance	9	The difference between influences of the two decision elements is extremely significant
Intermediate values between two adjacent judgments	2, 4, 6, 8	When compromise is needed

AHP — fuzzy

In this section, some of the theoretical concepts used in this paper are briefly introduced. This includes fuzzy sets, linguistic variables, fuzzy numbers and Fuzzy AHP process.

• **Fuzzy Sets**

How we can understand the vagueness of human thought with the fuzzy number?

A fuzzy set is a class of objects with continuum grades of membership. Such a set is characterized by a membership function (characteristics) which assigns to each object a grade of membership ranging between zero and one (see Ref. 42, p. 338).

• **Linguistic Variables**

Linguistic variables are the domain of the fuzzy sets. They are the input and output of the system whose values are words or sentences from natural language, instead of numerical values. As an example, size is a linguistic variable labeled small, medium, tall, rather than the number 0, 1, and 2. Then $S(s) = \{\text{small, medium, tall}\}$ can be the set of decompositions for the linguistic variable size. The concept of a linguistic variable facilitate the expression of rules and facts which are too complex or too ill-defined to be amenable to description in conventional quantitative terms.⁵²

• **Fuzzy Numbers**

According to Deng⁴¹ a fuzzy number \tilde{A} is a convex fuzzy set, characterized by a given interval of real numbers, each with a grade of membership between 0 and 1. Its membership function ($\mu_{\tilde{A}}(x)$) is precise continuous, satisfies the following conditions:

- $\mu_{\tilde{A}}(x) = 0$ for each $x \in]-\infty; a_1[\cup]a_4; +\infty[$.
- $\mu_{\tilde{A}}(x)$ is nondecreasing on $[a_1, a_2]$ and nondecreasing on $[a_3, a_4]$.
- $\mu_{\tilde{A}}(x) = 1$ for each $x \in [a_2, a_3]$ where $a_1 \leq a_2 \leq a_3 \leq a_4$ are real numbers.

It is possible to use different fuzzy numbers according to the situation. “Triangular and trapezoidal fuzzy numbers are used to express the decision makers

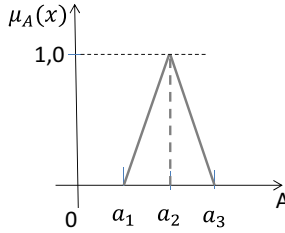


Fig. A.2. Triangular fuzzy number.

assessments on alternatives with respect to each criterion” (see Ref. 41, p. 216). In this study TFNs are adopted in the Fuzzy AHP, because of computational simplicity and easy to interpret. For example a (“value approximately to 50”) can be represented by (45; 50; 55) or by (40; 50; 60).

TFNs are a special class of fuzzy number, and can be denoted by $(a_1; a_2; a_3)$. The parameters a_1, a_2, a_3 , respectively, indicate the smallest possible value, the most likely value and the largest possible value that illustrate the fuzziness of data evaluated.

A triangular fuzzy number is shown in Fig. A.2:

Their membership functions are usually described as:

$$\mu_{\tilde{A}}(x) = \begin{cases} \frac{x - a_1}{a_2 - a_1}, & a_1 \leq x \leq a_2 \\ \frac{a_3 - x}{a_3 - a_2}, & a_2 \leq x \leq a_3 \\ 0, & \text{otherwise.} \end{cases} \quad (\text{A.2})$$

The algebraic operations of any two fuzzy numbers $A = (a_1; a_2; a_3)$ and $B = (b_1; b_2; b_3)$, used in this study are:

Fuzzy addition

$$A + B = (a_1 + b_1; a_2 + b_2; a_3 + b_3), \quad (\text{A.3})$$

where a_1, a_2, a_3 and b_1, b_2, b_3 are any real numbers.

Fuzzy subtraction

$$A - B = (a_1 - b_3; a_2 - b_2; a_3 - b_1), \quad (\text{A.4})$$

where a_1, a_2, a_3 and b_1, b_2, b_3 are any real numbers.

Fuzzy multiplication

$$A \times B = (a_1 b_1; a_2 b_2; a_3 b_3), \quad (\text{A.5})$$

where a_1, a_2, a_3 and b_1, b_2, b_3 are all nonzero positive real numbers.

Fuzzy division

$$A/B = (a_1/b_3; a_2/b_2; a_3/b_1), \quad (\text{A.6})$$

where a_1, a_2, a_3 and b_1, b_2, b_3 are all nonzero positive real numbers.

Scalar multiplication

$$\forall k > 0, \quad k \in R, \quad ka = (ka_1; ka_2; ka_3), \tag{A.7}$$

$$\forall k < 0, \quad k \in R, \quad ka = (ka_3; ka_2; ka_1). \tag{A.8}$$

• Fuzzy AHP

The systematic steps for evaluating relative weights using Fuzzy AHP process is utilized, which was introduced by Chang's.⁴⁵

Let $X = \{x_1, x_2, x_3, \dots, x_n\}$ an object set, and $G = \{g_1; g_2; g_3, \dots, g_n\}$ be a goal set. Then each object is taken an extent analysis for each goal performed, respectively. Therefore, m extent analysis values for each object can be obtained, with the following notation:

$$M_{gi}^1, M_{gi}^2, \dots, M_{gi}^m, \quad i = 1, 2, \dots, n \quad \text{where } M_{gi}^j \quad j = (1, 2, \dots, m) \quad \text{all are TFNs.}$$

According to extent analysis synthesis values with respect to main goal are calculated according to the steps of Chang's, such as:

Step 1: The value of fuzzy synthetic extent with respect to i th object is defined as:

$$S_i = \sum_{j=1}^m M_{gi}^j \times \left[\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j \right]^{-1}. \tag{A.9}$$

The fuzzy addition of M_{gi}^j values is performed such as:

$$\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j = \left(\sum_{i=1}^n l_i, \sum_{i=1}^n m_i, \sum_{i=1}^n u_i \right). \tag{A.10}$$

Then the inverse of the vector above is:

$$\left[\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j \right]^{-1} = \left(1 / \sum_{i=1}^n u_i, 1 / \sum_{i=1}^n m_i, 1 / \sum_{i=1}^n l_i \right). \tag{A.11}$$

Step 2: The degree of possibility for $M_2 \geq M_1$ of two TFNs $M_1 = (l_1, m_1, u_1)$ and $M_2 = (l_2, m_2, u_2)$ can be defined as:

$$V(M_1 \geq M_2) = hgt(M_1 \cap M_2) = \mu_2(d) = \begin{cases} 1, & \text{if } m_2 \geq m_1 \\ 0, & \text{if } l_1 \geq u_2 \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}, & \text{otherwise.} \end{cases} \tag{A.12}$$

In general, the priority weights are calculated by using

$$d'(A_i) = \min V(S_i \geq S_k) \quad \text{for } k = 1, 2, \dots, n; \quad k \neq i \tag{A.13}$$

that are the pairwise comparison of the M TFNs. Then the weight vector is given by

$$W' = (d'(A_1); d'(A_2); \dots; d'(A_n))^T. \quad (\text{A.14})$$

Finally we normalized the weight vector

$$W = (d(A_1); d(A_2); \dots; d(A_n))^T. \quad (\text{A.15})$$

where W is a nonfuzzy number.

References

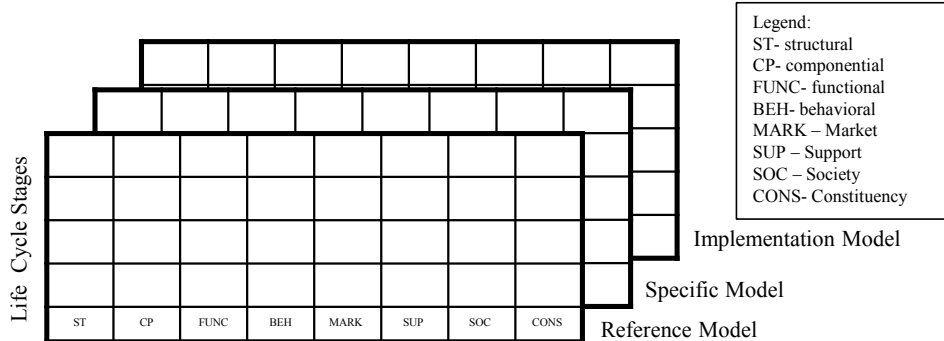
1. Z. Yang and R. T. Peterson, Customer perceived value, satisfaction, and loyalty: The role of switching costs, *Psychology & Marketing* **21** (2004) 799–822.
2. V. A. Zeithaml, Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence, *Journal of Marketing, American Marketing Association* **52** (1988) 2–22.
3. J. Lapiere, Customer-perceived value in industrial contexts, *Journal of Business & Industrial Marketing* **15** (2000) 122–145.
4. T. Woodall, Conceptualising value for the customer: An attributional, structural and dispositional analysis, *Academy of Marketing Science Review* **2003**(12) (2003) 1–42.
5. L. Camarinha and H. Afasarmanesh, ARCON reference models for collaborative networks, *Collaborative Networks: Reference Modeling* (Springer, 2008), pp. 83–112.
6. V. Allee, The value evolution: Addressing larger implications of an intellectual capital and intangibles perspective, *Journal of Intellectual Capital* **1**(1) (2000) 17–32.
7. V. Allee, Value network analysis and value conversion of tangible and intangible assets, *Journal of Intellectual Capital* **9**(1) (2008) 5–24.
8. V. Allee, The very human dynamics of knowledge and value conversion (2008), pp. 55–56.
9. L. Dubé and G. Paré, Rigor in information systems positivist case research: Current practices, trends, and recommendations, *MIS Quarterly* **27**(4) (2003) 597–636.
10. I. Gil-Saura, M. Frasquet-Deltoro *et al.*, The value of B2B relationships, *Industrial Management & Data Systems* **109**(5) (2009) 593–609.
11. D. W. Geoff Lancaster, Implementing value strategy through the value chain, *Management Decision* **38**(3) (2000) 160–178.
12. A. Lindgreen and F. Wynstra, Value in business markets: What do we know? Where are we going? *Industrial Marketing Management* **34**(7) (2005) 732–748.
13. V. Allee, A value network approach for modeling and measuring intangibles, Presented at Transparent Enterprise, Madrid, November 2002.
14. W. Ulaga and A. Eggert, Relationship value and relationship quality: Broadening the nomological network of business-to-business relationships, *European Journal of Marketing* **40**(3/4) (2002) 311–327.
15. R. Sánchez-Fernández and M. Á. Iniesta-Bonillo, The concept of perceived value: A systematic review of the research, *Marketing Theory* **7**(4) (2007) 427–451.
16. R. Woodruff, Customer value: The next source for competitive advantage, *Journal of the Academy of Marketing Science* **25**(2) (1997) 139–153.
17. J. Huber, J. Lynch *et al.*, Thinking about values in prospect and retrospect: Maximising experience utility, *Marketing Letters* **8**(3) (1997) 323–334.
18. A. Biem and N. Caswell, A value network model for strategic analysis, in *Proc. 41st Annual Hawaii Int. Conf. System Sciences* (IEEE Computer Society, 2008), p. 361.
19. V. Allee, Building value networks competencies (Value Networks, LLC, 2009).

20. K.-E. Sveiby, A knowledge-based theory of the firm to guide in strategy formulation, *Journal of Intellectual Capital* **2** (2001) 344–358.
21. L. Camarinha-Matos, Collaborative networks in industry trends and foundations, *Digital Enterprise Technology* (Springer, 2007), pp. 45–56.
22. L. Camarinha and H. Afasarmanesh (eds.), *Collaborative Networks: Reference Modeling* (Springer Science+Business Media, LCC, 2008).
23. A. R. Hevner, S. T. March *et al.*, Design science in information systems research, *MIS Quarterly* **28**(1) (2004) 75–105.
24. V. Allee, Reconfiguring the value network, *Journal of Business Strategy* **21** (2000) 36–39, doi: 10.1108/eb040103.
25. M. A.-Y. Oliveira and J. J. Pinto Ferreira, Facilitating qualitative research in business studies: Using the business narrative to model value creation, *African Journal of Business Management* **5**(1) (2011) 68–75.
26. B. Kaplan, J. Anderson *et al.*, *Qualitative Research Methods for Evaluating Computer Information Systems. Evaluating the Organizational Impact of Healthcare Information Systems* (Springer, New York, 2005), pp. 30–55.
27. A. Osterwalder and Y. Pigneur (eds.), *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers* (John Wiley & Sons, Inc., 2010).
28. C. W. Holsapple, H. Lai *et al.*, A formal basis for negotiation support system research, *Group Decision and Negotiation* **7**(3) (1998) 203–227.
29. M. Filzmoser and R. Vetschera, A classification of bargaining steps and their impact on negotiation outcomes, *Group Decision and Negotiation* **17**(5) (2008) 421–443.
30. A. De Moor and H. Weigand, Business negotiation support: Theory and practice, *International Negotiation* **9** (2004) 31–57.
31. P. J. Carnevale and D. G. Pruitt, Negotiation and mediation, *Annual Review of Psychology* **43**(1) (1992) 531–582.
32. R. Vetschera, Preference structures and negotiator behavior in electronic negotiations, *Decision Support Systems* **44**(1) (2007) 135–146.
33. R. Swaab, T. Postmes *et al.*, Negotiation support systems: Communication and information as antecedents of negotiation settlement, *International Negotiation* **9** (2004) 59–78.
34. C.-J. Tsay and M. H. Bazerman, A decision-making perspective to negotiation: A review of the past and a look into the future, *Negotiation Journal* **25**(4) (2009) 467–480.
35. G. Kou, Y. Lu *et al.*, Evaluation of classification algorithms using MCDM and rank correlation, *International Journal of Information Technology & Decision Making* **11**(1) (2012) 197–225.
36. N. Ahmad, D. Berg *et al.*, The integration of analytical hierarchy process and data envelopment analysis in a multi-criteria decision-making problem, *International Journal of Information Technology & Decision Making* **5**(2) (2006) 263–276.
37. G. L. Fu, C. Yang *et al.*, A multicriteria analysis on the strategies to open taiwan's mobile virtual network operators services, *International Journal of Information Technology & Decision Making* **6**(1) (2007) 85–112.
38. H.-L. Li and L.-C. Ma, Ranking decision alternatives by integrated DEA, AHP AND GOWER plot techniques, *International Journal of Information Technology & Decision Making* **7**(2) (2008) 241–258.
39. N. Ahmad and P. A. Laplante, Using the analytical hierarchy process in selecting commercial real-time operating systems, *International Journal of Information Technology & Decision Making* **8**(1) (2009) 151–168.

40. Y. Peng, G. Kou *et al.*, Ensemble of software defect predictors: An AHP-Based evaluation method, *International Journal of Information Technology & Decision Making* **10**(1) (2011) 187–206.
41. H. Deng, Multicriteria analysis with fuzzy pairwise comparison, *International Journal of Approximate Reasoning* **21**(3) (1999) 215–231.
42. L. Zadeh, Fuzzy sets, *Information and Control* **8**(3) (1965) 338–353.
43. M. E. El-Hawary, *Electric Power Applications of Fuzzy Systems* (Wiley-IEEE Press, 1998), pp. 15–58.
44. Kevin M. Passino and S. Yurkovich (1998), *Fuzzy Control* (Addison Wesley Longman, Prentice-Hall, 1998).
45. D.-Y. Chang, Applications of the extent analysis method on fuzzy AHP, *European Journal of Operational Research* **95**(3) (1996) 649–655.
46. U. Cebeci and D. Ruan, A multi-attribute comparison of Turkish quality consultants by fuzzy AHP, *International Journal of Information Technology & Decision Making* **6**(1) (2007) 191–207.
47. S. Nazari-Shirkouhi, A. Ansarnejad *et al.*, Information systems outsourcing decisions under fuzzy group decision making approach, *International Journal of Information Technology & Decision Making* **10**(6) (2011) 989–1022.
48. Y. Gao, G. Zhang *et al.*, A fuzzy multi-objective Bilevel decision support system, *International Journal of Information Technology & Decision Making* **8**(1) (2009) 93–108.
49. L. Mikhailov, H. Didekhani *et al.*, Weighted prioritization models in the fuzzy analytic hierarchy process, *International Journal of Information Technology & Decision Making* **10**(4) (2011) 681–694.
50. T. L. Saaty, How to make a decision: The analytic hierarchy process, *European Journal of Operational Research* **48** (1990) 9–26.
51. H. Chen, A research based on fuzzy AHP for multicriteria supplier selection in supply chain, Department of industrial management, University of Science and Technology (2004).
52. I. Ertuğrul and N. Karakaşoğlu, Comparison of fuzzy AHP and fuzzy TOPSIS methods for facility location selection, *International Journal of Advanced Manufacturing Technology* **39**(7) (2008) 783–795.
53. S. Bjork and J. Holopainen, *Patterns in Game Design* (Charles River Media, Hingham, MA, USA, 2005).
54. A. Parasuraman, Reflections on gaining competitive advantage through customer value, *Journal of the Academy of Marketing Science* **25**(2) (1997) 154–161.
55. http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/documents/Size%20class%20analysis_1.pdf
56. M. Uschold, M. King, *et al.*, The enterprise ontology, *Knowledge Engineering Review* **13**(1) (1998) 31–89.

ERRATA

Pg 665 Change figure 1 to:



Pg 667, Line 7 Presently reads: "...2010. Figure 2 illustrates the.."
Change to: "...2010. Figure 3 illustrates the..."

Pg 677, Line 34 Presently reads: "... This gives the society an indication what can"
Change to: "This gives the society an indication of what can"

Pg 678, Line 33 Presently reads: "... DL7 (Health and Safety Audits)"
Change to: "DL8 (Health and Safety Audits)"

Pg 679, Line 8 Presently reads: " $DL_i = \{DL_1, DL_2, \dots, DL_n\}$ "
Change to: " $DL = \{DL_1, DL_2, \dots, DL_n\}$ "

Pg 679, Line 33 Presently reads: " $E_i = \{E_1, E_2, \dots, E_p\}$ "
Change to: " $E = \{E_1, E_2, \dots, E_p\}$ "

Pg 684, Line 33 Presently reads: " $DL_i = \{DL_1; DL_2; DL_3; DL_5; DL_8; DL_{15}\}$ "
Change to: " $DL = \{DL_1; DL_2; DL_3; DL_5; DL_8; DL_{15}\}$ "

Pg 688 Change eq. 4 to: $u_{je} = \max(b_{jep}), \quad p = 1, 2, \dots, t; \quad j = 1, 2, \dots, m; \quad e = 1, 2, \dots, m$
Change eq. 5 to: $\tilde{b}_{je} = (l_{je}; m_{je}; u_{je}), \quad j = 1, 2, \dots, m; \quad e = 1, 2, \dots, m$

Pg 689 Change eq. to:

$$V(S_{A_1} \geq S_{A_3}) = hgt(S_{A_3} \cap S_{A_1}) = \mu_{A_1}(d) = \begin{cases} 1, & \text{if } m_{A_1} \geq m_{A_3} \\ 0, & \text{if } l_{A_3} \geq u_{A_1} \\ \frac{l_{A_3} - u_{A_1}}{(m_{A_1} - u_{A_1}) - (m_{A_3} - l_{A_3})}, & \text{otherwise} \end{cases}$$

Pg 701, Line 16 Change reference to:

LM Camarinha-Matos & H. Afasarmanesh (2008). ARCON reference models for collaborative networks. Collaborative Networks: Reference Modeling: 83-112

Pg 702, Line 5 Change reference to:

LM Camarinha-Matos & H. Afasarmanesh (2008). Collaborative Networks: Reference Modeling. Springer Science+Business Media, LCC

2.4 Paper IV

Susana Nicola, Eduarda Pinto Ferreira, J. J Pinto Ferreira, Building Perceived Value on the Value Chains Assets - A Quantitative Model for Decomposing Value for the Customer. Accepted in 28 June 2014 to the International Journal of Information Technology & Decision Making after revision. ISI impact factor (2013) - 1.89

Motivation

Using “multiple case studies” provides a more precise assessment of relationships between connections and constructs, as well as the accuracy and appropriate level of the constructs (Eisenhardt and Graebner, 2007). We indeed aim at creating more robustness and a generalizable and testable CMDVC model applied in several case studies. With this objective in mind, we wanted a new case study where we would be able not only to validate the relationships between connections and constructs used in Paper III, but, as well, to bring in the customer perspective into the equation. It should be reminded that “interviews are a highly efficient way to gather rich, empirical data”, however, data collection bias is a problem widely recognized (Eisenhardt and Graebner, 2007). This issue was overcome by the natural combination of the interviews and the filling of pair-wise comparison tables used for Fuzzy AHP method and, again, new interviews for the discussion of the quantitative results. This approach allowed new issues (not mentioned during the first interviews), to emerge from the results of the quantitative Fuzzy AHP method. On its turn, the final interviews allowed the review/confirmation of the quantitative results and findings. The whole process was combined with the continuous literature review to further support the research findings.

Building Perceived Value on the Value Chains Assets - A Quantitative Model for Decomposing Value for the Customer

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Abstract. This research provides a modeling framework and a quantitative model that could enable suppliers to better understand how the customers perceive value. This novel modeling framework, Conceptual Model Decomposing Value for the Customer (CMDVC) fills a research gap in the literature and builds value for managers that are provided with the means to rationalize how their customers perceive the value of their deliverables and how these relate to the enterprise endogenous¹ and exogenous² assets used by the company to provide the required deliverables to its customer. The Case Study builds on personal interviews both at enterprise and with a customer, as we seek the validation of the proposed Conceptual model for Decomposing Value for the Customer. The point we want to make at an Ex-Ante phase, is how far the application of the CMDVC, was in tuning the company value proposition. The tool, tested on a contract preparation phase (Ex-Ante phase), enables the discovery of previously disregarded connections between assets used and/or built in the foreseen exchange of deliverables and perceived benefits.

Keywords: Fuzzy AHP; customer perceive value; assets management

¹ Endogenous: Characteristics from inside the CNO, namely the identification of the main set of elements/properties that can together capture and represent CNO. (LM CAMARINHA-MATOS, & H. AFASARMANESH 2008a. Collaborative Networks: Reference Modeling. *Springer Science+Business Media, LCC.*)

² Exogenous: Characteristics between the CNO and its surrounding environment.

1. Introduction

Over several years, many authors (Huber et al., 1997, Lapierre, 2000, Woodall, 2003, Woodruff, 1997, Zeithaml, 1988, Lai, 1995) have discussed in literature the concept of Value for the Customer (VC). Woodruff (1997) said “many organizations search for new ways to achieve and retain a competitive advantage” (Woodruff 1997, p139). Also in 2001, (Flint and Woodruff, 2001) emphasized “no marketing research has yet focused on understanding why customer change what they value from suppliers” and it is most relevant that “research [that] would help marketers predict what customer may value in the future” (Flint and Woodruff 2001, p321). In 2002, the authors (Flint et al., 2002) noticed that “organizations are pushed to adopt customer value strategies in order to grow profits and ensure long-term survival” (p102). One such example in marketing literature is Woodall (2003), emphasizing that VC “is of increasing interest to marketers, both practicing and academic”. For this author, value can be defined “purely as what can be got for an item“ (Woodall 2003, p3). And “value derived by one individual is likely to be different to the value derived by another”. So “not only does each of us value the same things differently, we individually value different things, and at different times in different ways” (Woodall 2003, p4). It is therefore essential to determine which factors determine the perception on VC and how this value is perceived (Woodall 2003, p13), involving what the customer receives (e.g. benefits) and what he gives up to acquire and use a product (e.g.: price, sacrifices) (Woodruff, 1997). In 2004, (Overby et al., 2004) made some investigation on consumer perception of product related value. These authors mentioned that customer value perceptions relate not only to desired product or service attributes but also to perceptions of consequences, sacrifices or benefits that emerge as result of a purchase. In order for suppliers to have the capability to anticipate what customers will value, Flint and Blocker et al (2011) introduced the concept of “customer value anticipation”, that is, the “supplier's ability to look ahead at what specific customers will value from supplier relationships, including their product and service offerings and the benefits they create given the monetary and non-monetary sacrifices that must be made to obtain those offering benefits” (Flint, Blocker et al. 2011 p219).

In this context, our research aims at providing a modeling framework and a quantitative model that could enable suppliers to better understand how the customers perceive value. With this model, suppliers are provided with a quantitative model of benefits and sacrifices perceived by the customer and how these relate to the combination of endogenous/exogenous tangible and intangible assets used by the company to provide the required deliverables (DLs) to its customer. This novel modeling framework and a quantitative model fills a research gap in the literature and builds value for managers that are provided with the means to rationalize how their customers perceive the value of their DLs (Product/Service) and how these relate to the enterprise endogenous and exogenous assets. In a longitudinal perspective this model aims at an in-depth understanding of customer perceived value. To this end we break down each product/service value proposition into the so-called Deliverable (a value component). Each deliverable is then related to every built-and-used asset, including endogenous and exogenous perspectives along different time positions. The detailed conceptual model and its mathematical formulation, the so-called “Conceptual Model for Decomposing Value for the Customer” (CMDVC), along with an exploratory case study, is discussed in depth in (Nicola et al., 2012).

This research emerges in the intersection of several knowledge domains, combining results from three distinct research areas: a) from the Marketing area, the concept of Value for the Customer (Woodall 2003); b) from the collaborative networks area, the ARCON Reference Model for Collaborative Organizations Networks (Camarinha-Matos and Afasarmanesh 2008c); c) and from the Intellectual Capital area, the

concept of “Value Network”, introduced by (Allee 2000b), and intangible and tangible assets. The analysis of the Case Study is supported by the so-called Business Narrative Modeling Language (Oliveira and Pinto Ferreira, 2011). This process enables the simplification and acceleration of the qualitative analysis coding process. The mathematical model of the CMDVC, using the Fuzzy AHP (Analytical Hierarchical Process) method, is then applied in the context of textile company, called REMI, in a period before handing the value proposition - in an Ex-Ante phase. This paper concludes with the discussion of the results of the case study.

2. Background

According to some authors (Woodall, 2003, Woodruff, 1997) it is necessary “to explore the richness, nature, influence and measurability of VC in their variety ways dependent upon the place, time, cultural and socio-political agenda”. “No such theoretical certainty or consensus existed with regard to VC” (Woodruff 1997, p2). We need “variations on customer value theory to help understand how customers perceive value in different contexts” (Woodall 2003, p 150). Moreover, “customers are the only real estimators of value” (Perrey, 2004 p145), and this implies that we should have techniques to identify how the customers evaluate the various and competing proposals and, in the final phase of purchasing decisions, they should have understood the company's position within the product / market and “to do so with value as a key driver” (Evans 2002, p 135). One way to study and model VC is to study the enterprises, considering them as value networks. As some authors said, “(...) value is therefore an emergent property of the network, so that understanding the functioning of the network as a whole is essential to understand how and why value is created. (...)”, (Allee, 2008a)(p.12). The value networks offer “a way to model, analyze, evaluate and improve the capabilities of a business” examining the business activities and processes for their capability to deliver value to the network. We must understand the dynamics of the value conversion of every deliverable/asset between roles, determining who is adding value and how business relates to its competitive environment. As participants in the network, people playing roles in the enterprise are responsible for using assets under their controls” to create deliverables that can be traded into negotiable forms of value and to assess the benefits or sacrifices associated to each deliverable. The Fig.1 illustrates the value exchanges between different roles (Role1, Role3) in the business enterprise and a customer (Role2), at the point of the transaction (circle). In this scenario, we have two roles (Role1 and Role3) of the business enterprise that are able to fulfill the customer's need (Role2), and we can argue that they will perceive the value differently. Moreover, the enterprise itself has its own perception on the customer value it offers, and this is different from the customer own perspective ($P1 \neq P3 \neq PE \neq P$). The different perceptions of the enterprise members and the customer at the point of the exchange (represented as a circle), will be relating in the perceived benefits (PB)/sacrifices (PS) of each exchanged deliverables/assets. In order to reveal the knowledge for business enterprises, it is required to understand how each PB/PS is related with the endogenous and exogenous components, because the success of the business enterprise as a collaborative network depends on what value is and how value is created within the business enterprise. Some researchers (De Toni and Tonchia, 2003) think that the attention of managers and researchers must focus on the environment characteristic, namely “inside-out” view (called from others researcher as endogenous components) and “outside-in” view called from others researcher as endogenous components). In this context we apply the business enterprise architecture ARCON (A Reference Model for Collaborative Organizations), identifying two perspectives, the enterprise life-cycle and the combination of two environment characteristics. The model will also help

organizations to understand how and why value for the customer changes over time, from the pre-purchase until the end of the transaction (Value temporal positions). It would further help to explain what “managers should learn about their customers” (Woodruff 1997, p143).

To this end we derived the model in Fig. 1, which illustrates how to project the VC of each exchanged deliverable on to the following dimensions:

The Forms of Value and Temporal Positions

The diagram maps the Forms of Value within their temporal positions, because “suppliers can never predict how each consumer will perceive and react to specific attributes and/or bundles of product, service, price, communication and interaction. (...) Thus a proposed VC exists, longitudinally, before the consumer begins to identify what attributes represent value for him/her” (Woodall 2003, p17). Our concern is to evaluate the customer perceived value about a product/service before, during or after its use. For that reason we use the longitudinal perspective of Woodall (2003) dividing Value for the Customer (VC) into four value temporal positions: Pre-purchase - a phase of trying to predict how people perceive their services (Huber, Lynch et al. 1997) cited in Woodall (2003); At the point of trade – which implies a sense of VC experienced at the point of trade, e.g. Acquisition Value plus Exchange Value; Post- Purchase - a phase that delivers results of experiments based on customers’/suppliers’ choices; e.g.: Use value; Received Value (Huber, Lynch et al. 1997) cited in Woodall (2003); After/use experience - a phase that reflects the point of disposal/sale.

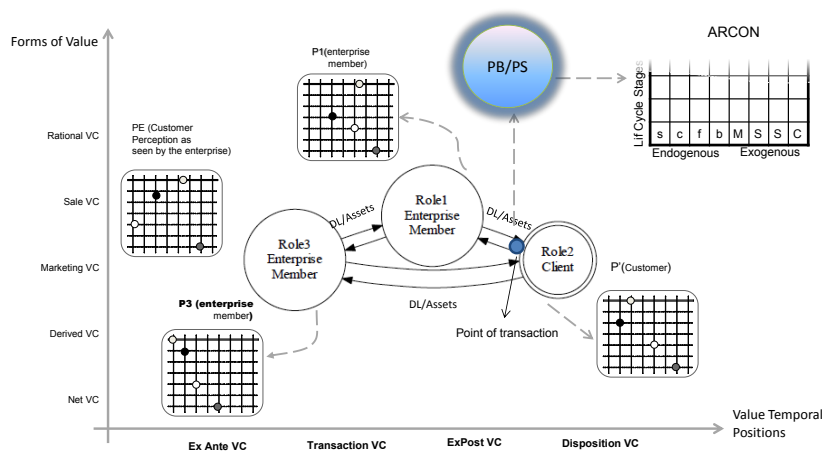


Fig. 1 An extension of the Conceptual Model for Decomposing the Value for the Customer

Woodall (2003) further identifies specific types of value for the customer associated with the above forms of value: Net VC – “balance of benefits and sacrifices” to provide the best or the worst VC; Marketing VC – “perceived products attributes”; Sale VC – primarily concerned with the price; Rational VC – “difference from the objective price”; Derived VC – users’ experiences.

ARCON Endogenous and Exogenous Components

In this dimension we use the Reference Model for Collaborative Organizations (ARCON) (Camarinha-Matos and Afasarmanesh 2008a). This enables the positioning of the organization under analysis either as a network of enterprises

or as an individual enterprise. ARCON features the Collaborative Organization life-cycle and a combination of analysis perspectives, namely the Endogenous and Exogenous perspectives that enables a look both into the “inside” and “outside” of the organization (network or individual company). The second dimension of our model stems from the need to relate each value form and time position with the enterprise (or enterprise network) Endogenous and Exogenous components. The ARCON Endogenous and Exogenous components are used in the context of the operation phase of the collaborative network life-cycle. These Endogenous and Exogenous components are further refined, as illustrated in Fig. 1. The so-called endogenous elements that capture the following four dimensions: Structural (ST), Componential (CP), Functional (FUNC) and Behavioural (BEH). On the other hand, the outside perspective is captured by the exogenous elements that reveal the interaction with the surrounding environment and are divided into four dimensions: Market (MARK), Support (SUP), Societal (SOC), and Constituency (CONS).

Tangible and/or Intangible Assets

The model makes explicit the usage and construction of tangible and/or intangible assets (Allee, 2002a). These assets are projected across the collaborative networks’ endogenous and exogenous perspectives. This builds on the fact that “intangibles are at the heart of all human activity, especially socio-economic activity” Allee (2002a), p4), and that “intangibles go to market as negotiable in economic exchanges”. In this context, “intangibles act as deliverables in key transactions that take place in any given business model”(Allee, 2002a)).

Perceived Benefits (PB) and Perceived Sacrifices (PS)

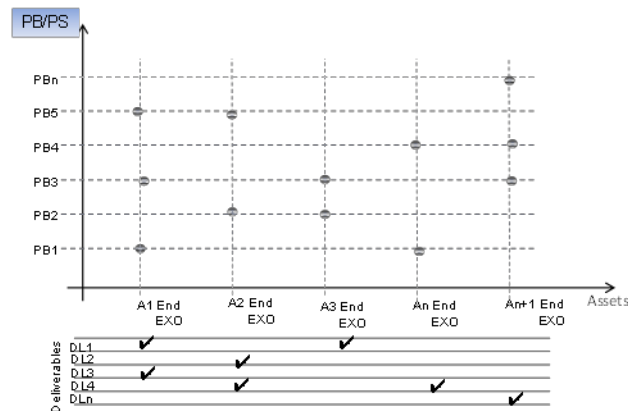


Fig. 2 Integration of the Perceived Benefits/Sacrifices into CMDVC

The last dimension was based on an extensive literature review of the Perceived Benefits (PB) and Perceived Sacrifices (PS) and builds on the work of the following authors: (Huber et al., 1997, Lapierre, 2000, Woodall, 2003, Lai, 1995, Khalifa, 2004, Zeithaml, 1988). Among many existing definitions, we build on Value defined “as the difference between customers perceptions of benefits received and sacrifices incurred” (Khalifa 2004, p649). The Perceived Benefits (PB) and Perceived Sacrifices (PS) are pictured in Fig. 1, both as perceived by the enterprise itself and as perceived by the Customer. Fig. 2 depicts the PB and PS that will provide the means to derive the relative value of

each used/built asset (endogenous/exogenous) and, as a consequence, the relative value of each tangible or intangible exchanged deliverable.

Example, DL1 is associate to A1 and A3 (End and EXO), so the set of PB are PB1, PB2, PB3 and PB5.

3. Research Approach

Along this project we have been following the Design Science approach (Hevner et al., 2004) to the development of the proposed CMDVC framework. This approach enabled the identification of an adequate match between the business need and the literature gap. The validation followed the Case Study approach with an early exploratory case study that enabled the early validation of the research questions:

1. How can the Value for the Customer be modelled?

1.1 How is this value built on top of assets endogenous and exogenous to the organization?

1.2 How do endogenous and exogenous assets influence the Value for the Customer?

2. Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?

In the exploratory case study, these research questions were validated in the context of a negotiation setting involving the company and the customer. In this paper we aim at a further validation of the answers to the above research questions and at going one small step further in the application of this model to a SME in the Textile Industry in Portugal, in the context of its Value Chain.

Using the same methodology, for the data collection, data analysis as used in the article of (Nicola et al., 2012), we made a personal interview of two business enterprise members, the CEO, that is also the owner and “Production” manager, and the person responsible for “Sales and Marketing“. At first we begin with a recorded interview with open-ended questions, where they explained their routine and perceptions of how services unfold within the enterprise. The information gathered in the interview and the documents provided by the business enterprise offered the researcher multiple sources of evidence to support this work. It further enabled data triangulation, constructing, in this way, a stronger case study as well as evidence (Yin, 1999). The coding process followed the Business Narrative Modeling Language (BNML) approach (Oliveira and Pinto Ferreira, 2011).

4. Applying the Conceptual Model for Decomposing Value for the Customer - Case Study

In this section we discuss the Conceptual Model for Decomposing Value for the Customer in the context of a Case Study at a Textile SME in the North of Portugal. The company name is Regina & Miguel Lda (REMI). As in (Nicola et al., 2012) we concentrate the research of the Value for the Customer at the Ex-Ante phase (EXA_VC). This corresponds to the period before the handing of the contract proposal to the customer, as it relates to the perceived Value for the Customer “whenever they contemplate the purchase” (Woodall 2003, p10). The analysis of the Ex-Ante perspective is about learning and better understanding how value is perceived, a point in time for anticipating future predictable occurrences so that we can “make choices to maximize the ex-post happiness” (Huber 1997, p325). There is no agreement of what constitutes a customer value proposition, or what make them

persuasive. Adequate, convincing and efficient values proposition “should be the basis of a firm’s functional, psychological and economic value, with related benefits”(Capon and Hulbert, 2007).“If the supplier doesn’t demonstrate and document that claim, a customer manager will likely dismiss it as a marketing puffery” (Anderson et al., 2006). Some authors stated that “Modelling and mapping value propositions helps better understanding of the value a company wants to offer its customer and makes it communicable between various stakeholders”(Osterwalder and Pigneur, 2003).

This section is organized as follows. We start by introducing the SME, REMI, its value network featuring the exchange of both tangible and intangible deliverables. Building on this, we will illustrate in section 5 the formal mathematical CMDVC model at the Ex-Ante time position by clarifying how the different model perspectives are brought together to a consistent whole.

4.1 REMI Presentation

The Unit of Analysis (Dubé and Paré, 2003) of the present Case Study was conducted at Regina & Miguel Lda (REMI) in Ermesinde, an SME with 20 employees in the North of Portugal, along the year of 2012. The origin of REMI dates back to 1986 and today its operations cover the complete garments circular knits production process. REMI is a leading company, with a fully integrated production process of garments, whose mission is to grow with profit, by strengthening proximity to its customers, in order to establish a trustful and long term relation with all partners – customers, employees, suppliers and community. For the understanding of REMI success it is fundamental to examine the competitive advantages beyond its own operations, it must look outward to its value chain, suppliers, distributors and customers. Fig. 3 shows REMI position in the value chain, outlining the endogenous and exogenous components. To face international competition and the need for fast response to customer needs, REMI has built a network of outsourcing partners, suppliers and distributors in order to create and deliver superior value to the market.

One of the largest distributors of REMI is located in Belgium. The close integration between REMI and this distributor enables improved production management and reduces inventory. The use of electronic communication with distributors provides REMI with updated information about sales, namely models, sizes and quantities that should be produced to meet the retailers’ needs.

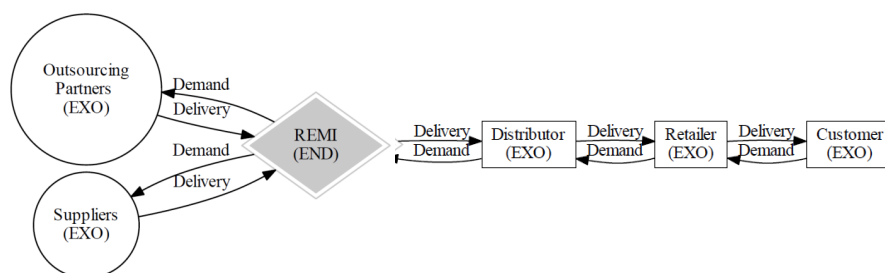


Fig. 3 – Value Chain (Components Endogenous and Exogenous)

Table 1 Classification of Deliverables in the Value Network

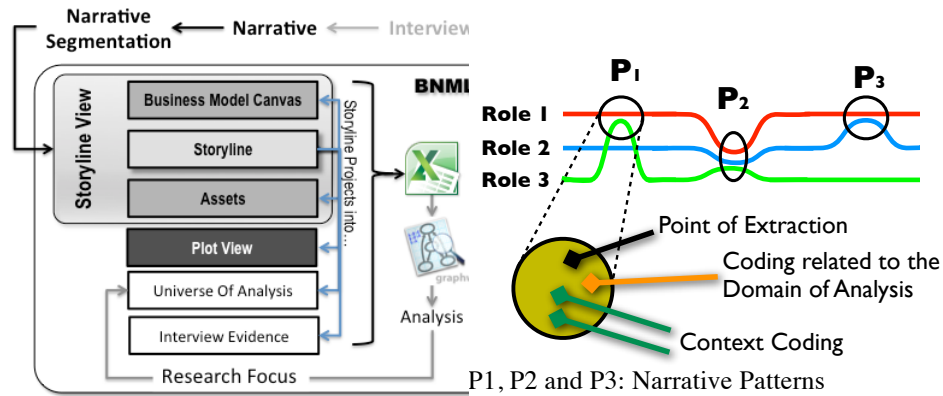
Value Chain Position/Interaction	Certifying Entity	Value Proposition	Sales and Operations Planning
REMI	DL1 - Legitimacy	DL4 - Product Information	DL23 - Research new design and models
	DL2 - Sets Legal Requirements	DL5 - Order Entry (Langenwaller 1999)	DL16 - Product/Service Quality
	DL3 - Feeling on acceptability	DL6 - New Ideas (Langenwaller 1999)	DL22 - Customer feedback
		DL13- Trust / Goodwill	DL18 - Expertise and help
		DL7 - Market Insights	DL19 - Knowledge and experience about the process
		DL10 - Closed Sales Proposal/Shipping	DL21 - Improves Worker Happiness
		DL15 - Product Innovation	DL20 - Order Entry (Langenwaller 1999)
		DL8 - Environment to Buy (Langenwaller 1999)	DL29 - OrderGeneration(Langenwaller 1999)
			DL24 - Production Proposal
	Outsourcing Partners		DL25 - Production Delivery
		DL26 - Payment (OP)	
Suppliers		DL27 - Payment (suppliers)	
		DL11- Production Proposal	
		DL14- Production Delivery	
Distributor /Retailer		DL9 - Customer wants, desires and requirements (Langenwaller 1999)	DL17 - Payment
			DL28- Customer Complaints/orders

5. Deriving the CMDVC in an Ex-Ante perspective.

In this section we build the basis for deriving the formal representation of the CMDVC for the REMI Case Study. Following the interview, we applied the BNML. This approach is a method to facilitate qualitative research in business studies. The narrative is segmented as chunks of text labeled with a Point of Extraction. Then, each point of extraction is projected into:

1. keywords referring to the domain of analysis:
 - a) Temporal Value Position (we will only look at the Ex-Ante time position)
 - b) Forms of Value
 - c) Tangible and Intangible Assets (e.g.: Deliverables)
 - d) Perceived Value and Benefits;
2. keywords referring to the context coding
 - a) ARCON Endogenous and Exogenous components

These projections stem from the model illustrated in Fig. 1



a) BNML Modeling Framework

b) Narrative Segmentation

Fig. 5 – Business Narrative Modelling Language (Oliveira and Pinto Ferreira, 2011)

In this context, the narrative segmentation allows the construction of a direct relationship between each narrative text segment and a narrative pattern and, as a consequence, with all other items (Assets, deliverable value identification, Value temporal position, Forms of Value, Arcon Endogenous and Exogenous components) used as a coding scheme (Table 2) for the analysis. The resulting relationships are structured as a table in Microsoft Excel. Pivot tables are finally used to select the desired views on data that is, finally, exported as a text file to Graphviz. This tool enables the visualization of graphs picturing the relationships among the keywords used in the coding scheme. The next paragraphs will picture several of these derived graphs as well as their rationale.

Table 2 - List of terms used in the coding scheme

Ontology	Keywords used in the model
Deliverables	DL1 - Legitimacy, DL2 - Sets Legal Requirements, DL3 - Feeling_on_acceptability, DL4 - Product_Information, DL5 - Order Entry, DL6 - New_ideas, DL7-Market_Insights, DL8- Environment_to_Buy, DL9 - Customer_wants_needs_requirements, DL10 - Closed_ Sales_Proposal/Shipping , DL11- Production Proposal, DL13- Trust / Goodwill, DL14- Production Delivery, DL15 - Product_Innovation, DL16 - Product_Service_Quality, DL17 - Payment , DL18-Expertise_and_help, DL19 - Knowledge and experience about the process, DL20 - Order Entry, DL21 - Improves_Worker_Happiness, DL22 - Customer feedback, DL23 - Research new design and models, DL24 – Production Proposal, DL25 - Production Delivery, DL26 - Payment (OP), DL27 - Payment (suppliers), DL28- Customer Complaints/orders, DL29 – Order Generation
Tangible and Intangible Assets [Builds/Uses] (Allee 2000; Allee 2008a)	A26:Uses_Alliances,A2:Uses_Know_How,A1:Builds_LicenceToOperate, A4:Builds_EmployeeInvolvement, A11: Uses_Years_of_Experience,A22: Builds_Sales_Per_Customer, A18: Builds_Quality, A23:Builds_Growth_Customer_Base,A8:Uses_SpeedofDecisionMaking,A 24:Uses_Product_Service_Development_Costs, A25: Builds_brand_Recognition
ARCON [Endogenous and Exogenous components](Camarinha and H. Afasarmanesh 2008a)	END_FUNC, END_ST, END_CP, END_BH, EXO_SUP, EXO_SOC, EXO_MARK, EXO_CONS
Forms of Value (Woodall 2003)	MARK_VC, RAT_VC, SALE_VC, DERIV_VC, NET_VC
Value Temporal Positions (Woodall 2003)	EXA_VC, TRANS_VC, EXP_VC, DISP_VC
Perceived Benefits (Lapierre 2000; Lapierre 2001; Zeithaml 1988)	PB4 - Service Quality, PB8- Service Performance, PB15- Reliability, PB44 - Responsiveness, PB47-Technical Competence, PB17 - Product Attributes, PB41-Alternative Solutions, PB42 - Product Quality, , PB48 - Image, PB49- Trust, PB51- Supplier Solidarity with Customer
Perceived Benefits (Woodall 2003)	PB21- Utility, PB18 Features, PB35 - Appreciation from Users
Perceived Sacrifices (Woodall 2003; Zeithaml 1988)	PS3- Monetary Costs, PS7- Perceived Costs

5.1 Forms of Value

For the Pre-Purchase (Ex-Ante) time position the graph in Fig. 6 illustrates how the different types of Value for the Customer (EXA_VC) (Woodall 2003) relate to the exchanged DLs at the point of analysis.

In an Ex-Ante perspective the customer will make judgments and predictions to maximize the value of the product and service to be acquired. As a result, all forms of value emerged for this phase. To illustrate and explain this graph will discuss the connections pictured as dashed lines, we detailed two examples:

- The “Net VC” (NET_VC) implies “that the customer makes some judgment on the worthwhileness of a product/service by computing or comparing weights and/or benefits and sacrifices”, by equating the weight and “balance of benefits and sacrifices” (Woodall 2003, p7). From the point of the customer, Product/Service Quality (DL16) is also a direct result of this and has a clear impact in the balance of the involved benefits and sacrifices as seen by the customer - “(...) REMI provides a good working environment for the enterprise workers and this is reflected on the actual quality of the final product.” (Interview excerpt). This further means that Net Value for the Customer has a relationship with deliverable DL21- Improves Worker Happiness. This form of value is also related directly with deliverable DL2 - Set legal Requirements – “(...) to operate the company must be legally empowered to do so.” – because the customer wants to work with a company that is legally empowered and, possibly, quality certified by a recognized auditor.
- The “Derived VC” (DERIV_VC) is related with the “‘use/experience outcomes’ is suggestive of the Aristotelean notion of ‘use value’” (Woodall 2003, p7). However, the ‘Derived VC’ also emerges at a point prior to the transaction as “a ‘Derived VC’ in prospect” that is “will likely have been imagined” (Woodall 2003, p19). It is in the context that the DERIV_VC is brought in, as an “expected promise” of value that, in the REMI case, builds on the lasting, and good, relationship between the company and it’s distributors. As a result, the Derived VC is further related with the perceived benefits of the results DL25 (Production Delivery). In fact, this “expected promise” of value builds on the REMI Derived VC in its relationship with their suppliers and outsourcing partners. Based on the same rationale, DERIV_VC relates to DL9 (Customer_wants_needs_requirements). In fact, the REMI customer (the large distributor) has expectations of how end customer needs could be fulfilled as fast as possible: “(...) within the organization, we received the orders entry from the customer, and sometimes our biggest customer sends 3 or 4 orders at the same time. In these cases we schedule the cutting plan and we try to fulfill that order as fast as possible”.

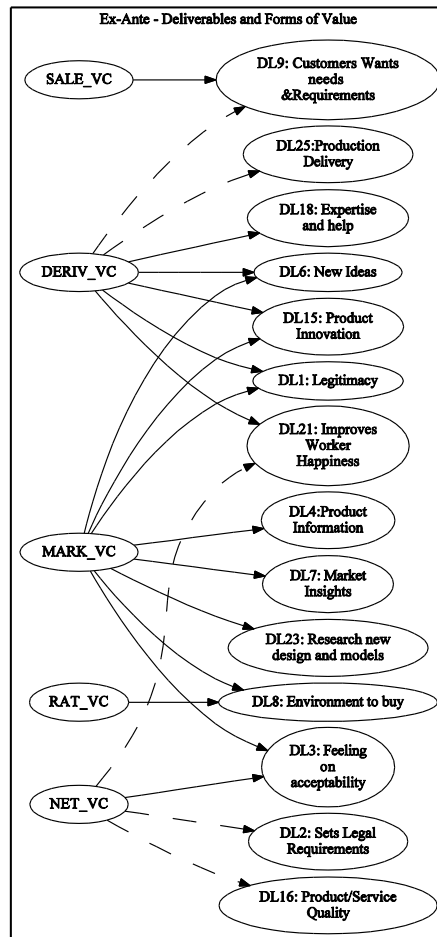


Fig. 6 Graph EX-Ante (EXA_VC) - Deliverables – Form of Value

5.2 Connecting Deliverables, Assets and ARCON Endogenous and Exogenous Components

The previous picture illustrated the connection between forms of value and its relationship with each deliverable, this for the Ex-Ante time position. Fig. 7 extends Fig. 4 by building the relationship between each deliverable, the Asset being Used or Built and the projection of each asset into the ARCON endogenous and exogenous components. This graph will enable a better understanding of how each deliverable and its value perception relates to the two components (endogenous and exogenous). As an example we have “DL6 - New Ideas”:

REMI CEO revealed the key value of new ideas to overcome the market challenges and to make the best benefits of opportunities that arise. These new ideas are about finding new and creative solutions in order to find a solution to the inconsistencies

that are many times detected in the models specified by the customers' orders. The result is that these New Ideas (DL6,) promote innovation and quality. They also build on [Using] Uses Years of Experience (A11, edge 20) for building the knowledge needed to help customers achieve their goals. Asset A11 will be projected into: 1) Endogenous Functional (END_FUNC, edge 54) because technical and functional capabilities allow companies to design, develop and manufacture the selected new product idea; 2) Exogenous Market (EXO_MARK, edge 55), because each new idea (product concept) may require different marketing communication and a marketing strategy; 3) and, finally, into Exogenous Support (EXO_SUP, edge 42) as it can be related with a third party interaction, namely outsourcing partners.

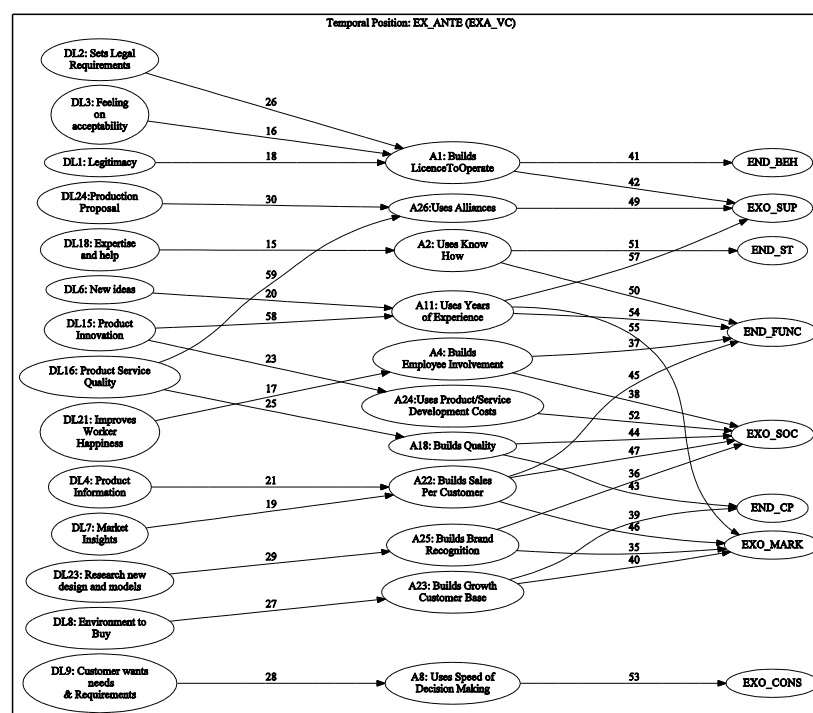


Fig. 7 Graph EX-Ante (EXA_VC)- Deliverables – Assets – Arcon

5.3 Connecting Perceived Benefits and Sacrifices, the 1st step towards the construction of a quantitative model

Customer do not purchase a firm's offering, "(...) instead they are attracted by and stay with firms that are able to act on the developed knowledge about customers' needs to serve them better through delivering greater value." (O'Cass and Ngo 2012, p127). In this context, since more "knowledge is needed about the construct and its operationalization" (Ulaga 2001) about customer value in the field of marketing, it is important that firms could understand its market and the value being sought (O'Cass and Ngo 2012), which could be the key to its strategic development and competitive advantage. To this end, we will now analyze in detail the Perceived Benefits (PB) and Sacrifices (PS) related to the previously identified exchanged DLs and enterprise

assets at an Ex-Ante time position.

Table 3 and 4 lists the whole set of perceived benefits and perceived sacrifices identified in the existing deliverable exchanges.

Table 3 – Perceived Benefits (by REMI customer)

	Perceived Benefits	REMI Assets	Deliverables
Service Related	<i>PB4 - Service Quality</i>	<i>A24 – Uses Product Service Developments Costs</i>	<i>DL15- Product Innovation.</i>
	<i>PB8 - Service Performance</i>	<i>A4- Builds Employee Involvement; A8 – Uses Speed of Decision Making; A26 - Uses Alliances;</i>	<i>DL21 - Improves Worker Happiness; DL9 - Customer wants, desires and requirements; DL24 - Production Proposal.</i>
	<i>PB15 - Reliability</i>	<i>A23 Builds Growth Customer Base; A8 – Uses Speed of Decision Making;</i>	<i>DL8 – Environment to buy; DL9 - Customer wants, desires and requirements.</i>
	<i>PB44 - Responsiveness</i>	<i>A8 – Uses Speed of Decision Making</i>	<i>DL9 - Customer wants, desires and requirements.</i>
	<i>PB47 -Technical Competence</i>	<i>A11 Uses years of Experience; A4- Builds Employee Involvement; A18- Builds Quality</i>	<i>DL4 – Product Information; DL6 – New Ideas; DL16 – Product/Service Quality;DL7 – Market Insights; DL21 - Improves Worker Happiness.</i>
Product Related	<i>PB17 - Product Attributes</i>	<i>A24 – Uses Product Service Developments Costs A25 Builds Brand Recognition</i>	<i>DL15- Product Innovation; DL23 – Research New Design and Models.</i>
	<i>PB21 - Utility</i>	<i>A22- Builds Sales per customer</i>	<i>DL4 – Product Information.</i>
	<i>PB41 - Alternative Solutions</i>	<i>A2- Uses Know-how</i>	<i>DL18 – Expertise and Help.</i>
	<i>PB42 - Product Quality</i>	<i>A11 Uses years of Experience; A25 Builds Brand Recognition</i>	<i>DL4 – Product Information; DL6 – New Ideas; DL23 - Research New Design and Models.</i>
Relationship Related	<i>PB35 - Appreciation from Users</i>	<i>A22- Builds Sales per customer</i>	<i>DL4 – Product Information.</i>
	<i>PB48 - Image</i>	<i>A25 Builds Brand Recognition</i>	<i>DL23 - Research New Design and Models.</i>
	<i>PB49 - Trust</i>	<i>A18- Builds Quality</i>	<i>DL16 – Product/Service Quality.</i>

Table 4 – Perceived Sacrifices (PS by REMI customer)

	Perceived Sacrifices	REMI Assets	Deliverables
Product Related	<i>PS3 – Monetary Costs</i>	<i>A11- Uses years of Experience; A18- Builds Quality</i>	<i>DL16 – Product/Service Quality; DL6 – New Ideas;</i>
	<i>PS7 – Perceived Costs</i>	<i>A25 - Builds Brand Recognition</i>	<i>DL23 - Research New Design and Models.</i>

In this context, the next few paragraphs build on REMI Case Study information gathered during the interview and on the interview made to REMI bigger customer (distributor).

The interview at REMI enabled the construction of a relationship between the enterprise endogenous and exogenous assets and the customer PB/PS, as seen by REMI. The interview with the REMI customer enabled the construction of a relationship between exchanged DLs and PB/PS. The graphs obtained for each PB / PS are now presented and discussed.

6. Quantifying the CMDVC using the fuzzy AHP method

6.1 Using the Fuzzy AHP method in the VC evaluation in an Ex-Ante perspective in a textile company

The valuation and measurement of tangible and intangible assets is a difficult task, since it brings together qualitative and quantitative variables. As a result, we must weigh the “value-based drivers” (term set by Lapierre 2000) identified by benefits and sacrifices, of each asset in the business enterprise. This involves Multi-Criteria Decision Making (MCDM), where we have several conflicting criteria in a setting where their importance is not easily determined (Kou, Lu et al. 2012).

The Analytic Hierarchy Process (AHP) method is extensively used for MCDM and has been successfully applied to many practical decision-making scenarios. This method was created by Thomas L. Saaty in 1980 and its use has been increasing because of the AHP’s advantages (Peng et al., 2011), such as great flexibility and wide applicability. Nevertheless, some authors criticized the method, “due to its use of unbalanced scale of judgments” (Ertuğrul and Karakaşoğlu, 2008)p785) and “failure to precisely handle the inherent uncertainty and vagueness in carrying out pair-wise comparisons” (Nukala and Gupta, 2005). To overcome these disadvantages, AHP will be used together with the fuzzy set environment. The fuzzy set theory is primarily concerned with quantifying vagueness in human perceptions and thoughts. As in the AHP method, the Fuzzy AHP also has: a set of i criteria; a set n alternatives; a set composed by the perception of p decision-makers. In this context, the decision maker defines the weights that relate criteria and alternatives by using the Saaty’s scale. Data is then clustered by using the triangular fuzzy numbers for a pair wise comparison of fuzzy AHP. A triangular fuzzy number is defined by three parameters (l, m, u) , where l is the lowest possible number, m is the most promising and u is the upper possible value that describes the linguistic value. The value of (l, m, u) is determined by the decisions makers themselves. Then, using the “extent analysis method for the synthetic extend values” (Chang’s 1996) of the pair-wise comparison and by applying the arithmetic operations on fuzzy numbers, one performs evaluations on the decision

makers and the customer perception (as seen by REMI) on the alternatives set with respect to each criteria.

6.2 Calculation with fuzzy AHP method

The application of this method integrates techniques/concepts such as: a) MCDM; b) AHP; and c) the Fuzzy Set Theory. The clear definition of the multi-criteria problem involves: 1) to identify which criteria we are concern with and, 2) many potential alternatives do we have. We want to provide all managers with the means to rationalize how their customers perceive the value of their offer – DLs – (Product/Service) and how these relate to the business enterprise endogenous and exogenous assets. In a longitudinal perspective this model aims at an in-depth understanding of customer perceived value. For the Ex-Ante time position under analysis, we identified 11 criteria (Allee, 2000): *A26–Uses_Alliances*; *A2–Uses_Know_How*; *A1–Builds_LicenceToOperate*; *A4–Builds_EmployeeInvolvement*; *A11–Uses_Years_of_Experience*; *A22–Builds_Sales_Per_Customer*; *A18–Builds_Quality*; *A23–Builds_Growth_Customer_Base*; *A8–Uses_SpeedofDecisionMaking*; *A24–Uses_Product_Service_Development_Costs*; *A25–Builds_brand_Recognition*.

The alternatives available for each criteria are the different possible combinations of Perceived Benefits (PBq) and Perceived Sacrifices (PSq), resulting in 13 alternatives, namely (Lapierre, 2000, Lapierre, 2001, Woodall, 2003, Zeithaml, 1988): *PB4–Service Quality*; *PB8–Service Performance*; *PB15–Reliability*, *PB44–Responsiveness*; *PB47–Technical Competence*; *PB17–Product Attributes*; *PB41–Alternative Solutions*; *PB42–Product Quality*; *PB48–Image*; *PB49–Trust*; *PB21–Utility*; *PB35–Appreciation from Users*; *PS3–Monetary Costs*.

After defining the criteria and the possible alternatives the next phase involves construction of the hierarchical model in Fig. 8, which can help us understand the framework of the MCDM problem.

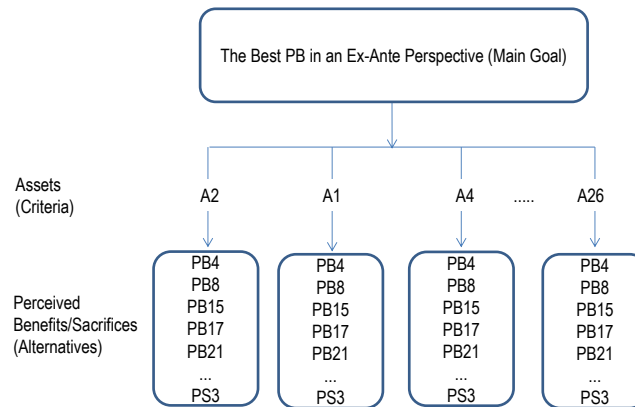


Fig. 8 –The structured hierarchy used in this research

In Fig. 8, the overall goal is laid at the highest level; the criteria are identified at the next level and the candidate alternatives are located at lowest level. We proposed a group decision makers, based on the fuzzy AHP (D_p) where $p = 1,2,3$. In this group and for the Ex-Ante time position, we have three decision makers (D1, D2 and D3)

from whom we will have to gather information about how each of them (D_p) grades:
1) the *relative importance* between each Criteria (Asset) (Table5);

Table 5 - Pair-wise comparisons for the eleven criteria

D1 Management REMI

D1	A2	A1	A4	A11	A22	A18	A23	A8	A24	A25	A26
A2	1	3	1	1	0.143	0.111	0.111	1	3	0.111	0.143
A1	0.33	1	9	9	9	9	9	9	9	9	9
A4	1	0.11	1	1	0.2	0.2	0.143	1	3	0.143	0.143
A11	1	0.11	1	1	0.2	1	0.111	1	5	0.143	0.333
A22	6.99	0.11	5	5	1	1	1	7	9	9	7
A18	9.01	0.11	5	1	1	1	1	7	5	3	9
A23	9.01	0.11	6.99	9.01	1	1	1	9	9	5	3
A8	1	0.11	1	1	0.14	0.14	0.11	1	0.111	3	3
A24	0.33	0.11	0.33	0.2	0.11	0.2	0.11	9.01	1	0.111	0.111
A25	9.01	0.11	6.99	6.99	0.11	0.33	0.2	0.33	9.01	1	1
A26	6.99	0.11	6.99	3	0.14	0.11	0.33	0.33	9.01	1	1

D2 Marketing team REMI

D2	A2	A1	A4	A11	A22	A18	A23	A8	A24	A25	A26
A2	1	1	5	0.333	0.111	3	0.111	4	2	0.111	0.143
A1	1	1	9	9	9	9	9	9	9	9	9
A4	0.2	0.11	1	1	0.111	0.25	0.111	2	4	0.143	0.111
A11	3	0.11	1	1	0.111	1	0.111	2	4	0.143	0.143
A22	9.01	0.11	9.01	9.01	1	9	1	7	9	9	1
A18	0.33	0.11	4	1	0.11	1	0.111	2	2	0.143	0.143
A23	9.01	0.11	9.01	9.01	1	9.01	1	9	9	1	1
A8	0.25	0.11	0.5	0.5	0.14	0.5	0.11	1	4	0.111	0.111
A24	0.5	0.11	0.25	0.25	0.11	0.5	0.11	0.25	1	0.111	0.111
A25	9.01	0.11	6.99	6.99	0.11	6.99	1	9.01	9.01	1	1
A26	6.99	0.11	9.01	6.99	1	6.99	1	9.01	9.01	1	1

D3 Perception of the customer of REMI company

D3	A2	A1	A4	A11	A22	A18	A23	A8	A24	A25	A26
A2	1	0.111	4	1	6	0.111	5	1	2	1	2
A1	9.01	1	2	2	2	2	2	2	2	2	2
A4	0.25	0.5	1	0.333	4	0.111	6	0.143	4	0.143	0.143
A11	1	0.5	3	1	5	0.143	5	0.111	5	0.143	3
A22	0.17	0.5	0.25	0.2	1	0.143	4	7	9	9	1
A18	9.01	0.5	9.01	6.99	6.99	1	9	1	5	2	3
A23	0.2	0.5	0.17	0.2	0.25	0.11	1	0.143	2	0.333	2
A8	1	0.5	6.99	9.01	0.14	1	6.99	1	9	0.111	2
A24	0.5	0.5	0.25	0.2	0.11	0.2	0.5	0.11	1	0.111	2
A25	1	0.5	6.99	6.99	0.11	0.5	3	9.01	9.01	1	0.143
A26	0.5	0.5	6.99	0.33	1	0.33	0.5	0.5	0.5	6.99	1

2) for each Criteria (Asset), the *relative importance* of each and every Alternative (Perceived Benefit / Perceived Sacrifice). Each individual pair-wise comparison is graded by using the Saaty's scale as illustrated in eq.1. The first two decision makers are respectively the REMI Executive Function (REF) and REMI Marketing and Sales (RMS). The information gathered for the third decision maker (D3) results from the joint perception of both D1 and D2 of how the REMI customer would assess those same relationships.

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \quad i = 1, 2, \dots, n; \quad j = 1, 2, \dots, n \quad (1)$$

Then, a comprehensive pair-wise comparison matrix (\tilde{D}_p) is built as in (appendix) by integrating the values of the evaluations made by D1, D₂ and D₃: \tilde{b}_{jep} through the Eqs. 2-6 (Chen, 2004).

$$l_{je} = \min(b_{jep}), \quad p = 1, 2, \dots, t; \quad j = 1, 2, \dots, m; \quad e = 1, 2, \dots, m \quad (2)$$

$$m_{je} = \frac{\sum_{p=1}^t (b_{jep})}{p}, \quad p = 1, 2, \dots, t; \quad j = 1, 2, \dots, m; \quad e = 1, 2, \dots, m \quad (3)$$

$$u_{je} = \max(b_{jep}), \quad p = 1, 2, \dots, t; \quad j = 1, 2, \dots, m; \quad e = 1, 2, \dots, m \quad (4)$$

$$\tilde{b}_{je} = (l_{je}; m_{je}; u_{je}), \quad j = 1, 2, \dots, m; \quad e = 1, 2, \dots, m \quad (5)$$

where \tilde{b}_{je} represents the relative importance among each criterion with triangular fuzzy numbers.

$$\tilde{D}_p = \begin{bmatrix} \tilde{b}_{11} & \tilde{b}_{12} & \cdots & \tilde{b}_{1m} \\ \tilde{b}_{21} & \tilde{b}_{22} & \cdots & \tilde{b}_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{b}_{m1} & \tilde{b}_{m2} & \cdots & \tilde{b}_{mm} \end{bmatrix} \quad (6)$$

As a result of this step, the different grading's made by the three decision makers (D1, D2 and D3) are transformed into a new matrix of triangular fuzzy numbers (TFN), (appendix). Building on this result, we now use the so-called extent analysis synthesis method (Chang, 1996) to calculate the final relative importance of each Criteria (Asset) as a priority weight vector (W_A), following the method proposed by Chang's (Chang, 1996):

Step1 | The value of fuzzy synthetic extent with respect to i th object is defined as:

$$S_i = \sum_{j=1}^m M_{gi}^j \times \left[\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j \right]^{-1} \quad (7)$$

The fuzzy addition of M_{gi}^j values is performed such as:

$$\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j = (\sum_{i=1}^n l_i, \sum_{i=1}^n m_i, \sum_{i=1}^n u_i) \quad (8)$$

And then the inverse of the vector above is:

$$\left[\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j \right]^{-1} = \left(\frac{1}{\sum_{i=1}^n u_i}, \frac{1}{\sum_{i=1}^n m_i}, \frac{1}{\sum_{i=1}^n l_i} \right) \quad (9)$$

Step2 | The degree of possibility for $M_2 \geq M_1$ of two TFNs $M_1 = (l_1, m_1, u_1)$ and $M_2 = (l_2, m_2, u_2)$ can be defined as:

$$\begin{aligned} V(M_1 \geq M_2) &= hgt(M_1 \cap M_2) = \\ &= \mu_2(d) = \begin{cases} 1, & \text{if } m_2 \geq m_1 \\ 0, & \text{if } l_1 \geq u_2 \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}, & \text{otherwise} \end{cases} \end{aligned} \quad (10)$$

In general, the priority weights are calculated by using

$$d'(A_i) = \min V(S_i \geq S_k) \text{ for } k = 1, 2, \dots, n; k \neq i \quad (11)$$

that are the pair wise comparison of the M TFNs. Then the weight vector is given by

$$W' = (d'(A_1); d'(A_2); \dots; d'(A_n))^T \quad (12)$$

Finally we normalized the weight vector

$$W = (d(A_1); d(A_2); \dots; d(A_n))^T \quad (13)$$

where W is a non-fuzzy number.

The result (Table 6) is the priority weight vector W_A , that results from the evaluation criteria (eq. 7-13). W_A^T is the transpose of the weight vector W_A .

Table 6 - Values of the priority weight vector from the evaluation criteria

	A2 [Uses] Know-how	A1 [Builds] License to Operate	A4 [Builds] Employee Involvement	A11 [Uses] Years of experience	A22 [Builds] Sales per Customer	A18 [Builds] Quality	A23 [Builds] Growth Customer Bas	A8 [Uses] Speed of Decision Making	A24 [Uses] Product/Service Developments Costs	A25 [Builds]Brand Recognition	A26[Uses] Alliances
W_A	0.0816	0.1312	0.0572	0.0744	0.0913	0.0997	0.1135	0.0895	0.0422	0.117	0.1077

As seen in Table 6, the ranking the order of the criteria with the fuzzy AHP method, one has $A_1 > A_{23} > A_{25} > A_{26} > A_{18} > A_{22} > A_8 > A_2 > A_{11} > A_4 > A_{24}$. The criteria A_1 has the highest priority weight and is likely to be the most relevant asset. Now that we have the priority weights for each criterion, we have to calculate

the priority weights for each alternative and, as a result, the impact this has in the relative importance of each Asset (criteria).

After calculating the relative weight of each element of each level, the composite priorities of the alternatives (PBq), will be determined aggregating the weights throughout the hierarchy. From the pair-wise comparisons of D1, D2, D3 for the 13 alternatives, evaluation matrixes are formed. Then, the priority weights of the alternatives (perceived benefits and perceived sacrifices) are determined by making the same calculation as for the criteria following the equations 7-13.

The judgment matrix M_{PBA} is called the matrix of priority weights of the perceived benefits and is made up of the overall judgement scores of alternative (PBq) with respect to criteria (Ai). The matrix of priority weights of the perceived benefits is M_{PBA} , such as:

	A02	A01	A04	A11	A22	A18	A23	A08	A24	A25	A26
B04	0,0972	0,0795	0,0931	0,0965	0,1071	0,1119	0,1047	0,0731	0,0973	0,0858	0,0891
B08	0,0804	0,0596	0,0893	0,0919	0,0971	0,1065	0,0957	0,1140	0,0897	0,0763	0,0900
B15	0,0706	0,0683	0,0598	0,0447	0,0366	0,0508	0,0899	0,0904	0,0654	0,0719	0,0662
B17	0,0858	0,0664	0,0718	0,0679	0,0917	0,1002	0,0988	0,0159	0,0758	0,0696	0,0814
B21	0,0072	0,0866	0,0525	0,0355	0,0221	0,0058	0,0295	0,0000	0,0601	0,0527	0,0508
B35	0,0504	0,0907	0,0526	0,0671	0,0044	0,0000	0,0165	0,0000	0,0539	0,0379	0,0579
B41	0,1094	0,0907	0,0789	0,0796	0,0782	0,0656	0,0593	0,1119	0,0775	0,0850	0,0719
B42	0,0992	0,0672	0,0943	0,0984	0,1112	0,1213	0,1061	0,1051	0,0877	0,0990	0,0842
B44	0,0930	0,0815	0,0774	0,0769	0,0814	0,0751	0,0831	0,1351	0,0778	0,0923	0,0851
B47	0,1062	0,0784	0,0986	0,1031	0,1100	0,1178	0,1071	0,1246	0,0916	0,1011	0,0896
B48	0,0913	0,0839	0,0780	0,0901	0,0925	0,0798	0,0746	0,0921	0,0810	0,0858	0,0782
B49	0,0665	0,0466	0,0702	0,0552	0,0792	0,0604	0,0495	0,0531	0,0474	0,0628	0,0728
S03	0,0428	0,1006	0,0837	0,0931	0,0883	0,1048	0,0853	0,0847	0,0947	0,0799	0,0828

The evaluation criteria is obtained by multiplying the matrix M_{PBA} obtained by the weights of each alternative with respect to main criteria with the normalized vector obtained by the weights of the criteria W_A^T . We get the normalized ranks for the benefits/sacrifices multiplying the matrix by the vector W_A^T , thus resulting in the final score (SC).

$$SC = M_{PBA} \times W_A^T \quad (14)$$

6.3 Interpretation of Results of the Data Collected at REMI

The overall calculation results are illustrated in the Table 7, showing:

- The relative relevance of the enterprise assets involved (column 14). The color scale clearly puts A1 with the top relevance. This follows the interview rational where asset A1 is about Building the License to Operate. It was a surprise for REMI's CEO that A23 (Build Growth Customer Base) appeared in second place, since they supposed that it would be the A18 (Builds Quality) in this place, but A18 was only the fifth in the list. The explanation for this difference is probably due to the fact that the people from the company regarded the interviewer as "potential customer". However, when asked to rank attribute comparisons as numbers, the respondent usually is on a more analytic mindset and, as a result, the core concerns emerge rather

than the means to overcome those concerns. The interviewee comments to these results make this clear, a “*company without customers doesn’t survive*”.

- b) The ranking of alternatives obtained for the Perceived Benefits (color grading in the bottom row). The alternative PB47 Technical Competence (column 10), which has the highest priority weight, is selected as the most important benefit that the enterprise may take in account in the decision making process in the Ex-Ante temporal phase. Therefore, PB47 would be considered the most relevant benefit in Ex-ante phase followed by the PB42 Product Quality (column 8).
- c) The relationship between Assets and Benefits that were not identified during the interview. These connections are identified in the matrix as cells in white background. It is interesting to see that A1 [Builds] License to Operate is a very important asset despite the fact that, during the interview, no related benefit was identified. Among these we would highlight: PB21 (Utility) and PB35 (Appreciation from users). Something similar happened with A23 - [Builds] Growth Customer Base), the asset ranked in second place regarding its relevance. In this case we have four perceived benefits that did not emerge during the interview, namely: PB4- Service Quality; PB17- Product Attributes; PB42 – Product Quality; and PB47 Technical Competence. This emergence of relationship is explained by the ranking of alternatives using Saaty’s scale for all possible relationships, thus leading to the analysis of previously disregarded relationships.

6.4 Integrating the Customer Perception

The derivation of Table 7 involves a considerable effort in filling quite an amount of tables by grading all combination of Assets as well as the combination of Assets and Perceived Benefits and Perceived Sacrifices. Upon the attempt to get equivalent information from the customer, regarding his perceptions of benefit and sacrifices and their relationship with REMI deliverables, we, along with REMI CEO, decided that we should reduce the burden on the customer and, therefore, concentrated only on the DLs where the above results revealed higher perceived benefits. The connection between perceived benefits and related DLs was done based on the previously presented and discussed graphs that were built from the interviews.

The interview and data collection with the REMI Customer was followed by the transformation of the customer perceptions set, using the Saaty’s scale, into triangular fuzzy numbers (Herrera Umaña and Osorio Gómez, 2006). The authors had then to go through the evaluation criteria obtained by multiplying the matrix M_{PBDL} obtained by the weights of each alternative with respect to main criteria with the normalized vector obtained by the weights of the criteria W_{DL}^T .

Table 7 – Summary of Results

Column	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	PB4 Service Quality	PB3 Service Performance	PB15 Reliability	PB17 Product Attributes	PB21 Utility	PB35 Appreciation from Users	PB41 Alternative Solutions	PB42 Product Quality	PB44 Responsiveness	PB47 Technical Competence	PB48 Image	PB49 Trust	PB03 Monetary Costs	Weight Priority (WA) vector of the assets
A2 [Uses] Know-how Operate	0.0972	0.0804	0.0706	0.0658	0.0072	0.0504	(0.1094)	0.0592	0.0930	0.1062	0.0913	0.0665	0.0428	0.0816
A1 [Builds] License to Operate	0.0785	0.0596	0.0683	0.0664	0.0866	0.0907	0.0907	0.0872	0.0815	0.0784	0.0839	0.0466	0.1006	0.1312
A4 [Builds] Employee Involvement	0.0981	(0.0893)	0.0598	0.0718	0.0525	0.0526	0.0789	0.0943	0.0774	(0.0986)	0.0780	0.0702	0.0837	0.0572
A11 [Uses] Years of experience	0.0965	0.0919	0.0447	0.0679	0.0355	0.0671	0.0796	(0.0984)	0.0769	(0.1031)	0.0901	0.0552	(0.0831)	0.0744
A22 [Builds] Sales per Customer	0.1071	0.0971	0.0366	0.0917	(0.0221)	(0.0044)	0.0782	0.1112	0.0814	(0.1100)	0.0925	0.0792	0.0883	0.0913
A18 [Builds] Quality	0.1119	0.1065	0.0508	0.1002	0.0058	0.0000	0.0656	(0.1213)	0.0751	(0.1178)	0.0798	(0.0604)	(0.1046)	0.0997
A23 [Builds] Growth	0.1047	0.0957	(0.0899)	0.0988	0.0295	0.0165	0.0593	0.1061	0.0831	0.1071	0.0746	0.0495	0.0853	0.1135
A8 [Uses] Speed of Decision Making	0.0731	(0.1140)	(0.0904)	0.0159	0.0000	0.0000	0.1119	0.1051	(0.1351)	0.1246	0.0921	0.0531	0.0847	0.0895
A24 [Uses] Product/Service Developments Costs	(0.0973)	0.0897	0.0654	(0.0758)	0.0601	0.0539	0.0775	0.0877	0.0778	0.0916	0.0810	0.0474	0.0947	0.0422
A25 [Builds] Brand Recognition	0.0868	0.0763	0.0719	(0.0696)	0.0527	0.0379	(0.0850)	(0.0590)	0.0923	0.1011	(0.0858)	0.0628	0.0799	0.1117
A26 [Uses] Alliances	0.0891	(0.0900)	0.0662	0.0814	0.0508	0.0579	0.0719	0.0842	0.0851	0.0896	0.0782	0.0728	0.0828	0.1077
Weight priority (WPB) vector of the PB	0.0935	0.0889	0.0661	0.0756	0.0374	0.0390	0.0822	0.0971	0.0876	0.1022	0.0842	0.0601	0.0860	0.0860

The evidence of relevance to the customer of both DL6 and DL23 emerges in a step prior to getting to the final results and is illustrated the triangular fuzzy numbers in Fig 9.

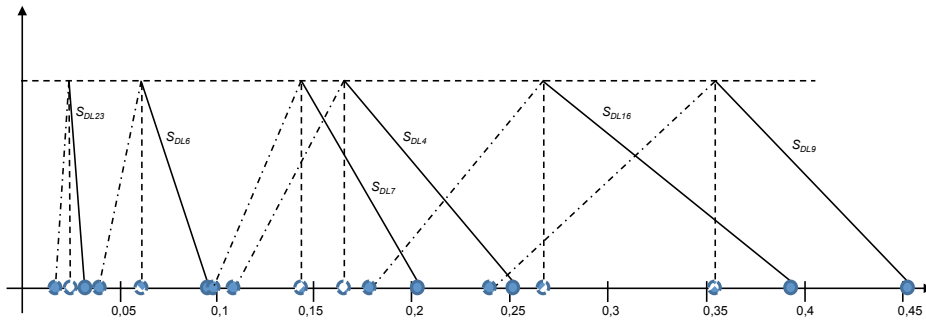


Fig. 9 The intersection of fuzzy weights of each deliverable

The relevance of each deliverable in

Fig. 9 is calculated by using the Chang’s method, applying it to the triangular fuzzy numbers in (Herrera Umaña and Osorio Gómez, 2006). This graphic illustrates the fuzzy weights of each deliverable. The rightmost triangles show the DLs with the higher degree of relevance.

Fig 9 shows the fuzzy weights of each deliverable. As we can see, the difference between l_i and u_i is quite large for most criteria, with the exception of DL23, DL6 and DL7. This means that the uncertainty associated with the customer’s valuation of these three DLs is low. As mentioned above, this is a typical result of fuzzy AHP. Due to fuzzy calculations and the required number of multiplications and addition operations, there is usually a wide span between values, l_i and u_i . After defuzzification we get $W_{DL} = (0,025605252; 0; 0; 0,57111148; 0,403283269; 0)$.

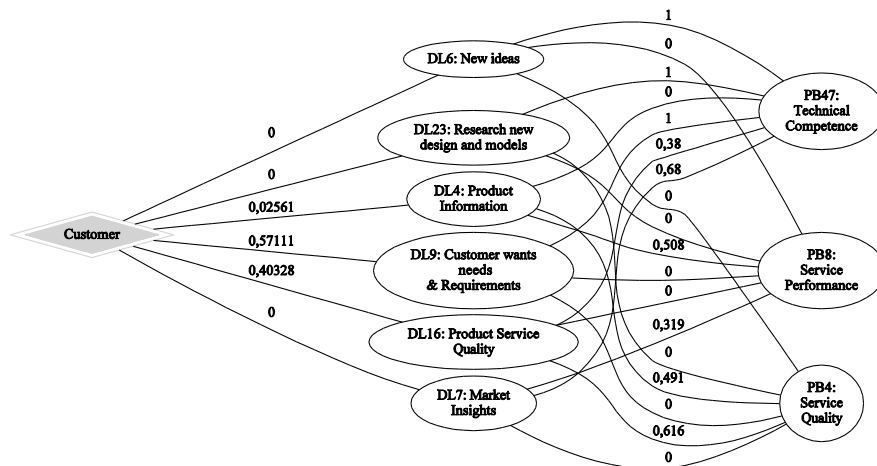


Fig. 10 - Graph representing the perception of the customer.

The final result was a matrix that was then converted into the graph of the Fig. 10. In

the extent analysis of Fuzzy AHP (Chang, 1996, Ertuğrul and Karakaşoğlu, 2008) the priority weights of the criterion or alternative can be equal to zero. We had several of these situations and they make sense, as they are a representation of the reality. In fact, the interviewed customer is outsourcing to REMI and this explains these zeros. DL6 and DL7 and DL23 are in fact irrelevant for this customer, as REMI receives all drawings and specifications for each production order. In this context, these zeros make all sense. However, DL6 was considered by REMI as a “consulting” activity they provide by tuning the received drawings and specifications, with the agreement of the subcontractor, to achieve the best end results that may imply using different types of meshes or yarns. This “consulting” service was not perceived as being part of “New Ideas” (DL6), maybe it was considered as part of DL9 and DL16. It is also possible the name “New Ideas” was not chosen properly. This could mean, for example, that REMI could assess if they would like to make this more explicit in the service value proposition, something like “Production Consulting”.

Fig. 10, further reveals that “Customer wants needs and requirements” (DL9) is the most important deliverable from the customers’ perspective (higher degree of relevance, with 0.571). “Product/Service quality” (DL16) and “Product Information” (DL4) are ranked in the second and third place, respectively. It is worthy to note that among the above-mentioned six DLs, “Customer wants needs and requirements” (DL9) and “Product/Service quality” (DL16) are ranked very close with 0.571 and 0.40, respectively. This reveals that these two DLs are almost equally important in the perception of the customer. Making now the bridge to the Perceived Benefits (PB), “Technical Competence” (PB47) shows the highest degree of relevance when related to “Customer wants needs and requirements” (DL9). For DL4 (“Product Information”), the most relevant PB is “Service Performance” (PB8) whereas for “Product/Service quality” (DL16) we have “Service quality” (PB4) followed by “Technical competence” (PB47) and “Service Performance” (PB8) with very close relevance.

6.5 Discussion of Results

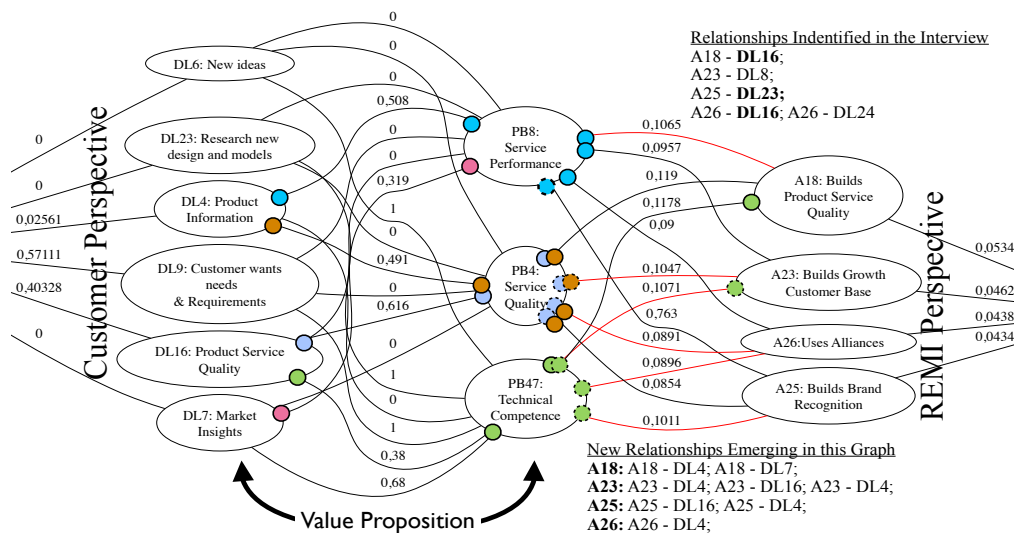
Fig. 11 builds the bridge between the items delivered to the Customer, the Deliverables, and the business enterprise Assets used/build by REMI to respond and meet the customer needs. The point we want to make at an Ex-Ante analysis is how relevant this exercise was for REMI in tuning its Value Proposition. This picture builds a most relevant connection between Deliverables, whose value is perceived (or not, as we have seen) by the customer and the supporting enterprise endogenous or exogenous assets, enabling therefore a better understanding of how to adjust the Value Proposition of the enterprise assets perceived as relevant.

There are sizeable differences in the value proposition from the customer’s and the company’s perspectives. After analyzing Table 7 and Fig. 11, REMI’s CEO concluded that this approach was quite useful, helping the company to overcome the current mismatch between the company’s and the customer’s valorization of the deliverables: *“(…) this study provided us a major sense of awareness of the benefits deriving from the company's assets. We can take the advantage to rely on certain assets that bring value and benefits beyond what, at first sight, we thought were possible”*.

The quantitative method provided new relevant relations between perceived benefits (PBs) and exogenous and endogenous assets. As an example, “Service Quality” (PB4) emerged as strongly related to “Builds Growth Customer Base” (A23) and “Uses Alliances” (A26). Some authors (Parasuraman et al., 1985) stress that the notion of service quality as “a measure of how well the service delivered matches customer expectations”. REMI’s opinion on this was:

"The Service quality (PB4) and Technical Competence (PB47) increase our list of customer, so the connection between the asset "Quality" (A18) and "Growth Builds Customer base" (A23) makes sense. However, it greatly depends on the type of customers. There are some customers that the main focus is not the quality, but the price. But they are not the type of customer that the company wishes for. It is very difficult to focus our competitiveness on price, especially with Asian competitors. The company has to focus on customers that emphasize quality. That is the way we want to grow. "

"We never had realized that technical competence (manufacturing) was so important for the brand image of the company the, over other aspects, such as product innovation. In fact, to bet on an image of quality of implementation could increase the number of international customers. The demand for quality involves the continuous development of the level of competence and knowledge of human resources".



Legend: 1) Red lines reveal connections that did not emerge during the interview; 2) Circles reveal logical connections identified by the authors; 3) Dashed Circles reveal causal connections identified by the author; 4) Endogenous and Exogenous components: A18-EXO_SOC, END_CP; A23 - EXO_MARK, END_CP; A25 - EXO_SOC, EXO_MARK; A26 - EXO_SUP; 5) Forms of Value: DL4 - MARK_VC; DL6 - DERIV_VC, MARK_VC; DL7 - MARK_VC; DL9 - SALE_VC, DERIV_VC; DL16 - NET_VC; DL23 - MARK_VC.

Fig. 11 The Integration of REMI and Customer Perspectives

REMI's decision makers first related the PB (PB8 – Service Performance) to the “Uses Alliances” asset. However, other relations emerged in the analysis, namely “Service Quality” (PB4) and “Technical Competence” PB47, which makes sense, as the partners' technical competence is a key factor in building a successful value chain.

On the other hand, the customer's perspective, according to the graph in Fig. 11, allowed the REMI CEO to understand how the customers see the deliverables (DLs or DL most important(s)) and how they correlate with PBs. This will help them focus on a value proposition more effective in the communication with customers. As an example, in Figure 12 the "New ideas" (DL6) and "Research new designs and

models" (DL23) and "Market Insights "(DL7) are not valued by the customer. REMI CEO's first reaction was to question, but after analyzing these results more carefully and taking into account the characteristics of the customer, he explained:

- DL6 "New Ideas" was not valued by the customer. The "New ideas" for REMI CEO emerge as the improvement of the garment piece but the customer perceived as a "New ideas" to the piece. To the company this makes sense because: *"With this type of customer, this makes sense, because the collection is idealized by the customer and what they claim, essentially, is that their ideas must be implemented efficiently and with quality."* This customer despite the fact that he is open to suggestions and improvements already has a very definite idea of what they want and what they value most. It was questioned whether this deliverable should be mentioned in the value proposition (VP). REMI CEO agreed, as DL6 is regarded by this type of customer as customer support, so that, in this case, the more appropriate word should be "customer support". For us "New ideas" meant the suggestion of improvements to their pieces.
- DL23 "Research New Designs and models" is defined by REMI CEO as the focus on creating new products, like new meshes or new mesh colors. In the interview it was said *"(...) I think the quality / price is important, but the design begins to be increasingly important. We must be attentive to fashion. The colors are also important as well as the research of new meshes."* The apparent mismatch may be explained by this customer's perception of the deliverable, regarded as the design of new products. This customer mainly subcontracts manufacturing, so the design of garments is made in-house. The lack of relevance of DL7 "Market insights" is also related to the special characteristics of this customer.

Regarding the endogenous and exogenous assets that were analyzed in the company and which Perceived Benefits they are connected to each one, "Service Performance" (PB8) - Table 10 - appears with the greatest value. From the interviewee testimonial: *"The service performance is important. As we work with very short deadlines, decision must be taken in a timely manner so that we can avoid endanger the operations of the entire supply chain, and ultimately reduce our quality and product service."*

As a final conclusion of this work, the authors highlighted the followings comments from the company: *"Looking at these results, it is very interesting to note what customers value and their perceptions of certain deliverables. The company unconsciously used much of it through common sense but never did this type of analysis. This work gives us the ability to know where we can invest more to achieve our objectives. The recognition of our brand is something we have been working for some time and is extremely useful to know that the perception of expertise is highly valued and emerges in places we did not expect. This means that we have to show more clearly not only our ability to meet quality and efficiency of customer needs, but also that we are prepared to innovate, follow fashion trends and technological progress."*

6.6 Reviewing the research questions

These results provide the answer to the first research question "How can the Value for the Customer be modelled?" and also to its refinement in question 1.1 "How is this value built on top of assets endogenous and exogenous to the organization?" The detailed analysis of the case study demonstrated the proposed connections. It also confirmed the role of endogenous and exogenous assets and their relationships to the exchanged deliverables whose value will, ultimately, be perceived by the Customer

(section 4.3).

We can finally confirm that the CMDVC formal model enabled the quantification of “How do endogenous and exogenous assets influence the Value for the Customer?” (Research Question 1.2). This influence emerges from the relations made explicit between the assets in Fig. 7 and ARCON dimensions intersected with the results of Table 7 that map the relative value of each asset as the result of weighting perceived benefits. These emerges clearly both in the interview with people at REMI and with customer.

The Research Question number two, “Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?” is implicitly responded by the validation of the formal quantitative model upon its validation by the interviewees at REMI and with the customer.

7. Lessons learned / Lessons for Practitioners

This was a quite long derivation process that aimed at validating the proposed model. The authors conclude that it is very time consuming and hard for the interview to handle many variables.

However, if we limit the number of variables analyzed, we must choose the most relevant ones. The authors think that this is must be done through an iterative process. In a first phase we should collect the whole set of variables and go through the full process with the company. In a second phase the selection of most relevant variables for the value proposition is made. This is fact what it was done in this study before interviewing the customer. This approach should enable the tuning of this model for future use in the company.

8. Limitation of the Study

Researchers tried to accomplish the study in the right way by following a correct and clear path to obtain the results at the end, but there are some limitations that appear at the time of conducting the research, that need to be acknowledged and addressed regarding the present study. These limitations are:

- Time is always an important issue in research; we were constantly making visits to the company to understand their services and the company was not as available as we would have wished.
- Decision-makers may find it hard and subjective to assess the pair-wise comparisons required using the Saaty scale
- On the customer’s interview, we had to reduce some of the variables.
- The company offered some resistance in allowing the interview with the customer.

9. Conclusion

This research proposed a modeling framework and a quantitative model that could enable suppliers to better understand how value is perceive by the customers a SME in the Textile Industry in Portugal in the context of its Value Chain. With this model, suppliers are provided with a quantitative model of benefits and sacrifices perceived by the customer and how these related to the combination of endogenous/exogenous

tangible and intangible assets used by the company to provide the required deliverables to its customer. Through a case study, the proposed constructs of the proposed model and their relations were first validated. Then, the quantitative model was derived and the final results computed into a matrix representing the degree of relevance among pairs of assets/Perceived Benefits. After a selection of the most relevant assets/Perceived Benefits pairs a new quantitative model and corresponding computed matrix was derived for the company customer. The whole process closed with a new interview with the company CEO to assess and review the obtained results.

As a conclusion, one could argue that the model provides the adequate answers to the research questions despite the recognized limitations.

Finally, we would add that the merits of this approach seem evident from the contact with the REMI, as it depicted in Table 7 and Fig. 11. The CMDVC and the quantitative process, tested on a contract preparation phase (Ex-Ante negotiation perspective), revealed itself useful by providing the discovery of previously disregarded connections between assets used and/or built in the foreseen exchange of deliverables and perceived benefits in the context of the value chain.

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References

- Allee, V. 2000. The value evolution: addressing larger implications of an intellectual capital and intangibles perspective. *Journal of intellectual capital*, 1, 17-32
- Allee, V. 2000a. Reconfiguring The Value Network. *Journal of Business Strategy*. Available: <http://www.emeraldinsight.com/10.1108/eb040103>
- Allee, V. 2000b The value evolution: Addressing larger implications of an intellectual capital and intangibles perspective. *Journal of Intellectual Capital*, 1, 17-32
- Allee, V. 2002. A Value Network Approach for Modeling and Measuring Intangibles
- Allee, V. 2008a. Value network analysis and value conversion of tangible and intangible assets. 9, 5-24
- Allee, V. 2008b. Value network analysis and value conversion of tangible and intangible assets. *Journal of Intellectual Capital*, 9, 5-24
- Allee, V. 2008c. The Very Human Dynamics of Knowledge and Value Conversion. 55-56
- Allee, V. 2009b. Building Value Networks Competencies
- Allee, V. 2002a). A Value Network Approach for Modeling and Measuring Intangibles. *Presented at Transparent Enterprise, Madrid, November*
- Anderson, J. C., Narus, J. A. & Van Rossum, W. 2006. Customer value propositions in business markets. *Harvard business review*, 84, 90
- Capon, N. & Hulbert, J. M. 2007. *Managing marketing in the 21st century: Developing and implementing the market strategy*, Wessex Press

- Chang, D.-Y. 1996. Applications of the extent analysis method on fuzzy AHP. *European Journal of Operational Research*, 95, 649-655
- Chen, H. 2004. *A research based on fuzzy AHP for multicriteria supplier selection in supply chain*. . Master thesis, University of Science and technology
- Dubé, L. & Paré, G. 2003. Rigor in information systems positivist case research: current practices, trends, and recommendations. *Mis Quarterly*, 597-636
- Ertuğrul, İ. & Karakaşoğlu, N. 2008. Comparison of fuzzy AHP and fuzzy TOPSIS methods for facility location selection. *The International Journal of Advanced Manufacturing Technology*, 39, 783-795
- Flint, D. J. & Woodruff, R. B. 2001. The Initiators of Changes in Customers' Desired Value: Results from a Theory Building Study. *Industrial Marketing Management*, 30, 321-337
- Flint, D. J., Woodruff, R. B. & Gardial, S. F. 2002. Exploring the phenomenon of customers' desired value change in a business-to-business context. *Journal of Marketing*, 66, 102-117
- Herrera Umaña, M. F. & Osorio Gómez, J. C. 2006. Modelo para la gestión de proveedores utilizando AHP difuso. *Estudios Gerenciales*, 22, 69-88
- Hevner, A. R., March, S. T., Park, J. & Ram, S. 2004. Design science in information systems research. *MIS Q.*, 28, 75-105
- Huber, J., J. Lynch & Al, E. 1997. Thinking About Values in Prospect and Retrospect: Maximising Experience Utility. *Marketing Letters*, 8, 323-334
- Khalifa, A. S. 2004. Customer value: a review of recent literature and an integrative configuration. *Management Decision*, 42 645-666
- Lai, A. W. 1995. Consumer Values, Product Benefits and Customer Value: A Consumption Behavior Approach. *Academic Journal*, 22, 381
- Lapierre, J. 2000. Customer-perceived value in industrial contexts. . *Journal of Business & Industrial Marketing, MCB UP Ltd.* , 15 122-140
- Lapierre, J. 2001. Development of measures to assess customer perceived value in a business-to-business context. *Advances in Business Marketing and Purchasing.*, 243-286
- LM Camarinha-Matos & H. Afasarmanesh 2008a. Collaborative Networks: Reference Modeling. *Springer Science+Business Media, LCC*
- Nicola, S., Pinto Ferreira, E. & Pinto Ferreira, J. J. 2012. A Novel Framework For Modelling Value For The Customer, An Essay On Negotiation. *International Journal of Information Technology & Decision Making*
- Nukala, S. & Gupta, S. M. A fuzzy AHP based approach for selecting potential recovery facilities in a closed-loop supply chain. Proceedings of the SPIE International Conference on Environmentally Conscious Manufacturing V, Boston, Massachusetts, 2005. 58-63
- Oliveira, M. A.-Y. & Pinto Ferreira, J. J. 2011. Facilitating qualitative research in business studies: Using the business narrative to model value creation., *African Journal of Business Management Decision*, 5, 68-75
- Osterwalder, A. & Pigneur, Y. Modeling value propositions in e-Business. Proceedings of the 5th international conference on Electronic commerce, 2003. ACM, 429-436
- Overby, J. W., Woodruff, R. B. & Gardial, S. F. 2004. French versus American consumers' attachment of value to a product in a common consumption

- context: A cross-national comparison. *Journal of the Academy of Marketing Science*, 32, 437-460
- Parasuraman, A., Zeithaml, V. A. & Berry, L. L. 1985. A conceptual model of service quality and its implications for future research. *The Journal of Marketing*, 41-50
- Peng, Y., Kou, G., Wang, G., Wu, W. & Shi, Y. 2011. Ensemble of software defect predictors: an AHP-based evaluation method. *International Journal of Information Technology & Decision Making*, 10, 187-206.
- Woodall, T. 2003. "Conceptualising Value for the Customer: an Attributional, Structural And Dispositional Analysis". *Academy of Marketing Science Review.*, 12
- Woodruff, R. 1997. "Customer Value: The Next Source for Competitive Advantage." *Journal of the Academy of Marketing Science.*, 25, 139-153
- Yin, R. K. 1999. Enhancing the quality of case studies in health services research. *Health Services Research*, 34, 1209
- Zeithaml, V. A. 1988. Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. *Journal of Marketing*, 52, 2-22

2.5 Paper V

Susana Nicola, Eduarda Pinto Ferreira, J. J Pinto Ferreira A Quantitative Model for Decomposing & Assessing the Value for the Customer. Accepted in 11 March to the Journal of Innovation Management after revision

Motivation

In this document the author consolidates the research developed in two previous case studies by bringing a third case to the discussion. The paper builds on the experience acquired in the data collection process, analysis and final discussion with the company, and proposes a “three-steps approach” to decomposing and assessing the value for the customer. This is an important realization and enables the systematic application of the process for future projects. This paper brings its contribution to supporting the proposed answers to the research questions and concludes with the proposal of future developments to bring the results of this research into practice.

A Quantitative Model for Decomposing & Assessing the Value for the Customer

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Abstract. This research builds on the different dimensions of the value creation analysis. The authors are aware that members of the organization may have different understanding of the perceived value of the enterprise offer. Time also has a direct impact in the perceived value, from the pre-purchase to the post-purchase phases. In this research, we proposed a Conceptual Model Decomposing Value for the Customer, combining several concepts, from the marketing area we have the concept of Value for the Customer, from the collaborative networks area we have the perspective of the enterprise life cycle and the environment characteristics and from the intellectual capital area we have the concept of the value networks. This research further proposes a quantitative model for the Value for the Customer. This is illustrated in this paper in the context of a case study of an enterprise in footwear industry (Pontechem). The merits of this approach seem evident from the contact with Pontechem as it provides a structured approach for the enterprises to know and understand the client/customer needs and how these relate to their endogenous and/or exogenous assets, therefore enabling the better adequacy of their value proposition.

Keywords: Value for the Customer; Value Proposition, Asset Management; Fuzzy AHP.

1. Introduction

Delivering and creating value for the customers is the foundation of any business enterprise, in today's highly competitive dynamic markets. There are many definitions of value and most of them share the fact that value is also about perception. We don't all value the same things the same way. Therefore, knowledge about customer's perceived value and "knowledge used to anticipate what customer will value in the future play central roles in building and maintaining a sustainable advantage", (Blocker and Flint, 2007). To this end, the challenge in many enterprises is to "develop an offering that is both flexible and capable of being tailored to fit the specific requirements of customers", (Rahikka et al., 2011). This is what the value proposition is about. A Value Proposition (VP) "is an overall view of a company's bundle of products and services that are of value to the customer." (Osterwalder, 2004). As some authors say, "the value proposition defines the specific strategy to compete for new customers", (Jalili and Rezaie, 2010). So it is essential to determine which factors determine the perception on value for the customer (VC) and how this value is perceived, involving what the customer receives (e.g. benefits) and what he gives up to acquire and use a product (e.g.: costs and sacrifices), (Flint et al., 2002, Lapierre, 2001, Ulaga, 2003, Komulainen et al., 2007). In this context and for any business enterprise to anticipate the value for the customer, it must understand that the "dynamics of value conversion requires expanding beyond the asset view of intangibles to understand the function of intangibles as negotiable goods and as deliverables" (Allee, 2008a)(p.6). In this we agree with Allee in that value is "(...) an emergent property of the network, so, understanding the functioning of the network as a whole is essential to understand how and why value is created. (...) " (Allee, 2008a)(p.12). In this context, this research builds on the different dimensions of the value creation analysis proposed (Allee, 2008a)(p.19), comprising the asset utilization, value conversion, value enhancements, the transaction's perceived value and the social value. Moreover, the authors are aware that different customer segments have different perceived values for the same product (Ulaga and Eggert, 2006). The same way, members of the organization involved in the sales activities will have different perceptions of the perceived value of enterprise offer. Time also has a direct impact in the perceived value, from the pre-purchase to the post-purchase phases (Woodall, 2003, Huber et al., 1997).

In this context, this paper discusses the application of the Conceptual Model for Decomposing Value for the Customer (CMDVC) framework and a quantitative model used to assess the adequacy of both the enterprise offering to the customer needs (the value proposition) and of its supporting assets. This model is presented and discussed in the context of a case study in the footwear industry in Portugal (APICCAPS, 2008).

2. Value for the Customer

2.1 The Concept of Value for the Customer

The concept of customer value is one of the most overused concepts in the literature and several definitions of customer value as perceived and defined by the customer have been offered, such as: "customer value" (Anderson et al., 2006, Woodruff, 1997b); "consumer value" (Lai, 1995); "customer perceived value" (Lapierre, 2000); "value for the customer" (Woodall, 2003). Woodall (2003), proposed a definition of these related customer concept of value, by choosing the term Value for the Customer (VC):

“Value for the customer (VC) is any demand-side, personal perception of advantage arising out of a customer’s association with an organisation’s offering, and can occur as reduction in sacrifice; presence of benefit (perceived as either attributes or outcomes); the resultant of any weighed combination of sacrifice and benefit; or an aggregation, over time, of any or all these”, (Woodall, 2003 p.2)

In this context, understanding “what buyers value within a given offering, creating value for them, and then managing it over time have long been recognized as essential elements of every market-oriented firm’s” (Desarbo et al., 2001). Determining the benefits and the utility of a product or service, as well as, to provide the means to explain how customers perceived the value of the exchanged deliverables of the product/service and how these are related to the enterprise endogenous/exogenous assets, helps a firm formulate a clear statement of its VP in contrast with its competitors.

2.1 A Conceptual Model for Decomposing Value for the Customer

The proposed Conceptual Model for Decomposing Value for the Customer builds on: 1) The concept of Forms of value and Value temporal positions (Woodall, 2003); 2) on the concept of Value Network and on the network exchange of tangible and intangible deliverables among the network roles, building on both tangible and intangible enterprise assets (Allee, 2000b, Allee, 2000a, Allee, 2002b), Allee, 2002a), Allee, 2008a); 3) Enterprise Endogenous and Exogenous assets, concept extracted from the Reference Model for Collaborative Network Organizations (ARCON) (Camarinha-Matos and Afasarmanesh, 2008c, Camarinha-Matos and H. Afasarmanesh, 2008a); and at last 4) on the concept of Perceived Benefits(PBi)/Sacrifices (PSi) (Lapierre, 2000, Lapierre, 2001, Woodall, 2003). The following three pictures illustrate the proposed model and its usage as a sequence of steps towards the final assessment of the enterprise Value Proposition (VP) and how it is supported by enterprise tangible and intangible Assets.

Fig. 1 pictures the first step of our research. We wanted to understand how value for the customer could be broken down into simpler constituents, integrating the value perceived by the enterprise members for a particular time position. The construction of the enterprise Value Network (through an interview with enterprise members), provides the identification of each deliverable (DL) exchanged with the customer, as well as the assets (endogenous and exogenous) built and/or used in the provision of that deliverable. This analysis further relates each deliverable (DL) with the forms of value. Some authors (De Toni and Tonchia, 2003) argue for a need to integrate the traditional “outside-in (which analyses the source of competitive analysis outside the enterprise)” and “inside-out (which analyses the source of competitive analysis inside the enterprise)” views of the enterprise into a competence theory. In this context we apply the concepts proposed by the Reference Model for Collaborative Organizations, to classify the assets built and/or used as endogenous or exogenous to the enterprise.

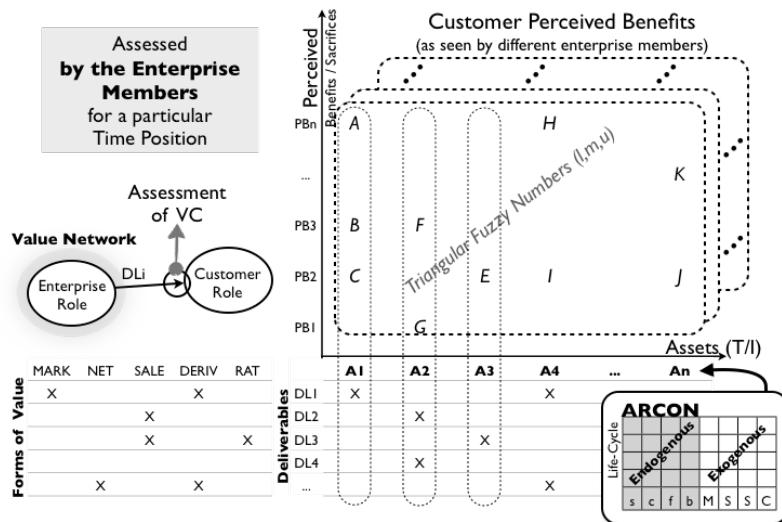


Fig. 1 Customer Perceived Value assessed by the Enterprise Members for a particular Time Position

The proposed model, at this stage, pictures the enterprise member's perspective. This shows: 1) how does the people inside the enterprise perceive the relative relevance of the assets involved in the process; and 2) how these assets relate to the Perceived Benefits (PB_i) / Sacrifices (PS_i). These two components are modelled as a comparison matrixes of the triangular fuzzy numbers resulting from: 1) each enterprise member assesses each asset relative relevance; and 2) assesses the relevance of each asset to each Perceived Benefit (PB_i)/ Sacrifice (PS_i). The combination of these comparison matrixes provide the input to a process that leads to the construction of the final matrix where we will be able to extract the most relevant assets and PB_i/PS_i.

In the 2nd step of this process, Fig. 2, we try to obtain the further information from the enterprise client/customer for a particular Time Position and regarding his perception of benefits and sacrifices. In this step and following the conclusions of the previous analysis we take the most relevant assets to select which deliverables we will use to assess how the customer perceives the enterprise value proposition. We take this step in order to reduce the burden on the customer on the number of comparison tables that he/she will have to fill. However, and to ensure that we do not eliminate any relevant deliverable, a brief interview with the customer helps ensuring that we get the most relevant set of deliverables analysed. In this step, the customer assesses the relevance of each deliverable to each PB_i/PS_i using the Saaty's scale.

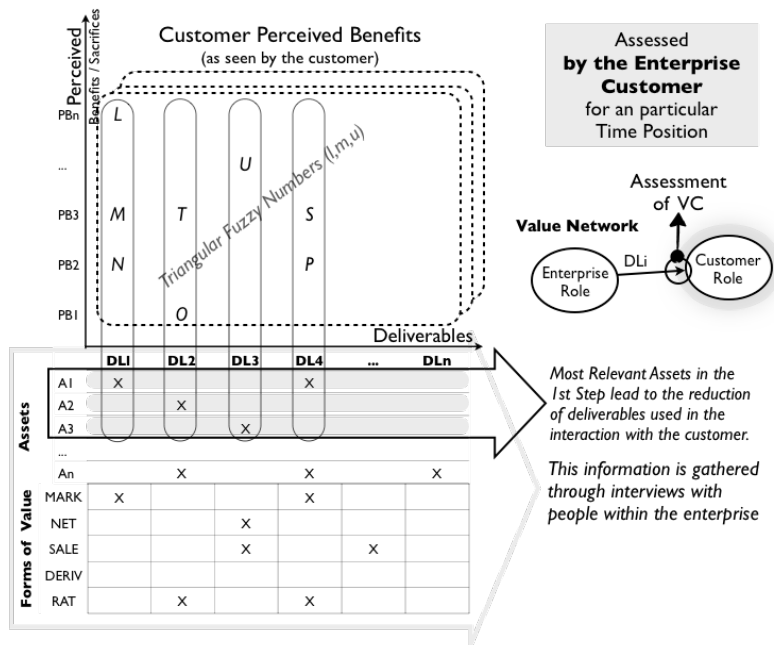


Fig. 2 Customer Perceived Value assessed by the Enterprise Customers for a particular Time Position

Fig. 3 pictures the last step of the assessment of the enterprise Value Proposition and of its supporting assets. This analysis combines the two described streams, the Enterprise perspective on the left and the Customer perspective on right. Let us analyse each of the steps in more detail in the following paragraphs.

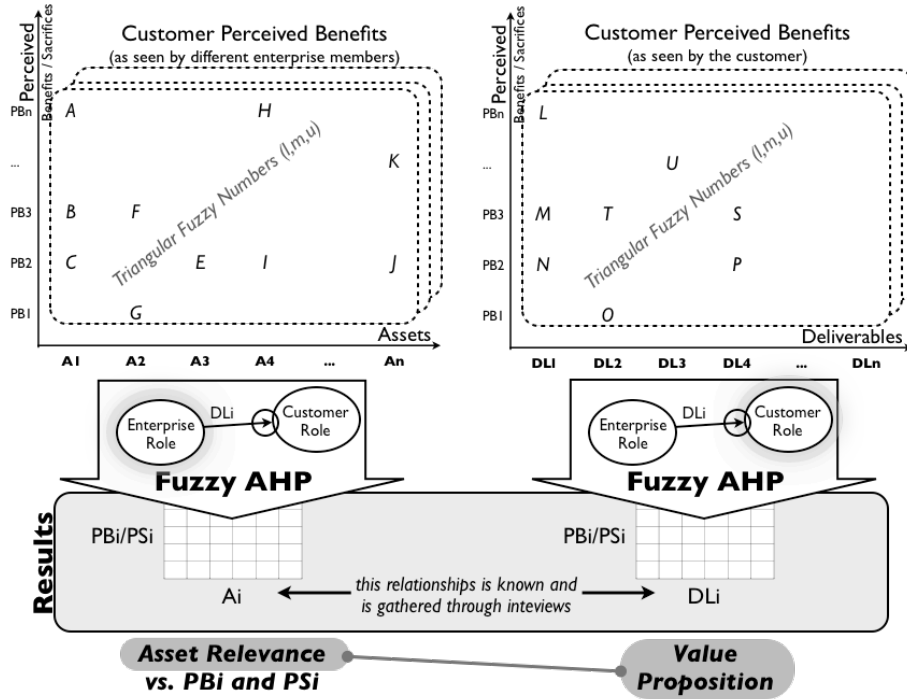


Fig. 3 Wrap-up and assessment of results

The Enterprise Perspective (1st Step)

For the enterprise we have a several and conflicting criteria (Assets) and alternatives (Perceived Benefits / Sacrifices) where an assessment is not easily determined. The input information containing the enterprise members' subjective judgements relating criteria and alternatives, is uncertain and imprecise. In this context, the fuzzy theory is usually applied to handle uncertain and subjective problems in the decision-making process. Therefore we apply the fuzzy Analytical Hierarchical Process (AHP) to solve this multi-criteria decision-making (MCDM) problem. The process unfolds as follows. Each enterprise member is performs an individual pair-wise comparison using the Saaty's scale. Then a comprehensive pair-wise comparison matrix (eq.3) is built by integrating the enterprise member's grades (b_{jep}) through the equations (1-2), (Chen, 2004), where enterprise members pair-wise comparison value is transformed into triangular fuzzy numbers.

$$l_{je} = \min(b_{jep}), \quad m_{je} = \frac{\sum_{p=1}^t (b_{jep})}{p}, \quad u_{je} = \max(b_{jep}),$$

$$p = 1, 2, \dots, t; \quad j = 1, 2, \dots, m; \quad e = 1, 2, \dots, m \quad (1)$$

$$\tilde{b}_{je} = (l_{je}; m_{je}; u_{je}), \quad j = 1, 2, \dots, m; \quad e = 1, 2, \dots, m \quad (2)$$

Then we apply the approach of Chang (Chang, 1996) for handling fuzzy AHP, by using the “extent analysis method” for the synthetic extent values, which derives crisp weights for fuzzy comparison matrix. Consider a triangular fuzzy comparison matrix (eq-3) obtained by the steps of Chen (2004):

$$\begin{aligned} \tilde{D}_p &= (\tilde{b}_{ij})_{n \times n} = \begin{bmatrix} \tilde{b}_{11} & \tilde{b}_{12} & \cdots & \tilde{b}_{1m} \\ \tilde{b}_{21} & \tilde{b}_{22} & \cdots & \tilde{b}_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{b}_{m1} & \tilde{b}_{m2} & \cdots & \tilde{b}_{mm} \end{bmatrix} \\ &= \begin{bmatrix} (1,1,1) & (l_{12}, m_{12}, u_{12}) & \cdots & (l_{1n}, m_{1n}, u_{1n}) \\ (l_{12}, m_{12}, u_{12}) & (1,1,1) & \cdots & (l_{2n}, m_{2n}, u_{2n}) \\ \vdots & \vdots & \ddots & \vdots \\ (l_{n1}, m_{n1}, u_{n1}) & (l_{n2}, m_{n2}, u_{n2}) & \cdots & (1,1,1) \end{bmatrix} \end{aligned} \quad (3)$$

where $\tilde{b}_{ij} = (l_{ij}, m_{ij}, u_{ij}) = \tilde{b}_{ij}^{-1} = (\frac{1}{u_{ij}}, \frac{1}{m_{ij}}, \frac{1}{l_{ij}})$ for $i, j = 1, \dots, n$ and $i \neq j$.

To calculate a priority vector of the above triangular fuzzy comparison matrix \tilde{D}_p , the steps of Chang’s extent analysis can be given as in the following:

1) First, sum up each row of the fuzzy comparison matrix \tilde{D}_p , by applying the fuzzy arithmetic operations:

$$\sum_{j=1}^n \tilde{b}_{ij} = (\sum_{j=1}^n l_{ij}, \sum_{j=1}^n m_{ij}, \sum_{j=1}^n u_{ij}), \quad i, j = 1, 2, \dots, n \quad (4)$$

Then the inverse of the vector (eq-4) above is:

$$[\sum_{j=1}^n \tilde{b}_{ij}]^{-1} = (1/\sum_{j=1}^n u_{ij}, 1/\sum_{j=1}^n m_{ij}, 1/\sum_{j=1}^n l_{ij}) \quad (5)$$

2) Second we normalize the rows sums (eq-5) by:

$$\tilde{S}_i = \sum_{j=1}^n \tilde{b}_{ij} \times [\sum_{j=1}^n \tilde{b}_{ij}]^{-1} \quad (6)$$

3) Third, compute the degree of possibility for $\tilde{S}_i \geq \tilde{S}_j$ of two TFNs $\tilde{S}_i = (l_i, m_i, u_i)$ and $\tilde{S}_j = (l_j, m_j, u_j)$ by the following equation (7):

$$V(S_i \geq S_j) = \begin{cases} 1, & \text{if } m_i \geq m_j \\ 0, & \text{if } l_j \geq u_i \\ \frac{l_j - u_i}{(m_i - u_i) - (m_j - l_j)}, & \text{otherwise} \end{cases} \quad (7)$$

a) In general, the priority weights are calculated by using the equation 8:

$$d'(A_i) = \min V(S_i \geq S_k) \quad k = 1, 2, \dots, n; k \neq i \quad (8)$$

are the pair wise comparison of the \tilde{S} TFNs.

b) Then the weight vector is given by the equation 9:

$$W' = (d'(A_1); d'(A_2); \dots; d'(A_n))^T \quad (9)$$

c) Finally we normalized the weight vector (eq-10)

$$W = (d(A_1); d(A_2); \dots; d(A_n))^T \quad (10)$$

where W is a non-fuzzy number.

By applying the fuzzy AHP method we obtain a matrix of overall results of the enterprise member perception of the relevant assets and the relevant PBi/PSi.

The Customer Perspective (2nd Step)

To obtain the matrix of the overall results for the enterprise customer perception relating relevant deliverables as well as the relevant PBi/PSi, the customer will have to make their pair-wise comparison using the Saaty's scale for the deliverables and for the perceived benefits and sacrifices. We then transform the customer perceptions using the Saaty's scale, by converting them into triangular fuzzy numbers using a comparison scale (Herrera Umaña and Osorio Gómez, 2006). As we have the comprehensive pair-wise comparison matrix (eq-1-2), we applied the "extent analysis method" for the synthetic extent values (eq-4-10).

Integrating the two Perspectives (3rd Step)

With these two matrixes we have the degree of priority one criterion or alternative against all others in a fuzzy comparison matrix, (Wang et al., 2008). On the left we have the degree of priority (relevance) as seen by the enterprise of an Asset and its relation to a PBi/PSi, whereas on the right we have the degree of priority (relevance) as seen by the customer of deliverable and its relation to a PBi/PSi. The relationship between the assets and the deliverables is known, which means that one now should be able to understand how the enterprise assets (endogenous or exogenous) relate to PBi/PSi, thus enabling the tuning of the enterprise offer Value Proposition.

3. Research Questions and Methodology

3.1. Design Science Approach and Research Questions

Along this project we followed the Design Science approach (Hevner et al., 2004) to the development of the proposed model. This approach enabled the identification of an adequate match between the business need and the literature gap (Nicola et al., 2010, Nicola et al., 2012). The validation followed the Case Study approach with an early exploratory case study that enabled the early design and assessment of the following research questions:

1. How can the Value for the Customer be modelled?
 - 1.1. How is this value built on top of assets endogenous and exogenous to the organization?
 - 1.2. How do endogenous and exogenous assets influence the Value for the Customer?
2. Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?

According to the article of Dubé and Paré (2003), the "key criteria for the appropriate use of the case study method is the type of the research questions posed". The work of (Eisenhardt and Graebner, 2007) argue that cases studies typically answers to the "research questions that address 'how' and 'why' in unexplored research areas", helping researchers to clarify why the research questions are significant. Furthermore "in-depth case investigations open the way to new ideas and new lines of reasoning"(Dubé and Paré, 2003). In this context, we use the case study approach, as useful tool, to develop new insights and to support deeper and more detailed investigation that is necessary to answer the research questions. This also means that

literature review is a continuous process that also helps paving the way to the building of “informed arguments” in the support of research results (Hevner et al., 2004).

3.1. Methodology

Case Study Selection

This paper consolidates the previous research in two other case studies by bringing a third case to the discussion. All cases were made in SMEs in Portugal in three different sectors, one in the sector of Occupational Safety and Health Services, the other Textile Industry sector, and the one discussed in this paper in the Footwear Industry sector. It has been clear that Portugal is facing one of the worsening employment crises. Increasingly, attention has turned to the micro-enterprises sector as a provider of employment. According to Eurostat 5% percent of microenterprises in European Union (EU) are located in Portugal, where they represent 95.4 percent of the sector of Small and Medium Enterprises and employ 41% of workers. According to data from the statistics office of the EU, the share of the sector of Small and Medium Enterprises (SMEs) in employment is in Portugal, 80.9 percent and 66.9 percent in the EU. "Microenterprises are much more dominant in the SME sector in Portugal than in almost all other Member States," reads the study on the essential contribution of the same for job creation presented by the European Commission (EC)(Lusa, 2012). Also, according to the National Statistics Institute, in 2011, “84.7% of non-financial corporations were microenterprises, while medium-sized firms accounted for 2% and large companies were only 0.4% of the total” (Santos, 2014). The enterprise where we are conducting this case study is, therefore representative of an important group of microenterprise for the Portuguese Economy.

The case study was conducted in the footwear industry, that has been the largest contributor to the external accounts since it is the sector with the largest trade surplus, revealed the database in Bank of Portugal, (November de 2012). The year of 2012 (November 2012) exceeded 1,3 billion euros in international sales (more than in 2011) and is expected to growth in 2013 with the strategy of the entrance in new markets such as United States, China and Chorea (Santos Pereira, 2013). Pontechem is an import/export enterprise with more than 20 years of experience. They are suppliers to the footwear industry. In response to the customer needs they realized they had look for new products to offer their clients and became suppliers of other companies namely for the leather goods section, decoration, clothing and accessories. Pontechem key partners are the Company A, producing synthetic fabrics for various applications with a great capacity for innovation and adaptation on the growing market demand. At this moment, they have also as a key partnership a representation of prefabricated soles (Company B). Company A and B are aliases for existing companies that the authors are not allowed to disclose.

Approach to data collection and processing

Two personal semi-structured recorded interviews of two enterprise members were conducted, the Pontechem CEO, which is also the owner and the responsible of the synthetic-fabrics leather and soles sales department, and the person responsible for the Purchasing/Sales and Operations Planning (Fig.4). There was also one important meeting with the Pontechem CEO to position and clarify the research objectives and to provide a detailed explanation of the ongoing research. Right after the interviews and after an in-depth analysis of the recorded interview, a first version of the Pontechem Value Network (PVN) was made. Fig. 4 illustrates this value network identifying roles and exchanged deliverables, both tangible and intangible. Both interviewees were later asked to analyse the PVN and, together with the research team, improve and validate it. In the analysis of the case study the so-called Business

Narrative Modelling Language (Oliveira and Pinto Ferreira, 2011) was applied. The interview was segmented into narrative patterns, and each pattern was modelled as one or more Microsoft Excel line establishing the relationship among the different terms of coding scheme. Each line also includes text from the interview, thus providing the evidence that supports the rationale for those relationships. The Excel worksheet is then further processed using “pivot tables” in order to extract the desired perspectives onto the data model. Further processing transforms these relationships into graphs. The visualization of graphs picturing the relationships among the keywords is used in combination with the coding scheme in order to simplify the analysis of the whole context. This analysis was made for an Ex-Ante Phase (Pre-purchase phase).

4. Applying the Conceptual Model Decomposing Value for the Customer in the footwear industry

Fig. 4, shows the outcome of a value network analysis performed at Pontechem, picturing roles or actors in the value network, including the four functional departments, as well as other two external entities (suppliers). The dashed lines show that an intangible deliverable has been exchanged (e.g “Requirements for new collection” (DL3) and “Product Information” (DL2)) whereas the solid lines show the tangible deliverable exchanges (such as payment, sale confirmation) (Allee, 2008a).

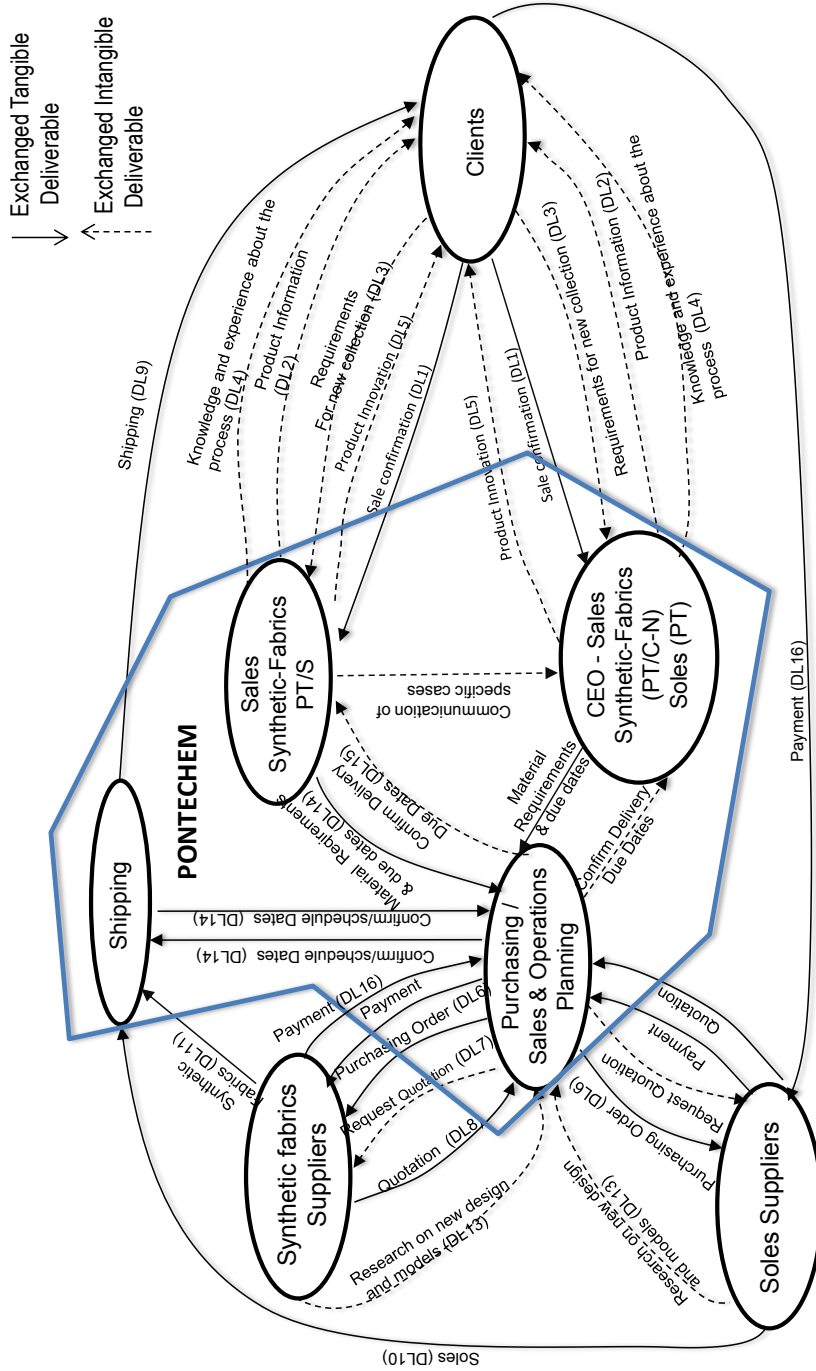


Fig. 4 Pontechem Value Network

This study will focus on four roles:

- The Pontechem CEO is responsible for the role Sales Synthetic-Fabrics PT/N and Soles (PT). This role assures the sales fabric and synthetic leather in north and centre of Portugal and also soles for the whole country. He creates the environment in which the client decides to buy, in learning what people want and need trying to persuade them to buy. In this context, the information about their products (“Product Information” – DL2) is critical to their client, and must clearly identify the diversity and specifications of their raw material, as well as their certifications and the minimum quantities of the product the client could acquire. This role also comprises the continuous search on “Products Innovation” (DL5) among both current and potential suppliers. This involves the participation in fairs, visits to suppliers, understanding fashion trends and reporting the “Requirements for new collections” (DL3). In their sales and promotion activities they build on with their “Knowledge and experience about the process” (DL4) provided by their suppliers and also on many years of experience in this market.
- The Sales Synthetic-Fabrics PT/S develops the same activities as above (except for the soles) in centre and south of Portugal.
- The Shipping role is responsible for managing the delivery of Synthetic-Fabrics and Soles to the clients. Soles are in fact shipped directly from the producer, whereas the Synthetic-Fabrics are received by Pontechem and then shipped to the clients.
- The Purchasing/Sales & Operations Planning role is responsible for the financial area and the management of daily operations between suppliers and clients, namely:
 - a) Acquiring material from suppliers, by requesting: “Quotation” (DL7), “Purchasing Order” (DL6);
 - b) “Material requirements & due dates” (DL14) as well their confirmation (“Confirm Delivery due dates” (DL15)), ensuring the clients’ orders will be shipped right on time;
 - c) “Payment” (DL16) for the suppliers;
 - d) Receiving from the suppliers’ new designs and models for both Sales Synthetic-Fabrics and Soles: “Research on new design and models” (DL13).

5. Value for the Customer vs. Endogenous and Exogenous Assets

In this paragraph we discuss fundamentally the first research question:

1. How can the Value for the Customer be modelled?
 - 1.1 How is this value built on top of assets endogenous and exogenous to the organization?
 - 1.2 How do endogenous and exogenous assets influence the Value for the Customer?

The analysis of this research questions, will enable the assessment that the relationships that we have proposed in our model are verified and confirmed in real world. We limited the discussion at a particular time position, an Ex-Ante phase, corresponding to the period before the handing of the contract proposal to the customer, as it relates to the perceived Value for the Customer “whenever they

contemplate the purchase” (Woodall 2003, p10). In an Ex-Ante (EXA_VC) value temporal position, the customer will make some judgments and predictions to maximize the value of the product/service to be acquired. In this phase, the customer starts to think what can be expected (such as “expected value” (Huber et al., 1997, Parasuraman, 1997) from their products/services and what is desirable (such as “desired value” (Flint et al., 1997)) of the value proposition of the enterprise. These expectations are related to both benefits expect from the product/service as well as sacrifices the customer is prepared to make upon its acquisition (Komulainen et al., 2005). Also, as a desired value is what the customer wants to happen and the benefits is seeking for. So this phase seems most interesting to study, because this will reduce the uncertainty the enterprise has in understanding the customer needs and in trying to maximise the ex-post happiness (Woodall, 2003). The next sections will illustrate the relationship between forms of value with endogenous and exogenous assets. This is shown in the form of graphs, using pictures to support the explanation of their relationship rational in an Ex-Ante phase: 1) the relationship between the exchanged deliverables and how different forms of value emerge in this phase; 2) the connections between deliverables, assets and ARCON Endogenous and Exogenous Components.

5.1 Forms of Value and deliverables

In the Fig.5, three forms of value emerged for this phase: Marketing (MARK_VC), Net (NET_VC) and Sale (SALE_VC).

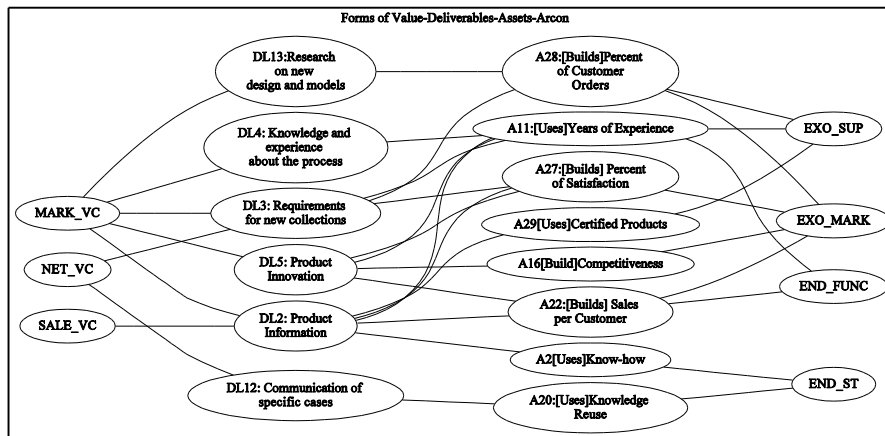


Fig. 5 Map of Emerging Relationships: Forms of Value, Deliverables, Enterprise Assets and Types of endogenous and exogenous components (Ex-Ante Phase)

Marketing VC

From the literature, MARK_VC is related with a “pre-experience zone and can be best associated with an Ex-Ante temporal position” (Woodall, 2003 p17). MARK_VC is seen as a “perceived component”, because “suppliers can never predict how each consumer will perceive and react to specific service” (Woodall, 2003 p17), that’s why MARK_VC is the form of value related with almost all deliverables. This is about combining the supply side and the demand side interpretations of the enterprise offering.

1. “Product Information” (DL2). The client needs to be confident that the

information of the product is correct and up to date. They inform the customers of all kind of products for making the footwear and for all new innovations in each collection;

“(...) we provide information about our products including minimum quantities, product certification, complete product portfolio and innovative products. We have to ensure [through product certification by our suppliers] that our products do not contain PVC, acids, acetone or enzymes. (...) This is an advantage for our clients that will also in having their products certified, instead having to make tests with raw material bought in other countries that do not have the European specification requirements. (...) We also have no child labour. (...)” (Interview excerpts)

2. “Knowledge and experience about the process”(DL4) it is an important deliverable since according to the interview “(...) the client knows very little about raw materials and even about the process applying and combining these raw materials (...)”. The Knowledge of the raw material “(...) is vital to a salesperson’s effectiveness, because we must always be attentive to ever-changing client needs, other market trends, competitors’ products or services as well as new products to answer the questions of our clients” (interview excerpt). Without it the company will have lack of credibility and confidence;
3. “Product Innovation” (DL5) it is about search for new products;
“(...) in the footwear industry we must constantly innovate and search for new products. According to the product innovation they know we have a multiple sources of new products and we are constantly innovating” (interview excerpt).
4. “Research on new design and models” (DL13) (suppliers). Suppliers must constantly improve the manufacturing processes, must be proactive and anticipate client needs.

NET VC

In the NET_VC the client is focusing purely “on the balance of benefits/sacrifices” (Woodall, 2003 p7). By looking at the “Requirements for new collections” (DL3), the customer will make a balance of benefits/sacrifices as a utilitarian perspective on purchase and consumption. DL3 is related with a particular characteristics and specifications of a product /service made by the customer.

“An example of a requirement is when a clients wants a specified material, for instance, a fabric mounted on cork.” (Interview excerpts)

This relates the benefit of the innovation and its value perception by the end-consumer, versus the difficulty of having a fabric properly mounted on cork. As an outcome perspective the evaluation of the benefits and sacrifices “(...) has to be done by the client (...)” (interview excerpt).

However it is important that Pontechem helps the client in assessing balance the involved benefit and sacrifices. This implies a consistent and in-depth knowledge of all materials and how they can, or not, be used together. This assistance is important and valued by the enterprise clients that will, along the process, buy innovative materials for footwear.

Quoting the interviewee:

“(...) if we contributed to clients gains they can come again and buy our products [Building percent of Client orders]. From the point of view of the client we can advise them if it is feasible or not [to use or combine particular raw materials], contributing for their satisfaction” (interview excerpt).

SALE_VC

SALE_VC, as a concept, relates only to the reduction of sacrifice “(...) predicted purely upon units of exchange (...) and influence perceptions of VC at EX-Ante (...)” phase (Woodall, 2003 p19). In this form of value, the client perceives the price, the quality of products, the services, according to the information of the enterprise products (“Product Information” - DL2).

5.2. Deliverables vs. Endogenous/Exogenous Assets

The previous discussion related forms of value and their relationship with each deliverable for the Ex-Ante time position and is illustrated in Fig.5. This picture also shows the relationship between each deliverable, the enterprise assets being used or built and the projection of each asset into the types of endogenous and exogenous components. The following discussion will use the deliverable “Product Information” (DL2) as an example to illustrate this relationship. The same exercise was extended to the other deliverables thus further demonstrating the answer to research question 1.1 and 1.2. The authors, however, refrained from including here all this description in order to make this document shorter and more convenient to read.

Deliverable DL2 is about providing information about Pontechem products and services: 1) relates to certified products by [Using] Certified Products (A29); 2) and to the diversity of their product portfolio and to their ability to suggest improvements the client’s products by [Using] Years of Experience (A11), and Know-how (A2) (using their knowledge) to help clients achieve their goals. Pontechem wants to increase sales [Building] asset A22 (Sales per Customer) and [Build] Percentage of Satisfaction (A27) among their clients.

[Building] Sales per Customer (A22)

The asset [Building] Sales per Customer (A22) will be projected into: 1) Endogenous Functional (END_FUNC), reflecting on the competency of their human resources, such as CEO and the personal of the enterprise, in their procedures and methodologies to sale their raw material; 2) Exogenous Market (EXO_MARK) related with the interaction with clients by giving them information about the competence of their services and products in acquiring potential sales and new clients.

[Use] Certified Products (A29)

The asset [Using] Certified Products (A29) will be projected into Exogenous Support (EXO_SUP), reflecting both the suppliers role and their certification provided by those entities that are entitled to issue certificates confirming compliance with regulations and norms.

[Use] Know-how(A2)

The asset [Use] Know-how will be projected into Endogenous Structural (END_ST), reflecting a direct participation in the main business process, responsible for operation and collaboration among its actors, (Camarinha-Matos and Afasarmanesh, 2008c). The CEO is responsible for the daily general support activities to their clients by helping them solving all different problems that arise from the usage of supplied materials. The CEO [Uses] know-how to perform these enterprise activities.

5.3. Discussion

The focus of this section was answer the 1st research question, to understand how we could model the Value for the Customer. At this stage we aimed at understanding how value was built on top of assets endogenous and exogenous to the organization and how do those assets influence or relate the Value for the Customer. This brief

illustration using DL2, “Product Information” helped demonstrating the relevance of both endogenous and exogenous assets, of different types (e.g.: Endogenous Functional, Exogenous Support and Exogenous Market) to the construction of the value for the customer. Our objective, however, is to build on a quantitative model that may help us in the decision making process. This will be discussed in the following sections.

6. Value For the Customer Quantitative Model, Application and Discussion

Now that the relevance of both endogenous and exogenous assets for the Value for the Customer was demonstrated, we want to address the second research question:

2. Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?

Moreover, as illustrated in the proposed model presentation we would like to use this quantitative model to support the tuning the enterprise Value Proposition. To this end the client or end-customer perceived benefits and sacrifices have to be understood and included in the equation. As a result, this section is organized as follows. We start by introducing the list of relevant perceived benefits and sacrifices derived from the interview at the enterprise. We then use the Fuzzy AHP method to assess the two “sides”, that is, the enterprise perspective and the client perspective. Finally we integrate both results in a final analysis of the value proposition.

6.1. Perceived Benefits and Sacrifices

The detail of the Perceived Benefits (PB_i) and Sacrifices (PS_i) related to the previously identified exchanged deliverables and enterprise assets at an EX-Ante time position were derived from the interview at Pontechem (Table 1). This table lists the whole set of PB/PS identified in the existing deliverable exchange.

Table 1 – Perceived Benefits/Sacrifices

Deliverables	Assets Use/Build	Perceived Benefits/Sacrifices
DL2 - Product Information	A29[Uses]Certified Products (EXO_SUP)	PB21 Utility PB29 Financial Benefits
	A22[Builds]Sales per customer (END_FUNC)(EXO_MARK)	PB2 Product Quality PB47 Technical Competence PB49 Trust PS3 Monetary Costs PS22 Price
	A27[Builds]Percent of Satisfaction (EXO_MARK)	PB2 Product Quality PB4 Service Quality PB46 Reliability PB43 Product Customization PB17 Product Attributes
	A11[Uses]Years of Experience (EXO_SUP)(END_FUNC)	PB49 Trust
	A2 [Uses]Know-how (END_ST)	PB49 Trust
DL3 - Requirements for new collections	A27[Builds]Percent of Satisfaction (EXO_MARK)	PB2 Product Quality PB4 Service Quality PB46 Reliability PB43 Product Customization PB17 Product Attributes
	A28[Builds]Percent of Customer Orders (EXO_MARK)(EXO_SUP)	PB21 Utility PB33 Convenience PB45 Flexibility
	A11[Uses]Years of Experience (EXO_SUP)(END_FUNC)	PB47 Technical Competence PB49 Trust
	A2[Uses] Know-how (END_ST)	PB47 Technical Competence PB49 Trust
	A11[Uses]Years of Experience (EXO_SUP)(END_FUNC)	PB47 Technical Competence PB49 Trust
DL4 - Knowledge and experience about the process	A27[Builds]Percent of Satisfaction (EXO_MARK)	PB2 Product Quality PB4 Service Quality PB46 Reliability PB43 Product Customization PB17 Product Attributes
	A22[Builds]Sales per customer (END_FUNC)(EXO_MARK)	PB2 Product Quality PB47 Technical Competence PB49 Trust PS3 Monetary Costs PS2 Price PB47 Technical Competence
DL5 - Product Innovation	A11[Uses]Years of Experience (EXO_SUP)(END_FUNC)	PB49 Trust
	A16[Build]Competitiveness (EXO_MARK)	PB26 Logistic Benefits PB29 Financial Benefits
	A20[Uses]Knowledge Reuse (END_ST)	PB43 Product Customization
DL12 - Communication of specific cases	A28[Builds]Percent of Customer Orders (EXO_MARK)(EXO_SUP)	PB21 Utility PB29 Financial Benefits PB28 Strategic Benefits
DL13 - Research on new design and models (suppliers)		

6.2. Using the Fuzzy AHP extent analysis on the enterprise perspective

One of the most common Multi-Criteria Decision Making (MCDM) techniques is Analytical Hierarchy Process (AHP) (Ahmad et al., 2006, Ahmad and Laplante, 2009, Peng et al., 2011). As the direct application of AHP cannot reflect the human thinking (Nukala and Gupta, 2005, Vahidnia et al., 2008), in this study AHP will be used together with fuzzy theory. The authors believe this approach is better in dealing with ambiguous and self-defined situations (Aggarwal and Singh, 2013). The so-called Fuzzy AHP method uses the Saaty's scale for each decision maker, individually carrying out each pair wise-comparison for the criteria/alternatives. In our case study, a comprehensive pair-wise comparison matrix (eq-3) is built, integrating the three perceptions of the two decision makers and client (as perceived by the company). Using equation (eq-1-2), these values are transformed into triangular fuzzy numbers (\tilde{b}_{je}). Then, the extent analysis is used to obtain the synthetic extent value (Chang, 1996) of the pair-wise comparison.

In this context, in order to evaluate the criteria and the alternatives, the interviewees

in the enterprise graded the pair-wise comparison by using the Saaty's scale giving: 1) the relative importance between each Criterion (8 Assets); 2) for each Criterion (Asset), the relative importance of each and every Alternative (13 PB/PS). The overall calculations by using the fuzzy AHP method, through the equations (3-10), are depicted in the Table 2, showing: a) the relative relevance of the enterprise assets involved (colour grading column); b) the ranking of alternatives obtained for the Perceived Benefits/Sacrifices (colour grading in the bottom row); c) the relationship between Assets and Benefits that were not identified during the interview; d) the deliverables identified with each asset (endogenous/exogenous); e) the form of value related with each deliverable.

Relative importance between each Criterion

According to the pair-wise comparison of the company and after the calculation by using the AHP Fuzzy Method, Table 2, the higher value emerges for the exogenous market (EXO_MARK) asset [Builds] Competitiveness (A16). Pontechem must identify opportunities for achieving sustainable competitive advantage (Camarinha-Matos and Afasarmanesh, 2008 p105), which means the enterprise must focus on partnerships to achieve its goals, "showing the best potential value within their chosen marketplace"(Woodall, 2003) by delivering adequate "Product Innovation"(DL5) in the communication of their value proposition. The interview comments to this result make this clear:

"(...)due to the fact of our collection changes from to season to season it is necessary to look for our client needs. We have a high variety of articles. The client is going to find whatever he wants and the prices are not high. This saves the client the need to undergo further developments and increases competitiveness. Basically we provide reliable products that our clients trust. Our products are also trendy and innovative, thus meeting their needs for the new season collections." (interview excerpt).

The relevance of A16 emerges firstly from the price (PS22). Then we have the Reliability (PB46), the quality of their Products and Services (PB2, PB4) and Trust (PB49). These PB and PS were indeed mentioned in the interview but not related with A16. This is an interesting result. Indeed, during the interview the whole list of PB/PS was analysed one at a time, however, as result of the pair-wise comparison, these new relationships emerged. The discussion of these results with the interviewee confirm the rational for those relationships:

"(...) Our advantage is the diversification and the quality of our products, service and innovation. (...)There is an amount of different and innovative products each year in each collection. Also, the client may come to us and get everything to make shoes." (Interview excerpts)

The asset [Uses] Years of experience (A11) was ranked second. The perceived benefits with higher values on using this asset were Reliability (PB46) and Trust (PB49). The client perceived Reliability as "the ability of the supplier to do things right at the first time" (Lapierre, 2001 p255) and perceived Trust, as the ability to honour his promises capturing the client confidence that the enterprise is telling the truth about the products. The interview testimonials confirm the rational for those relationships:

"(...) we need to know if the product is technically feasible and this knowledge results from our years of experience in the footwear market. Indeed, the reliability more than trust is very important in our business." (Interview excerpts)

Ranking of alternatives obtained for the Perceived Benefits

For the ranked alternatives, the highest priority vector of the PB/PS was PS22 – Price. Thus, it is the most important alternative that the enterprise may take into account in the decision making process, followed by PB46-Reliability, PB2-Product quality and PB4-Service quality. These results were confirmed by the enterprise and emphasized by some authors, whose words can be summarize as: “price is always a part of the client’s value calculation (...) and is one of the elements which is given up to obtain a product or a service” (Woodall, 2003, Zeithaml, 1988). PB46-Reliability is ranked second and is defined “as the ability of the supplier’s to keep his promises and the accuracy of the transactions” (Lapierre, 2001). In this context, [Using] Years of experience (A11), Certified Products (A29) and Knowledge Reuse (A20) are contributing for PB46-Reliability. The relationship between assets and benefits that were not identified during the interview are the cells in white background. It is interesting to see that A16 is a very important asset, although the PB associated with it (as mentioned in the interview) has not the highest value in the whole set of PBs/PSs. The results revealed that four perceived benefits emerged with a fuzzy weight vector bigger than those mentioned in the interview, namely: PB46-Reliability, PB4-Service quality; PB2-Product quality and PB49-Trust. These relationships are explained by the Saaty’s scale ranking of alternatives, thus leading to the analysis of previously disregarded relationships.

Table 2- Overall Results of Pontechem (eq-10)

Forms of Value	Deliverables	ARCON	Assets	F82 Product Quality	P84 Service Quality	PE17 Product Attributes	P821 Utility	P826 Logistics Benefits	P828 Strategic Benefits	PE29 Financial benefits	P843 Product Customization	P846 Reliability	P847 Technical Competence	P848 Trust	PS3 Monetary Costs	PS22 Price	Weight Priority vector of the Assets										
SALE_VC	DL2 Product Information	END_ST	A22 [Use] Know-how	0.1038	0.0554	0.0486	0.0884	0.0217	0.0407	0.0976	0.0473	0.1388	0.0956	0.0635	0.0663	0.1023	0.1438										
MARK_VC	DL4 Knowledge and experience about the process; DL5 Product Innovation; DL3 Requirements for new collections	END_FUNC EXO_SUP	A11 - [Use] Years of experience	0.1007	0.1271	0	0.1116	0.0016	0	0.1229	0	0.1821	0	0.1637	0.0413	0.1489	0.1904										
SALE_VC; MARK_VC	DL2 Product Information; DL5 Product Innovation	END_FUNC EXO_MARK	A22 [Build] Sales per Customer	0.1487	0.1095	0	0.1447	0	0	0.1101	0.0307	0.1115	0	0.1068	0.0702	0.1679	0.1053										
NET_VC	DL12 Communication of specific cases	END_ST	A20 [Use] Knowledge Reuse	0.1089	0.0534	0.0455	0.0939	0.0141	0.0366	0.1018	0.0312	0.1483	0.0995	0.0933	0.0659	0.1076	0										
MARK_VC; SALE_VC	DL5 Product Innovation; DL3 Requirements for new collections; DL2 Product Information	EXO_MARK	A27 [Build] Percent of Satisfaction	0.1576	0.1151	0	0.108	0.0465	0	0.1003	0.0481	0.1283	0	0.0971	0.0467	0.1534	0.1608										
MARK_VC	DL13 Research on new designs and models; DL3 Requirements for new collections	EXO_SUP	A28 [Build] Percent of Customer Orders	0.1593	0.1111	0.0104	0.149	0.0164	0.007	0.1058	0.0496	0.1062	0.0109	0.0883	0.0945	0.1444	0										
SALE_VC	DL2 Product Information	EXO_SUP	A25 [Use] Certified Products	0.251	0	0.2239	0	0	0.0276	0	0	0.2224	0.0914	0	0.0256	0.1632	0										
MARK_VC	DL5 Product Innovation	EXO_MARK	A16 [Build] Competitiveness	0.1317	0.1395	0.0303	0.0518	0.0445	0	0	0.108	0.1586	0.0714	0.1261	0.0299	0.1782	0.3897										
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:15%;">Weight Priority vector of the PB/PS</td> <td style="width:15%;">0.127641</td> <td style="width:15%;">0.1173384</td> <td style="width:15%;">0.0785853</td> <td style="width:15%;">0.0283745</td> <td style="width:15%;">0.0609866</td> <td style="width:15%;">0.06618281</td> <td style="width:15%;">0.1500809</td> <td style="width:15%;">0.12160287</td> <td style="width:15%;">0.0444671</td> <td style="width:15%;">0.15613783</td> </tr> </table>																	Weight Priority vector of the PB/PS	0.127641	0.1173384	0.0785853	0.0283745	0.0609866	0.06618281	0.1500809	0.12160287	0.0444671	0.15613783
Weight Priority vector of the PB/PS	0.127641	0.1173384	0.0785853	0.0283745	0.0609866	0.06618281	0.1500809	0.12160287	0.0444671	0.15613783																	

Remark: shaded squares in the matrix picture the PB/PS associated to each deliverable during the interview and the construction of the Value Network. The other relationships emerge upon the pair-wise comparison of the different criteria/alternatives.

6.3. Results from the integration on the customer perception

Upon the attempt to get information from the client, regarding his perception of benefits and sacrifices, and their relationship with the Pontechem deliverables, the research team along with Pontechem members, decided to concentrate only on the assets with higher relevance to identify which deliverables would have to be analysed by the client. The results of the matrix of the table 2, led to the use of the the following deliverables, for evaluation the criteria with the client: “Product Information” (DL2); “Requirements for new collections” (DL3); “Knowledge and experience about the process” (DL4) and “Product Innovation” (DL5). The client made the pair-wise comparison using the Saaty’s scale for these deliverables and then, because we have only one client, we transformed the client perceptions set into triangular fuzzy numbers using the comparison scale proposed by (Herrera Umaña and Osorio Gómez, 2006). The calculated the results are in Table 3. After this calculation and by applying the extent analysis method on fuzzy AHP method we obtain the priority weight vector (eq-10) for the deliverables:

$$W_{DL} = [0,1949 \ 0,4025 \ 0 \ 0,4025].$$

Table 3 - The fuzzy comparison matrix over different criteria

Criteria	DL2-Product Information			DL3- Requirements for new collections			DL4-Knowledge and experience about the process			DL5- Product Innovation		
DL2-Product Information	1	1	2	0,25	0,333	0,5	4	5	6	0,25	0,333	0,5
DL3- Requirements for new collections	2	3	4	1	1	2	4	5	6	1	1	2
DL4- Knowledge and experience about the process	0,167	0,2	0,25	0,167	0,2	0,25	1	1	2	0,167	0,2	0,25
DL5- Product Innovation	2	3	4	0,5	1	1	4	5	6	1	1	2

To assess the alternatives, we used all PB/PS except PB21 (Utility) and PS3 (Monetary Costs). Table 4 illustrates two of the four matrixes resulting from this process.

Table 4 - Fuzzy comparison matrix with respect to DL2 and DL3.

DL2	PB2 Product Quality	PB4 Service Quality	PB17 Product Attributes	PB26 Logistics Benefits	PB28 Strategic Benefits	PB29 Financial benefits	PB43 Product Customization	PB46 Reliability	PB47 Technical Competence	PB49 Trust	PS22 Price
PB2 Product Quality	1 1 2	2 3 4	1 1 2	4 5 6	0,25 0,33 0,5	0,25 0,33 0,5	8 9 9	0,17 0,2 0,25	1 1 2	4 5 6	1 1 2
PB4 Service Quality	0,25 0,33 0,5	1 1 2	0,25 0,33 0,5	4 5 6	0,17 0,2 0,25	0,25 0,33 0,5	2 3 4	0,13 0,14 0,17	0,25 0,33 0,5	1 1 2	0,17 0,2 0,25
PB17 Product Attributes	0,5 1 1	2 3 4	1 1 2	4 5 6	0,17 0,33 0,5	0,25 0,33 0,5	8 9 9	0,17 0,2 0,25	1 1 2	4 5 6	1 1 2
PB26 Logistics Benefits	0,17 0,2 0,25	0,17 0,2 0,25	0,17 0,2 0,25	1 1 2	0,13 0,14 0,17	0,13 0,14 0,17	1 1 2	0,13 0,14 0,17	0,13 0,14 0,17	0,13 0,14 0,17	0,13 0,14 0,17
PB28 Strategic Benefits	2 3 4	4 5 6	2 3 4	6 7 8	1 1 2	2 3 4	8 9 9	1 1 2	1 1 2	4 5 6	1 1 2
PB29 Financial benefits	2 3 4	4 5 6	2 3 4	6 7 8	0,25 0,33 0,5	1 1 2	8 9 9	1 1 2	1 1 2	4 5 6	1 1 2
PB43 Product Customization	0,11 0,11 0,13	0,25 0,33 0,5	0,11 0,11 0,13	0,5 1 1	0,11 0,11 0,13	0,11 0,11 0,13	1 1 1	0,11 0,11 0,13	0,17 0,2 0,25	0,13 0,14 0,17	0,17 0,2 0,25
PB46 Reliability	4 5 6	6 7 8	4 5 6	6 7 8	0,5 1 1	0,5 1 1	8 9 9	1 1 2	6 7 8	7 8 9	4 5 6
PB47 Technical Competence	0,5 1 1	2 3 4	0,5 1 1	6 7 8	0,5 1 1	0,5 1 1	4 5 6	0,13 0,14 0,17	1 1 2	4 5 6	0,25 0,33 0,5
PB49 Trust	0,17 0,2 0,25	0,5 1 1	0,17 0,2 0,25	6 7 8	0,17 0,2 0,25	0,17 0,2 0,25	6 7 8	0,11 0,13 0,14	0,17 0,2 0,25	1 1 2	0,17 0,2 0,25
PS22 Price	0,5 1 1	4 5 6	0,5 1 1	6 7 8	1 1 2	0,5 1 1	4 5 6	0,17 0,2 0,25	2 3 4	4 5 6	1 1 2

DL3	PB2 Product Quality	PB4 Service Quality	PB17 Product Attributes	PB26 Logistics Benefits	PB28 Strategic Benefits	PB29 Financial benefits	PB43 Product Customization	PB46 Reliability	PB47 Technical Competence	PB49 Trust	PS22 Price
PB2 Product Quality	1 1 2	0,13 0,14 0,17	1 1 2	1 1 2	0,13 0,33 0,5	0,25 0,33 0,5	0,13 0,14 0,17	0,17 0,2 0,25	1 1 2	0,13 0,14 0,17	0,17 0,2 0,25
PB4 Service Quality	6 7 8	1 1 2	6 7 8	6 7 8	0,17 0,2 0,25	0,25 0,33 0,5	1 1 2	0,13 0,14 0,17	4 5 6	1 1 2	1 1 2
PB17 Product Attributes	0,5 1 1	0,13 0,14 0,17	1 1 2	1 1 2	0,17 0,33 0,5	0,25 0,33 0,5	0,13 0,14 0,17	0,13 0,14 0,17	1 1 2	0,13 0,14 0,17	0,17 0,2 0,25
PB26 Logistics Benefits	0,5 1 1	0,13 0,14 0,17	0,5 1 1	1 1 2	0,13 0,14 0,17	0,13 0,14 0,17	0,13 0,14 0,17	0,11 0,11 0,13	0,17 0,2 0,25	0,13 0,14 0,17	0,17 0,2 0,25
PB28 Strategic Benefits	6 7 8	4 5 6	6 7 8	6 7 8	1 1 2	2 3 4	1 1 2	0,17 0,2 0,25	4 5 6	2 3 4	1 1 2
PB29 Financial benefits	4 5 6	2 3 4	6 7 8	6 7 8	0,25 0,33 0,5	1 1 2	0,17 0,2 0,25	0,13 0,14 0,17	1 1 2	0,17 0,2 0,25	1 1 2
PB43 Product Customization	6 7 8	0,5 1 1	6 7 8	6 7 8	0,5 1 1	4 5 6	1 1 2	0,17 0,2 0,25	4 5 6	1 1 2	1 1 2
PB46 Reliability	6 7 8	4 5 6	6 7 8	8 9 9	4 5 6	6 7 8	4 5 6	1 1 2	6 7 8	4 5 6	4 5 6
PB47 Technical Competence	0,5 1 1	0,17 0,2 0,25	0,5 1 1	4 5 6	0,17 0,2 0,25	0,5 1 1	0,17 0,2 0,25	0,13 0,14 0,17	1 1 2	0,17 0,2 0,25	0,5 1 1
PB49 Trust	6 7 8	0,5 1 1	6 7 8	6 7 8	0,25 0,33 0,5	4 5 6	0,5 1 1	0,17 0,2 0,25	4 5 6	1 1 2	0,17 0,2 0,25
PS22 Price	4 5 6	0,5 1 1	4 5 6	4 5 6	0,5 1 1	0,5 1 1	0,5 1 1	0,17 0,2 0,25	4 5 6	4 5 6	1 1 2

The authors had then to go through the evaluation criteria obtained by multiplying the matrix $M_{PB\text{DL}}$ (Table5 by applying eq3-10) obtained by the weights of each alternative (PB/PS) with respect to main criteria (deliverables) with the normalized vector obtained by the weights of the criteria (eq10) W_{DL}^T . The summary of the results of the fuzzy comparison of each PB/PS to each deliverables was a matrix (Table5) and thus the resulting of the final score (SC) for the alternatives (PB/PS) is given by the $SC = M_{PB\text{DL}} \times W_{DL}^T$ (Fig. 6).

Table5 - Matrix MPBDL: Importance weightings, of all alternatives, with respect to each deliverable

	DL2	DL3	DL4	DL5
PB2	0,21	0	0	0
PB4	0	0,06	0,24	0,21
PB17	0,03	0	0,24	0,04
PB26	0	0	0	0
PB28	0,22	0,17	0	0
PB29	0,18	0	0	0
PB43	0	0,09	0	0,11
PB46	0,37	0,55	0,27	0,34
PB47	0	0	0,25	0,3
PB49	0	0,11	0	0
PS22	0	0,02	0	0

$$SC = \begin{bmatrix} 0,206 & 0 & 0 & 0 \\ 0 & 0,064 & 0,243 & 0,214 \\ 0,027 & 0 & 0,243 & 0,041 \\ 0 & 0 & 0 & 0 \\ 0,219 & 0,172 & 0 & 0 \\ 0,183 & 0 & 0 & 0 \\ 0 & 0,093 & 0 & 0,109 \\ 0,365 & 0,549 & 0,27 & 0,34 \\ 0 & 0 & 0,245 & 0,296 \\ 0 & 0,106 & 0 & 0 \\ 0 & 0,016 & 0 & 0 \end{bmatrix} \times \begin{bmatrix} 0,1949 \\ 0,4025 \\ 0 \\ 0,4025 \end{bmatrix} = \begin{bmatrix} 0,04014 \\ 0,11186 \\ 0,02173 \\ 0 \\ 0,11203 \\ 0,03559 \\ 0,08135 \\ 0,42888 \\ 0,11911 \\ 0,04261 \\ 0,00662 \end{bmatrix}$$

Fig. 6 - Final score (SC) for alternatives (PB/PS)

The overall result integrating the client perspective is presented in the Table 6, giving us: a) the priority weights of each deliverable as well as their correspondence to each endogenous/exogenous or used/built assets; b) the priority weights of each PB/PS; c) and the relationship between the deliverables and PB/PS.

Relative importance between each Criterion (deliverables)

Based on the overall composite value in Table 7, we can comment the priority weights of each criterion:

“Requirements for new collection” (DL3) and “Product Innovation” (DL5) are the best ranked deliverable (criteria) with 0,403 followed by the “Product Information” (DL2) with 0,195. The interview testimonial of the client, confirm the rational for those relationships:

(...) the enterprise has a huge assortment of products and they innovate constantly for each season (related with DL5) . This implies, we don't need to develop a specific product, for example a new textile or new soles. Also we have reliability on this enterprise, since they have certified products reflecting in their service quality and in their technical competence. (...)(Client interview excerpts).

“(...) When we think in DL3, we related this component with the fact we can take the product catalogues with us and with it we can more easily create our collection (...).” (Client interview excerpts).

The deliverable “Knowledge and Experience about the process” (DL4) is irrelevant for this client, because this deliverable is embedded in DL3, and this zero make sense according to the interview at the client:

“(...) I know very little about the raw material. For example, we don't know if fabrics are with good quality, i.e, if they had the U.E. tests, if it is possible to make a detail in a certain product without having the risk of the fabric doesn't rip, etc. In this context, we depend on the reliability that we have on the company and with their technical competence to advise us of those characteristics. I think this is more related with DL3” (Client interview excerpts).

Table 7 -Final results, integrating of the Client perception

	PB2 Product Quality	PB4 Service Quality	PB17 Product Attributes	PB26 Logistics Benefits	PB28 Strategic Benefits	PB29 Financial benefits	PB43 Product Customization	PB46 Reliability	PB47 Technical Competence	PB49 Trust	PS22 Price	Weight priority (WDLT) vector of the assets
A02 [Uses]Know-how; A22[Builds] Sales per Customer;A27[Builds]Percent of Satisfaction;A29 [Uses]Certified Products	0,206	0,000	0,027	0,000	0,219	0,183	0,000	0,365	0,000	0,000	0,000	0,195
A02 [Uses]Know-how; A27[Builds]Percent of Satisfaction; A28[Builds]Percent of Customer Orders; A11 – [Uses] Years of experience;	0,000	0,064	0,000	0,000	0,172	0,000	0,093	0,549	0,000	0,106	0,016	0,403
A11 – [Uses] Years of experience; A27[Builds]Percent of Satisfaction;A11 – [Uses] Years of experience; A22[Builds] Sales per Customer; A16 [Build]Competitiveness	0,000	0,243	0,243	0,000	0,000	0,000	0,000	0,270	0,245	0,000	0,000	0,000
DL2-Product Information	0,206	0,000	0,027	0,000	0,219	0,183	0,000	0,365	0,000	0,000	0,000	0,195
DL3- Requirements for new collections	0,000	0,064	0,000	0,000	0,172	0,000	0,093	0,549	0,000	0,106	0,016	0,403
DL4-Knowledge and experience about the process	0,000	0,243	0,243	0,000	0,000	0,000	0,000	0,270	0,245	0,000	0,000	0,000
DL5- Product Innovation	0,000	0,214	0,041	0,000	0,000	0,000	0,109	0,340	0,296	0,000	0,000	0,403
Weight priority (W/PB) vector of the PB	0,040	0,112	0,022	0,000	0,112	0,036	0,081	0,429	0,119	0,043	0,007	

Relative importance between each Alternatives (PB/PS)

Making now the bridge to the perceived benefits, and based on the overall composite value in Table 7, we can comment the priority weights of each alternative.

The alternative “Reliability” (PB46), with 0,429, scored the highest priority according to the other PB/PS, followed by the “Technical Competence” (PB47) with 0,119 and “Strategic Benefits”(PB28) with 0,112. “Reliability” also scored the highest degree of relevance on “Requirements for new collection” (DL3) with 0,549, “Product Innovation” (DL5) with 0,340 and in “Product Information” (DL2) with 0,365. Therefore, “Reliability” will be chosen the most relevant perceived benefit among the set of the alternatives.

The “Technical Competence” (PB47) was in second rank on the client perspective, having the highest value in the “Product Innovation” (DL5). And this makes sense as PB47 “captures the creativity of the supplier’s stuff” (Lapierre, 2001 p 256), by the development of new products. Also by providing knowledge and experience about the process (DL4) they “demonstrate comprehensive process knowledge of the client’s business” (Lapierre, 2001 p 256). According to Table 2, the enterprise perspective did not value this perceived benefit (PB47), since:

“(…) in our perspective the client should not value the technical competence, because we do not produce the raw material” (enterprise interview excerpts)”.

Although, the client said:

“(…) we know they don’t produce, but the value becomes from the enterprise understand our requirements and their expertise in the client activity sector, namely how to develop new materials with good quality”(client interview excerpts).”

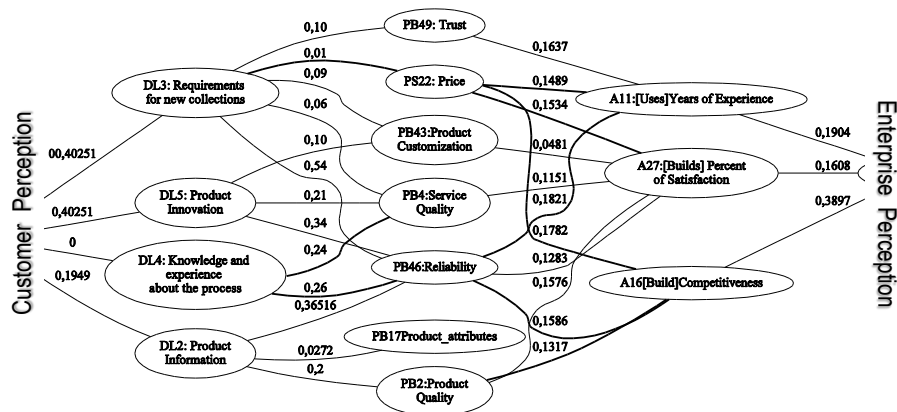
It is worthy to note that among the 11 alternatives the “Strategic Benefits” (PB28) and “Service Quality” (PB4) are ranked very close with 0,112 and 0,1118 respectively. This reveals that these two alternatives are almost equally important in the perception on the client. The PB28 shows the highest degree of relevance when related to “Product Information” (DL2), and PB4 shows the highest degree of relevance when related to “Knowledge and Experience about the process” (DL4).

It is interesting to observe that “Price” (PS22) is not relevant for this client. It is clear that clients do not buy solely based on price. They buy the trade-off between the benefits a client receives from a product and what he pays for it. Intuitively, the client may think on price, but when evaluating the overall alternatives the price is not the most relevant alternative.

6.4. Discussion of the results

Fig. 7 builds the bridge between the items delivered to the Client, the Deliverables, and the enterprise Assets used/build by PONTECHEM to respond to and meet the client needs. The point we want to make at an Ex-Ante analysis is how relevant this exercise was for Pontechem in understanding of how their Value Proposition is seen by the client. This picture builds a most relevant connection between deliverables, whose value is perceived (or not, as we have seen) by the client and the supporting enterprise endogenous or exogenous assets, enabling therefore a better understanding of how to adjust the Value Proposition and the supporting enterprise assets perceived as relevant.

There were not sizeable differences between the enterprise and client perception. From the evaluation of the two perspectives the alternative with higher value was Reliability (PB46). It is worth noting that the quantitative method provided new relevant relations between perceived benefits/sacrifices (PBs/PSs) and exogenous and exogenous assets. As an example from the enterprise perspective, we have “Reliability” (PB46) that emerged strongly as related with [Uses] years of experience (A11) and [Builds] Competitiveness (A16).



Legend: Bold lines were not mentioned in the interview. These connections emerged upon the pair-wise comparison of the different criteria/alternatives.

Fig. 7 - The integration of Pontechem and Customer perspectives

Regarding the endogenous/exogenous assets that were analysed in the company, some connections emerged after the evaluation of 11 alternatives, which were not mentioned in the interview. As an example, “Reliability” (PB46) emerged in the assets [Builds] Competitiveness (A16) and in [Uses] Years of experience (A11). According to literature review, this represents the reality, “the enterprise must always be aware of the reliability level” (Theotokas,1999 p4) by [using] their years of experience (A11) contributing to “perform the promised service dependably and accurately” (Lapierre 2000, p255). Also, with the continuous scanning in searching new products (“Product Innovation” (DL5)) they contribute for the improvement of the competitiveness / reliability relation ([Building] Competitiveness). Indeed, according to the Theotokas “competition is based on the ability of the enterprise to provide high reliability” (Theotokas, 1999p2). The interview testimonial of the client and enterprise perception, confirm the rational for those relationships:

“ (...) if we want a specific development of new textile material, we have the reliability on the Pontechem to develop the new material. In this sense we expected also the U.E. tests applied in the new material and with the efficiency that results from their years of experience.” (Client interview

excerpts)

“(...) with our years of experience the possibility to fail is very low.” (Enterprise interview excerpts).

Also, “Reliability” (PB46) and “Product Quality” (PB2) emerges with a logical connection in the asset [Builds] Competitiveness (A16), relating with the accuracy of the transaction.

“(...) when we promise a solution for their problems we must do it right at first time (reliability) to guarantee our success. Also we have a European supplier the U.E tests are covered on the raw material. We have these conditions in relation to other enterprises. This gives us some competitiveness. We have no records of any material being delivered and classified as not complying with the requirements. The client have these guaranties, and therefore, they relate also, competitiveness with product quality ”(enterprise interview excerpts)

The Price (P22) emerges in [Uses] Years of experience (A11) and in [Builds] Competitiveness (A16), because price is “always a part of the customer’s value calculation” (Lapierre, 2001 p259).

“(...) the years of experience gave us technical knowledge which allowed us nulling certain costs that will be reflected in the price of the final product (...).”(enterprise interview excerpts).

Also, the perceived benefit, Price (P22) emerge in [Build] Percent of satisfaction (A27), because the enterprise must “adapt to customer needs and must set price with regard for the customer” (Lapierre, 2000 p259):

“(...) in fact, the client knows we do not practice prices outside the market. We present prices, which represents the client satisfaction. We offer a good price, not the cheapest. It is a fair price. Also, we show solutions for their requirements (e.g new materials), that are not excessive in cost.” (enterprise interview excerpts)

On the other hand and building the bridge to the client perception of the deliverables, the Pontechem CEO and his team responsible for Purchasing/Sales & Operations Planning, were able to understand how clients saw the most important deliverables, and how they correlate with PBs. As an example, the client did not value deliverable “Knowledge and Experience about the process” (DL4) (Fig.7), however, the client “reads” this deliverable as embedded in DL3 “Requirements for new collections”. The Pontechem CEO and the responsible of Purchasing/Sales & Operations Planning and taking into account the characteristics of the client, explained:

“(...) the client knows very little about the products. But indeed they relate with “Technical Competence” (PB47) and “Reliability” (PB46) and also “Service Quality” (PB4). We think the client did not value this deliverable, because he doesn’t negotiate with the supplier” (enterprise interview excerpts)

Making the zoom on the Fig. 7, on “Knowledge and Experience about the process” (DL4), a new logical connection emerges with “Service Quality” (PB4), Fig. 8.

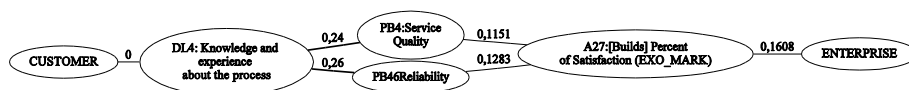


Fig. 8 – Zoom on DL4

According to the literature, the definition on service quality, relates to the procedures by the enterprise in two dimensions: technical and functional, (Grubor et al.). At a functional dimension includes an assessment of how well a delivered service conforms to the client's expectations, namely uses, receives, and pays perceived for a certain service and all aspects of a service delivery process. At the technical dimension the client perceives and understands how the enterprise identifies problems to better assess client satisfaction. In this context, it is the enterprise role to assist clients and provide immediate services by informing, giving the knowledge and expertise required to provide the service.

"(...) the functional dimension is related with the sales, orders, bills. The technical dimension it also when the client have some doubts and ask for the prototypes that are not included in the collection and wait for an answer. (...)" (enterprise interview excerpts)

"Requirements for new collection" (DL3) and "Product Innovation" (DL5) have the same value to the client. The DL3 is defined, as the possibility of taking the samples to the client, and suggestions for some changes in the products.

"(...) It is obvious this deliverable (DL3) emerge with price. When there is a new collection or another specific requirement, there is a new table of prices. Sometimes the client wants to personalize the material. If the client wants the shoes to go to the market at a 20 € and we have a product a 30€ linear meter, the client must do the calculation to verify if it matches. That's why the DL3 is related with Product Customization (PB43)." (enterprise interview excerpts)

As a final conclusion of this work, the authors highlighted the following comments from the enterprise:

"(...) When we look at this scheme without looking at our suppliers what we can achieve and what we can adjust in case of failure, may be related to the quality service and the reliability. In Pontechem only buy and sell materials. If the customers feel dissatisfied with something, this model came to help clarify the points where we can focus on to reduce this dissatisfaction. We can work on service quality, reliability and without doubt in trust that appears with lower values because it is related to reliability. Have no influence on the product because we are not the producer. The characteristics of the products are not connected to us. The reliability and quality of service is related to us. In price can make small adjustments. (...)" (enterprise interview excerpts)

As a final result we were finally able to respond to the 2nd research question, "Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?" Figure 7 shows how these quantitative relations emerge and the interviews further validated and stressed the uncovered dependencies.

7. Limitations of the Research and Benefits to Managers

The research team performed this study by following clear methodological approach. However, some limitations have emerged and they should be acknowledged and addressed regarding the present study:

- As a main limitation we would highlight is the fact that people find that it is hard and subjective to assess the pair-wise comparisons using the Saaty scale. In this study the problem was overcome by having interviews with the involved persons, both at the target enterprise and with their client and how their endogenous and exogenous assets contribute to that perception. This has enabled

a further assessment of how reasonable and logic the achieved results were. This approach as well as the discussions of the outcomes with all parties involved, allowed the collection of testimonials that helped the validation of the proposed model.

- The fact that we have only one customer is not the best scenario, as it does not allow the desired approach to the construction of the triangular fuzzy numbers. This restriction results from limitations imposed in all our case studies where the company is usually reluctant in allowing interviews and long questionnaires with the customers/clients.

As main benefits of this exercise for a micro enterprise as this one, we would highlight that this tool may be useful to help these companies in the generation of an internal discussion of how their offer is perceived by their clients. In this case study it was interesting to realize that some unexpected variables emerged as being more relevant than initially thought. From the management perspective this brought up the awareness on those issues that may now be looked upon in a new way.

8. Future Research, Bringing Results into Practice

The unfolding of this research shows that this is a useful exercise for SMEs if they want to assess the value proposition of their offer and, moreover, if they want to understand the adequacy of their enterprise assets to supporting the desired value proposition. This case study as well as the previous one's, revealed that awareness increases on issues that were previously disregarded. As future research we foresee the development of a tool for Micro companies and SMEs, which would allow users in the enterprise to build a model combining both the internal and the perspective of their clients.

9. Conclusion

This research builds on the different dimensions of the value creation analysis comprising the asset utilization, value conversion, value enhancements, the transaction's perceived value and the social value. The authors are aware that members of the organization may have different understanding of the perceived value of the enterprise offer. Time also has a direct impact in the perceived value, from the pre-purchase to the post-purchase phases. In this research, we proposed a Conceptual Model Decomposing Value for the Customer, combining several concepts, from the marketing area we have the concept of Value for the Customer, from the collaborative networks area we have the perspective of the enterprise life-cycle and the environment characteristics and from the intellectual capital area we have the concept of the value networks. This research proposed a quantitative model for the Value for the Customer that was applied in a case study of an enterprise in footwear industry (Pontechem) aiming at understanding the components of its Value Proposition. The case study allowed the validation of the proposed model constructs and their relations. Interview testimonials enabled the validation of the answers to the 1st research questions. The quantitative model was then derived and the final results computed into a matrix representing the degree of relevance among pairs of assets/Perceived Benefits. This was done independently both from the enterprise and the client perspective, thus enabling the connection between endogenous and exogenous assets and perceived benefits and sacrifices, which, in its turn enabled the response to the 2nd research question. Interviews and further literature were used to validate the achieved results.

Finally, we would add that the merits of this approach seem evident from the contact with the Pontechem as it provides a structured approach for enterprises to know and understand the customer needs and how these relate to their endogenous and/or exogenous assets, therefore enabling the better adequacy of their value proposition.

“Looking to these results it was very interesting making this analysis. This model clarifies some points, where we could focus to improve client satisfaction.”

This enterprise knows very well their client’s needs. The results revealed common findings related with the relevance of each exchanged deliverables. The most relevant deliverable from both perspectives was “Product innovation”. As stated in the final interview:

“(…) the model and the quantitative method becomes useful for the company, we had never realize how the technical competence was linked with the DL5 and DL4. It is good to know, we are well prepared for the technical challenges in innovation” (enterprise interview excerpts)

This novel proposed approach revealed its usefulness by uncovering disregarded connections between assets used and/or built in the foreseen exchange of deliverables and perceived benefits / sacrifices in the context of the enterprise offer value proposition, thus allowing the enterprise further discussion about these issues.

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References

- November de 2012. Análise Setorial da Indústria do Calçado
- Aggarwal, R. & Singh, S. 2013. AHP and Extent Fuzzy AHP Approach for Prioritization of Performance Measurement Attributes. *World Academy of Science, Engineering and Technology*, 73, 145 - 151
- Ahmad, N., Berg, D. & Simons, G. R. 2006. The Integration of Analytical Hierarchy Process and Data Envelopment Analysis in a Multi-Criteria Decision-Making Problem. *International Journal of Information Technology & Decision Making* 5, 263-276
- Ahmad, N. & Laplante, P. A. 2009. Using the Analytical Hierarchy Process in Selecting Commercial Real-Time Operating Systems. *International Journal of Information Technology & Decision Making*, 8, 151-168
- Allee, V. 2000a. Reconfiguring the value network. *Journal of Business strategy*, 21, 36-39
- Allee, V. 2000b. The value evolution: addressing larger implications of an intellectual capital and intangibles perspective. *Journal of intellectual capital*, 1, 17-32

- Allee, V. 2002b). A value network approach for modeling and measuring intangibles. *Proceedings Transparent Enterprise, Madrid*
- Allee, V. 2002a). A Value Network Approach for Modeling and Measuring Intangibles. *Presented at Transparent Enterprise, Madrid, November*
- Allee, V. 2008a. "Value Network Analysis and Value Conversion of Tangible and Intangible Assets." 9, 5-24
- Apiccaps. 2008. *Footure 2015* [Online]. <http://www.apiccaps.pt/web/guest/home>
- Blocker, C. P. & Flint, D. J. 2007. Exploring the dynamics of customer value in cross-cultural business relationships. *Journal of Business & Industrial Marketing*, 22, 249-259
- Chang, D.-Y. 1996. Applications of the extent analysis method on fuzzy AHP. *European Journal of Operational Research*, 95, 649-655
- Chen, H. 2004. *A research based on fuzzy AHP for multi-criteria supplier selection in supply chain*. Master, University of Science and Technology
- De Toni, A. & Tonchia, S. 2003. Strategic planning and firms' competencies: traditional approaches and new perspectives. *International Journal of Operations & Production Management*, 23, 947-976
- Desarbo, W. S., Jedidi, K. & Sinha, I. 2001. Customer value analysis in a heterogeneous market. *Strategic Management Journal*, 22, 845-857
- Dubé, L. & Paré, G. 2003. Rigor in information systems positivist case research: current practices, trends, and recommendations. *Mis Quarterly*, 597-636
- Eisenhardt, K. M. & Graebner, M. E. 2007. Theory building from cases: opportunities and challenges. *Academy of Management Journal*, 50, 25-32
- Flint, D. J., Woodruff, R. B. & Gardial, S. F. 1997. Customer value change in industrial marketing relationships - A call for new strategies and research. *Industrial Marketing Management*, 26, 163-175
- Flint, D. J., Woodruff, R. B. & Gardial, S. F. 2002. Exploring the phenomenon of customers' desired value change in a business-to-business context. *Journal of Marketing*, 66, 102-117
- Grubor, A., Salai, S. & Leković, B. Service Quality As A Factor Of Marketing Competitiveness
- Herrera Umaña, M. F. & Osorio Gómez, J. C. 2006. Modelo para la gestión de proveedores utilizando AHP difuso. *Estudios Gerenciales*, 22, 69-88
- Hevner, A. R., March, S. T., Park, J. & Ram, S. 2004. Design science in information systems research. *MIS Q.*, 28, 75-105
- Huber, J., J. Lynch & Al, E. 1997. Thinking About Values in Prospect and Retrospect: Maximising Experience Utility. *Marketing Letters*, 8, 323-334
- Jalili, M. & Rezaie, K. 2010. Quality principles deployment to achieve strategic results. *International Journal of Business Excellence*, 3, 226-259
- Komulainen, H., Mainela, T., Tähtinen, J. & Parhi, P. Expected, realized and potential value in a new service setting. *Proceedings of the 21st Annual IMP Conference, Rotterdam, Netherlands, 1-3 September, 2005*. Sage, 1-19
- Komulainen, H., Mainela, T., Tähtinen, J. & Ulkuniemi, P. 2007. Retailers' different value perceptions of mobile advertising service. *International Journal of Service Industry Management*, 18, 368-393
- Lai, A. W. 1995. Consumer Values, Product Benefits and Customer Value: A Consumption Behavior Approach. *Academic Journal*, 22, 381

- Lapierre, J. 2000. Customer-perceived value in industrial contexts, *Journal of Business & Industrial Marketing*, MCB UP Ltd. , 15 122 - 140
- Lapierre, J. 2001. Development of measures to assess customer perceived value in a business-to-business context. *Advances in Business Marketing and Purchasing*, 243 - 286
- LM Camarinha-Matos & H. Afasarmanesh 2008a. Collaborative Networks: Reference Modeling. *Springer Science+Business Media, LCC*
- LM Camarinha-Matos & Afasarmanesh, H. 2008c. Collaborative Networks: Reference Modeling. *Springer Science+Business Media, LCC*. for Collaborative Networks. . *Collaborative Networks: Reference Modeling*, 83-112
- Lusa 2012. Portugal tem cinco por cento das microempresas da UE 16-01-2012 ed. CONFAGRI
- Nicola, S., Pinto Ferreira, E. & Pinto Ferreira, J. J. Value Model For Supporting Negotiation In Collaborative Networks. *In: ISAÍAS, P. K. A. P., ed. IADIS - International Conference, 2010. 474-478*
- Nicola, S., Pinto Ferreira, E. & Pinto Ferreira, J. J. 2012. A Novel Framework For Modelling Value For The Customer, An Essay On Negotiation. *International Journal of Information Technology & Decision Making*
- Nukala, S. & Gupta, S. M. A fuzzy AHP based approach for selecting potential recovery facilities in a closed-loop supply chain. *Proceedings of the SPIE International Conference on Environmentally Conscious Manufacturing V*, Boston, Massachusetts, 2005. 58-63
- Oliveira, M. A.-Y. & Pinto Ferreira, J. J. 2011. Facilitating qualitative research in business studies: Using the business narrative to model value creation,. *African Journal of Business Management Decision*, 5, 68-75
- Osterwalder, A. 2004. The business model ontology: A proposition in a design science approach. *Institut d'Informatique et Organisation. Lausanne, Switzerland, University of Lausanne, Ecole des Hautes Etudes Commerciales HEC*, 173
- Parasuraman, A. 1997. Reflections on gaining competitive advantage through customer value. *Journal of the Academy of Marketing Science*, 25, 154-161
- Peng, Y., Kou, G., Wang, G., Wu, W. & Shi, Y. 2011. Ensemble of software defect predictors: an AHP-based evaluation method. *International Journal of Information Technology & Decision Making*, 10, 187-206
- Rahikka, E., Ulkuniemi, P. & Pekkarinen, S. 2011. Developing the value perception of the business customer through service modularity. *Journal of Business & Industrial Marketing*, 26, 357-367
- Santos, A. S. 2014. Empresas vão pagar taxas de 19% em 2018. *Jornal Expresso. Economia*
- Santos Pereira, S. 2013. Exportações: Empresas de calçado antecipam subida das vendas em 2013 *Económico*
- Uлага, W. 2003. Capturing value creation in business relationships: A customer perspective. *Industrial Marketing Management*, 32, 677-693
- Vahidnia, M., Alesheikh, A., Alimohammadi, A. & Bassiri, A. 2008. Fuzzy analytical hierarchy process in GIS application. *The International Archives*

of the Photogrammetry, Remote Sensing and Spatial Information Sciences,
37, 593-596

Wang, Y.-M., Luo, Y. & Hua, Z. 2008. On the extent analysis method for fuzzy AHP and its applications. *European Journal of Operational Research*, 186, 735-747

Woodall, T. 2003. "Conceptualising Value for the Customer: an Attributional, Structural And Dispositional Analysis". *Academy of Marketing Science Review.*, 12

Zeithaml, V. A. 1988. Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. *Journal of Marketing*, 52, 2 - 22

3 General Discussion

3.1 Introduction

The two research questions were critical in framing the problem for this project. In the beginning these questions were much discussed and suffered several iterations and finally reached the following phrasing:

1. How can the Value for the Customer be modelled?
 - 1.1 How is this value built on top of assets endogenous and exogenous to the organization?
 - 1.2 How do endogenous and exogenous assets influence the Value for the Customer?"
2. Can we derive a formal mathematical model that provides for the quantitative handling of the proposed model?

The papers presented answered to these questions with the support of the case studies and the continuous literature review. In this chapter we would like to avoid repeating the discussion that unfolded along those papers. We would like to look at the overall achievements and make explicit the contributions of this research to the body of knowledge.

3.2 Contribution to the Body of Knowledge

The following authors discussed and studied the concept of Value and of Perceived Value:

- (Zeithaml, 1988) From a customer perspective, "customer value is what they get benefits relative to what they have to give up" (costs or sacrifices).
- (Day, 1990) Perceived customer value "represents the difference between customer's perceived benefits and customer's perceived costs".
- (Lai, 1995) "Customer Value focuses on the buyer's evaluation of product purchase

- at the time of buying". The model integrates "cultural value, personal values, consumption values and product benefits".
- (Treacy and Wiersma, 1995) Value is the "sum of benefits received minus the costs" incurred by the customer in acquiring a product or service.
- (Sheth et al., 1991) Identified five consumption values – "functional", "social", "emotional", "epistemic" and "conditional" which consumer purchase.
- (Huber et al., 1997) Believes that benefits and costs are defined in terms of consumer's perceptions in the activities of acquisition, consumption and maintenance.
- (Holbrook, 1994) Customer value is defined as an "interactive relativistic preference and experience".
- (Flint et al., 1997) "Perspectives of value can be classified as dealing with value, desired value and value judgment."
- (Woodruff, 1997) "Customer value is a customer's perceived preference for and evaluation of those product attributes, attribute performances and consequences arising from use that facilitate achieving the customer's goals and purposes in use situations."
- (Lapierre, 2000) Develop a scale to measure customer perceived value: called the "key drivers" - benefits and sacrifices.
- (Lapierre, 2001) Customer perceived value can be defined as the "difference between the benefits and sacrifices perceived by the customers in response to their expectations, that is their needs and wants".
- (Evans, 2002) "Value can be defined simply as the ratio of perceived benefit to perceived cost".
- (Khalifa, 2004) "The value exchange model is basically a give-and-take model or a benefits-costs model."
- (Sánchez-Fernández and Iniesta-Bonillo, 2007) Value is an "outcome on an evaluative judgment". Value implies a trade-off between benefits and sacrifices; moreover, it implies an interaction between a customer and a product or a service".
- (Smith and Colgate, 2007) Four major types of value that can be created by organization: "functional/instrumental; experiential/hedonic: symbolic/expressive; cost/sacrifice".
- (Lindic and Silva, 2011) Perceived value comprises two concepts the perceived benefits and perceived costs. "Value=benefits minus costs."

In this context, and in the scope of perceived value, we aimed at providing a modelling framework and a quantitative model that would make explicit the sources of value perception. The following quotation stresses how this research aimed at contributing to the body of knowledge in the:

"(...) The perspectives "Value for the Customer" and "Perceived Value" were explored in depth in Refs. 4 and 15, but the decomposition of value is not dissected and broken down into its components, namely the firm assets used and build in the construction of the exchanged value, whether internal or external to the company or organization. For this reason we seek the integration of the above definitions with concepts that stem from research areas such as value networks and collaborative networks. (...)" Paper III (p 28).

The contribution of this research to the body of knowledge may be structured along the following dimensions:

1. The Conceptual Model where the relationships between the different components of the model are listed and related. (Papers III, IV and V)

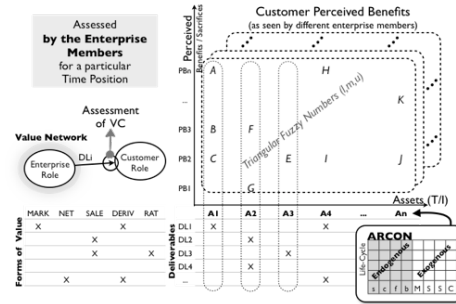


Figure 2 - Customer Perceived Value assessed by the Enterprise Members for a particular Time Position (Fig.1 Paper V, p110)

2. The extension of the Conceptual Model to enable an easier interaction with the customer (by reducing the burden of task demanded from the customer). (Papers III, IV and V)

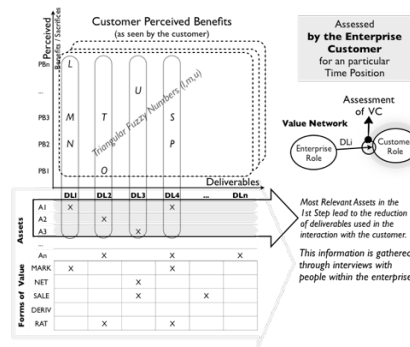


Figure 3 - Customer Perceived Value assessed by the Enterprise Customers for a particular Time Position (Fig.2 Paper V, p111)

3. The method for assessing and integrating of both the enterprise and the customer perspectives of the perceived value (Papers IV and V).

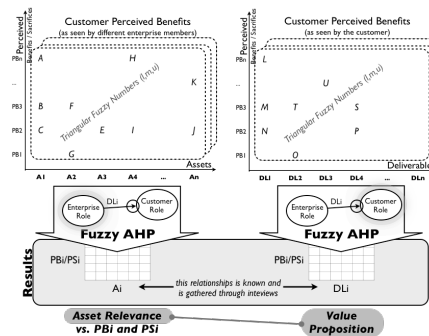


Figure 4- Wrap-up and assessment of results (Fig.3 Paper V, p112)

4. The supporting Fuzzy AHP quantitative formulation for this multi-criteria decision making problem (Papers III, IV and V).
5. The application of this concept to a negotiation setting (Paper III).
6. A computational implementation of the quantitative model that was developed in PHP using a MySQL database (Papers III, IV and V).

3.3 Limitations of the Study

Along this research we came across issues that we would like to highlight as possible limitations that need to be acknowledged and addressed regarding the present study. These limitations are:

- Decision-makers may find it hard and subjective to assess the pair-wise comparisons required using the Saaty scale. In this study the problem was overcome by having interviews with the involved persons, both at the target enterprise and with their clients. The interviews were conducted at the different stages of the process, enabling the step-wise validation and consistency of the achieved intermediate and final results. This approach has enabled a further assessment of how reasonable and logic the achieved results were. The discussions of the outcomes with all parties involved allowed the collection of testimonials that helped the validation of the proposed model.
- The companies offered some resistance in allowing the interviews with their customers.
- As a consequence of the previous point we had to reduce the customer's questionnaire dimension by reducing some of the variables (deliverables). We used the most relevant enterprise assets to select the deliverables to be assessed by the customer. We believe that this is a sensible approach. However, it would be interesting to further investigate the impact of this decision.
- The fact that we have only one customer is not the best scenario, as it does not allow the desired approach to the construction of the triangular fuzzy numbers. This restriction results from limitations imposed in all our case studies where the company is usually reluctant in allowing interviews and long questionnaires with their customers/clients.

Time is always an important issue in research; and we were constantly making visits to the company to understand their products and services and the company was not as available as we would have wished. Despite this expected difficulty, we are most thankful for their cooperation and for the cooperation of their customers.

As main benefits of this research, we would highlight that this tool may be useful to help these companies in the generation of an internal discussion of how their offer is perceived by their clients. In all case studies it was interesting to realize that some unexpected variables emerged as being more relevant than initially thought. From the management perspective this brought up the awareness on those issues that may now be looked upon in a new way.

4 Conclusion

As explained throughout this dissertation, the Conceptual Model for Decomposing Value for the Customer (CMDVC) is a novel framework for modelling value and a useful tool for enterprises to better understand how value is perceived by their customers in the context of the value proposition. This was, also, demonstrated on a negotiation scenario. The developed tool builds on a mathematical formulation for the CMDVC as well as on a computational implementation. We envisage the possibility of using this tool to assess perceived value of a particular offer and of redesigning the actual product/service offer to better meet the customers' needs through the preparation of a new proposal.

The proposed quantitative model revealed its usefulness by providing the discovery of previously disregarded connections between assets used and/or built in the foreseen exchange of deliverables and perceived benefits. In general, people of the enterprise would likely realize that some of their expectations regarding the customer perceived value may not be what they think and that adjustments are needed. This was evident from the comments we had of enterprise members and customer interviews (Paper III, IV, V):

"(...) this novel approach can be quite useful for CPMT to better manage its service offering and marketing approach." (CPMT enterprise)

"(...) looking at these results, it is very interesting to note what customers value and their perceptions of certain deliverables" (REMI enterprise)

"(...) the model and the quantitative method becomes useful for the company, we had never realize how the technical competence was linked with the DL5 and DL4." (Pontechem enterprise).

We thus hope that our research on Value for the Customer as well as concerning the development of the CMDVC will contribute not only to extend and improve the existence knowledge foundations. We further hope produce significant value to the enterprises, building the bridge between the Value for the Customer, customer perception of value and the enterprise endogenous and exogenous assets, whether it is applied to negotiation setting or in the context of the value proposition.

Future Research

The unfolding of this research shows that this is a useful exercise for SMEs if they want to assess the value proposition of their offer and, moreover, if they want to understand the adequacy of their enterprise assets to support the desired value proposition. These three case studies revealed that awareness increases on issues that were previously disregarded. We would like to extend our research in two complementary directions:

1. Develop a set of case studies to perform this study for different value temporal positions, namely at the point of the trade, in a post-purchase phase and after use experience.
2. Further research on how this concept can be used in the value creation for Micro and SMEs enterprises. This further research is also related with the previous one, in fact, the combination of different time positions might bring extra value for the enterprise, namely to the product development phase.

Bringing Results into Practice

The unfolding of this research shows that this is a useful exercise for SMEs if they want to assess the value proposition of their offer and, moreover, if they want to understand the adequacy of their enterprise assets to supporting the desired value proposition. The last two case studies, the only ones involving the customer, revealed that awareness increased on issues that were previously disregarded. As future development we foresee the development of a tool for Micro companies and SMEs, which would allow users in the enterprise to build a model of the value perception combining both the internal perspective and the perspective of their customers/clients.

The development of the proposed future research would mean that this tool would likely profit from integrating the application of the proposed tool to those different time positions.

5 References

- Allee, V. 2000a. Reconfiguring the value network. *Journal of Business strategy*, 21, 36-39
- Allee, V. 2000b. The value evolution: addressing larger implications of an intellectual capital and intangibles perspective. *Journal of intellectual capital*, 1, 17-32
- Allee, V. 2002a). A Value Network Approach for Modeling and Measuring Intangibles. *Presented at Transparent Enterprise, Madrid, November*
- Allee, V. 2008a. "Value Network Analysis and Value Conversion of Tangible and Intangible Assets." 9, 5-24
- Anderson, J. C., Narus, J. A. & Van Rossum, W. 2006. Customer value propositions in business markets. *Harvard business review*, 84, 90
- Baxter, P. & Jack, S. 2008. Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, 13, 544-559
- Eisenhardt, K. M. 1989. Building theories from case study research. *Academy of management review*, 14, 532-550
- Eisenhardt, K. M. & Graebner, M. E. 2007. Theory building from cases: opportunities and challenges. *Academy of Management Journal*, 50, 25-32
- EUROSTAT. 2008. *Special features on SMEs* [Online]. Available: http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/documents/Size%20class%20analysis_1.pdf
- Evans, G. 2002. Measuring and managing customer value. *Work study*, 51, 134-139

- Dubé, L. and G. Paré (2003). "Rigor in information systems positivist case research: current practices, trends, and recommendations." *Mis Quarterly*: 597-636
- Flint, D. J., Woodruff, R. B. & Gardial, S. F. 1997. Customer value change in industrial marketing relationships - A call for new strategies and research. *Industrial Marketing Management*, 26, 163-175
- Gerring, J. 2004. What is a case study and what is it good for? *American Political Science Review*, 98, 341-354
- Hassan, A. 2012. The Value Proposition Concept in Marketing: How Customers Perceive the Value Delivered by Firms—A Study of Customer Perspectives on Supermarkets in Southampton in the United Kingdom. *International Journal of Marketing Studies*, 4, p68
- Hevner, A. R., S. T. March, et al. (2004). "Design science in information systems research." *MIS Q.* 28(1): 75-105
- Holbrook, M. 1994. Ethics in consumer research: An overview and prospectus. *Advances in consumer research*, 21, 566-566
- Huber, J., J. Lynch & AL, E. 1997. Thinking About Values in Prospect and Retrospect: Maximising Experience Utility. *Marketing Letters*, 8, 323-334
- Khalifa, A. S. 2004. Customer value: a review of recent literature and an integrative configuration. *Management Decision*, 42 645 - 666
- Lai, A. W. 1995. Consumer Values, Product Benefits and Customer Value: A Consumption Behavior Approach. *Academic Journal*, 22, 381
- Lapierre, J. 2000. Customer-perceived value in industrial contexts. . *Journal of Business & Industrial Marketing*, MCB UP Ltd. , 15 122 - 140
- Lapierre, J. 2001. Development of measures to assess customer perceived value in a business-to-business context. *Advances in Business Marketing and Purchasing*, 243 - 286
- Lindgreen, A. & Wynstra, F. 2005. Value in business markets: what do we know? Where are we going? *Industrial Marketing Management*, 34, 732-748
- Lindic, J. & Silva, C. M. D. 2011. Value proposition as a catalyst for a customer focused innovation. *Management Decision*, 49, 1694-1708
- LM Camarinha-Matos, & Afasarmanesh, H. 2008c. ARCON Reference Models for Collaborative Networks. . *Collaborative Networks: Reference Modeling*, 83-112
- LM Camarinha-Matos, & H. Afasarmanesh 2008a. Collaborative Networks: Reference Modeling. *Springer Science+Business Media, LCC*
- usa 2012. Portugal tem cinco por cento das microempresas da UE 16-01-2012 ed. CONFAGRI
- Miller, D. C. & Salkind, N. J. 2002. *Handbook of research design and social measurement*, Sage

- Oliveira, M. A.-Y. & Pinto Ferreira, J. J. 2011. Facilitating qualitative research in business studies: Using the business narrative to model value creation., *African Journal of Business Management Decision*, 5, 68-75
- Rahikka, E., P. Ulkuniemi, et al. (2011). "Developing the value perception of the business customer through service modularity." *Journal of Business & Industrial Marketing* 26(5): 357-367
- Sánchez-Fernández, R. & Iniesta-Bonillo, M. Á. 2007. The concept of perceived value: a systematic review of the research. *Marketing Theory*, 7, 427-451
- Santos, A. S. 2014. Empresas vão pagar taxas de 19% em 2018. *Jornal Expresso*. Economia
- Sheth, J. N., Newman, B. I. & Gross, B. L. 1991. Why we buy what we buy: a theory of consumption values. *Journal of business research*, 22, 159-170
- Smith, J. B. & Colgate, M. 2007. Customer value creation: a practical framework. *The journal of marketing theory and practice*, 15, 7-23
- Sumantri, Y. & Lau, S. K. 2010. Desired and received customer value models in logistics service outsourcing
- Teece, D. J. 2010. Business models, business strategy and innovation. *Long Range Planning*, 43, 172-194
- Voss, C., Tsikriktsis, N. & Frohlich, M. 2002. Case research in operations management. *International Journal of Operations & Production Management*, 22, 195-219
- Woodall, T. 2003. "Conceptualising Value for the Customer: an Attributional, Structural and Dispositional Analysis". *Academy of Marketing Science Review*., 12
- Woodruff, R. B. 1997. Marketing in the 21st century customer value: The next source for competitive advantage (vol 25, pg 142, 1997). *Journal of the Academy of Marketing Science*, 25, 256-256
- Yin, R. K. 1999. Enhancing the quality of case studies in health services research. *Health Services Research*, 34, 1209
- Zeithaml, V. A. 1988. Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. *Journal of Marketing*, 52, 2 - 22