FACULTY OF ECONOMICS AND BUSINESS ADMINISTRATION

# Capability-Actor-Resource-Service: A conceptual modelling approach for value-driven strategic sourcing

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# Summary in English

This PhD research addresses a problem within strategic sourcing, which is a critical area of strategic management that is centered on decision-making related to procurement. Strategic sourcing is related to two disciplines: (i) procurement and supply management and (ii) strategic management. Sourcing is the strategic part of procurement that refers to tasks like determining cost saving and value-driven opportunities, choosing the most appropriate go-to market strategies, and selecting and evaluating suppliers for building long-term and short-term contractual relationships. Many companies face challenges in obtaining the benefits associated with effective strategic sourcing. Although the concept of strategic sourcing is fairly well recognized, managers are still challenged by many barriers to its implementation. The main problem is the lack of practical instruments (i.e., tools and techniques) to implement the value-driven management approach to strategic sourcing, while at the same time preparing companies for fact-based decision-making by delivering data management and data analytics capabilities. This is the problem which is addressed with this PhD research. To address this problem, the research goal has been defined as "develop a modeling approach that enables companies 1) to drive fact-based decision-making with respect to procurement data management and procurement analytics"; and 2) to implement strategic sourcing toward achieving value-driven targets". We apply conceptual modeling as our main solution approach to achieve the above research goal. We define three major areas where conceptual modeling can contribute to strategic sourcing decision-making: conceptualization, design and computer support. The proposed conceptual modeling approach is characterized by four different perspectives: (i) a way of thinking (i.e., a conceptual foundation), (ii) a way of modeling (i.e., a modeling language and method to use it), (iii) a way of working (i.e., a model-based analysis approach), and (iv) a way of supporting (i.e., a computer-aided design tool). The scope of PhD research is limited to the first three perspectives, while for the fourth perspective a solution architecture will be proposed as part of future research. This PhD dissertation is a paper-based dissertation consisting of six chapters. Three chapters (chapter 3, 4, 5) of this dissertation have been submitted to international peer-reviewed journals (chapter 4 is published and chapters 3 and 5 are accepted) and one chapter (chapter 2) has been published in the post-conference proceedings of an international workshop.

# 1

# Introduction

**Summary:** The introduction clarifies the research context (section 1.1), problem description (section 1.2), research objectives and solution approach (section 1.3), knowledge base (1.4), and research methodology (section 1.5). Furthermore, it provides an overview of the structure of this dissertation (1.6).

## 1.1 Research Context

Our PhD research addresses a problem within *strategic sourcing*, which is a critical area of strategic management that is centered on decision-making related to procurement. Strategic sourcing is related to two disciplines: (i) procurement and supply management and (ii) strategic management. To better clarify the context of our PhD research, we first position strategic sourcing within these two disciplines.

*Procurement* has gained importance in supply chain management due to factors such as globalization, increased added value in supply, and accelerated technological change. Vice versa, the growing importance of supply chain management has led to an increasing recognition of the strategic role of procurement (Anderson and Rask, 2003). Procurement has evolved from mere buying into strategic sourcing (Ellram and Carr, 1994); (Cooper and Ellram, 1993) and has recently been recognized as a critical driving force in the strategic management of supply chains (Chen et al., 2004); (Ellram and Liu, 2002); (Paulraj et al., 2006). Strategic sourcing recognizes that procurement is not just a cost function, but supports the firm's effort to achieve its long-term objectives like value creation and sustainability (Weele, 2009). Sourcing is the strategic part of procurement that refers to tasks like determining cost saving and value-driven opportunities, choosing the most appropriate go-to market strategies, and selecting and evaluating suppliers for building long-term and short-term contractual relationships.

*Strategic management* is the art and science of formulating, designing and evaluating strategic options and alternatives, which enable an organization to achieve its long-term objectives (David, 2001). Strategic management deals with survival and competitiveness in the long-term (Frynas and Mellahi, 2005). Strategic sourcing has become a critical area of strategic management that is centered on decision-making regarding an organization's procurement function such as spend management, choosing sourcing strategies, supplier selection and evaluation, value-driven management and sustainability management (Figure 1.1).

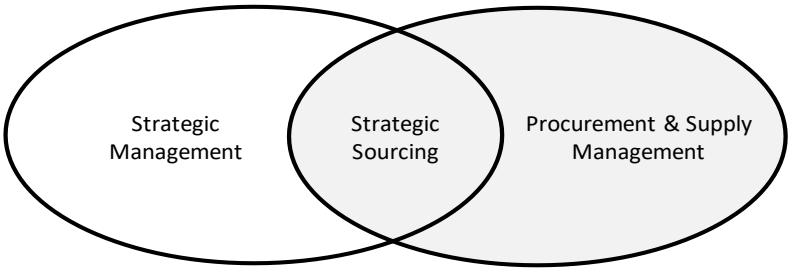


Figure 1.1. Positioning of strategic sourcing as the intersection of two management disciplines

## 1.2 Problem Statement

Many companies face challenges in obtaining the benefits associated with effective strategic sourcing. This research focuses on two organizational challenges, *fact-based decision-making* and *value-driven management*, which are recognized as being critical in today's practice of strategic sourcing.

From an organizational perspective, procurement data management is a core organizational challenge for chief procurement officers (CPOs) for realizing fact-based strategic sourcing decision-making (IBM, 2013); (Aberdeen Group, 2014). Fact-based decision-making means the ability to gain fact-based insights faster than the competition, and to turn those insights into good decision-making (Marr, 2013). Fact-based insights cannot be gained without facts, i.e., procurement data. Hence, to drive fact-based decision-making, organizations require two critical competencies, data management and data analytics. The data management competency is the ability to address issues of data architecture, extraction, transformation, movement, storage, integration, and governance. The data analytics competency is the ability to analyze data for answering key business questions through applying advanced techniques such as modeling (e.g., statistical, contextual, quantitative, predictive, cognitive, other emerging models), deep learning, simulation, data mining, and optimization. Procurement analytics uses procurement data systematically through techniques from applied analytical disciplines to drive strategic sourcing decision-making for planning, management, measurement and learning. Advanced procurement analytics provides the fuel for an organization to make better sourcing decisions faster (Finch et al., 2014); (LaValle et al., 2010).

In reality, a number of businesses have insufficient accurate and timely information about their spending patterns and suppliers. Most businesses

are challenged with spend analysis and need to manage vast volumes of internal and external supplier data due to the disparate nature of systems and data sources (IBM, 2013); (Aberdeen Group, 2014). With a large and increasingly global supply base and scattered data, most companies are overwhelmed with supplier information management and challenged to apply that information for procurement analytics to drive fact-based decision-making (Dhawan et al., 2011); (Dhawan et al., 2010).

On the other hand, in today's practice, procurement is strongly driven by a tactical spend management process aimed at cost saving targets, which is not able to support organizations in achieving strategic objectives like sustainable competitive advantage, value creation and long-term partnerships. A paradigm shift from a tactical way of thinking about sourcing to a more strategic way of thinking is needed by focusing on value-driven targets.

Strategic sourcing is traditionally seen as a sub-process of procurement as described in (Weele, 2009); (Cox, 2015) (Fig. 1.2). The procurement process starts with spend analysis and ends with payment and is composed of two distinct phases: sourcing and purchasing. Sourcing is the strategic part of procurement that refers to all activities from spend analysis to the contracting of suppliers and includes tasks like determining cost saving opportunities, choosing the most appropriate go-to market strategies, and selecting and evaluating suppliers for building long-term and short-term contractual relationships. Purchasing is the operational part of procurement that refers to all activities from purchasing to paying such as purchase requisition, purchase ordering, delivery acceptance and invoice payment. The sourcing phase encompasses the source-to-contract (S2C) sub-process of procurement with three executive steps: 1) spend analysis to collect and analyze spend data and then identify potential opportunities for cost reduction; 2) strategic sourcing to select the most appropriate go-to market sourcing strategies and then selection and evaluation of suppliers in alignment with the strategic goals of the firm; and 3) contract management for controlling and tracking the formal and legal agreements with suppliers to fully exploit the value of the contract arrangements. The purchasing phase encompasses the purchase-to-pay (P2C) sub-process of procurement with three executive steps: 1) the purchase requisition; 2) the purchase order and order confirmation; and 3) the delivery notification and invoice payment.

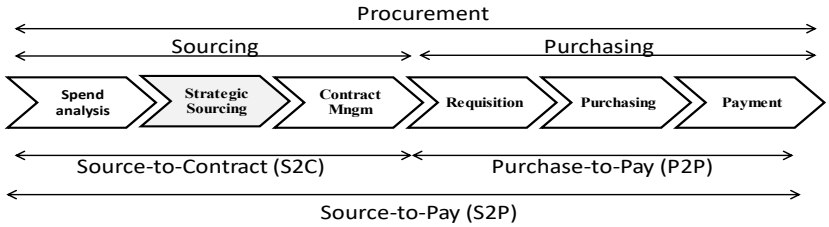


Figure 1.2.Procurement process

The strategic sourcing step within the S2C process is itself a sub-process including three activities (Fig. 1.3): i) Define purchasing categories and determine their positioning to classify purchases; ii) Determine dependency positioning to assess the buying strengths against the strengths of the supply market for each purchasing category; and 3) Identify purchasing strategies and recommendations for each purchasing category (Cox, 2015).

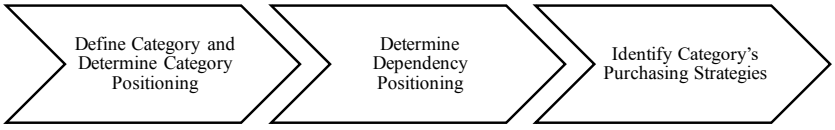


Figure 1.3. Traditional steps of strategic sourcing

*Step 1: Define purchasing categories and determine their positioning*. This step aims at classifying the different purchase categories for setting generic purchasing strategies. A purchase category is a grouping of materials, products, components or services that have similar supply and usage characteristics to meet business objectives. A typical technique used for this activity is the Purchasing Category Portfolio of Kraljic (1983) (Fig. 1.4). This model has had a broad influence on professional purchasing and is used widely by managers and consultants to determine sourcing options (Kamann and Bakker, 2004); (Gelderman, 2003). Kraljic's portfolio model is based on two dimensions: (1) the importance or criticality of the purchases (i.e., potential profit impact) and (2) the complexity of the supply market (i.e., supply risk). This approach classifies a firm's purchase categories into the four quadrants of a 2-2 matrix: bottleneck, non-critical, leverage and strategic items. The Kraljic matrix gives only one recommendation for each portfolio quadrant, namely: build partnerships (for long-term collaboration) with suppliers for the strategic quadrant; assure the supply (for short-term availability) for the bottleneck quadrant; exploit the buyer's power for the

leverage category (for short-term cost leverage) and ensure efficient processing of purchases (for short-term functional efficiency) for the non-critical category (Kraljic, 1983).

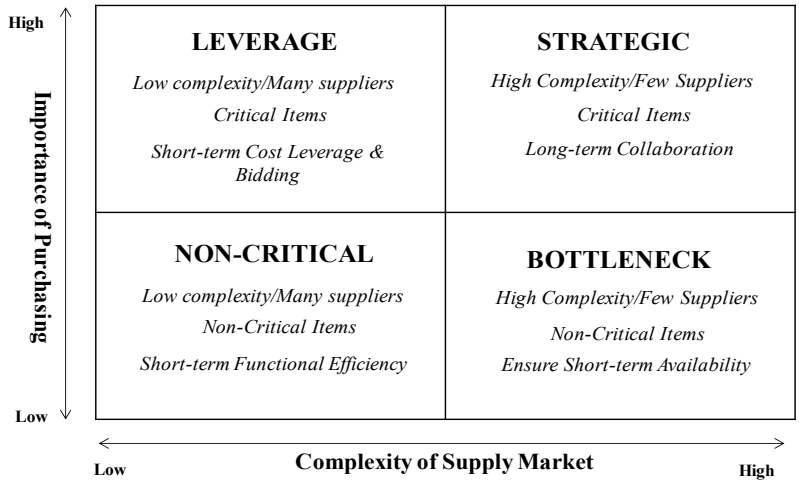


Figure 1.4. Kraljic purchasing category portfolio

Kraljic's purchasing category portfolio includes a simple analysis of purchase category value by focusing on the importance of purchased items. By applying spend analysis those purchase categories are identified that offer the greatest potential for cost savings. How different categories of purchased items help to create value for the organization is not taken into account. Kraljic's portfolio also includes a simple analysis of the complexity of the supply market through applying Porter's Five Forces approach.

*Step 2: Determine buyer-supplier dependency positioning*. Power and dependence are generally considered important for the understanding of buyer-supplier relationships (Caniels and Gelderman, 2005); (Cox et al., 2002); (Cox, 2004). A popular technique for capturing power and dependency in buyer-supplier relationships is the Cox Power Portfolio model (Fig. 1.5), which allows decision makers to analyze and cluster the relationships in four basic types of power structure: buyer dominance, supplier dominance, buyer-supplier interdependence (i.e., high mutual dependence), and buyer-supplier independence (i.e., low mutual dependence). The Cox power portfolio provides four different supply market characterizations (leverage, alliance, market and dependency) rather than the two positions of supply market complexity (high/low) used in Kraljic's matrix (Cox, 2001).

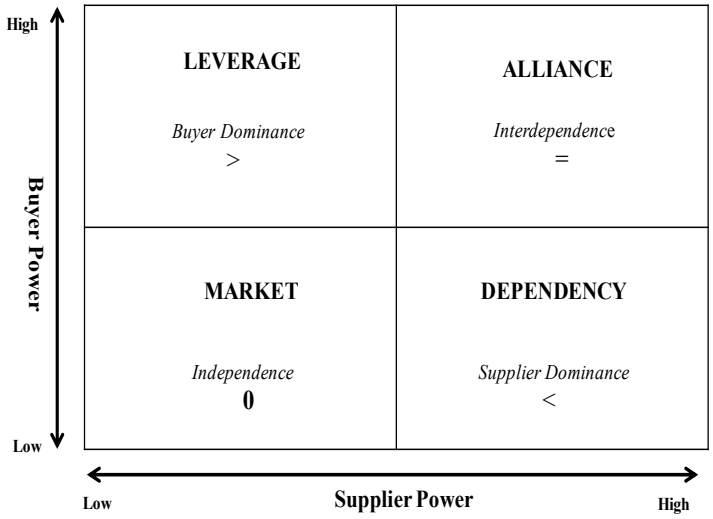


Figure 1.5. Cox power portfolio

The Cox power portfolio analysis of buyer-supplier positions and dependencies is based on metrics like the availability of alternative sources, supplier switching cost, buyer search cost, the critically of a purchasing category for both supplier and buyer and the financial magnitude of a purchasing category for both supplier and buyer.

*Step 3: Identify purchasing strategies and recommendations.* This step aims at choosing the right purchasing strategies, tactics and methods for the identified purchase categories. Given the techniques used in the previous steps, this choice can be made through applying the purchasing chessboard approach (Schuh et al., 2009) (Fig. 1.6). The purchasing chessboard overlays the four quadrants in the Kraljic purchasing category portfolio with the four dependency positions identified in the Cox power portfolio and assumes high buyer power for important purchase categories. For each quadrant, the chessboard defines one purchasing strategy, with 4 tactical levers and 16 methods, resulting in a 'chessboard' of 64 fields.

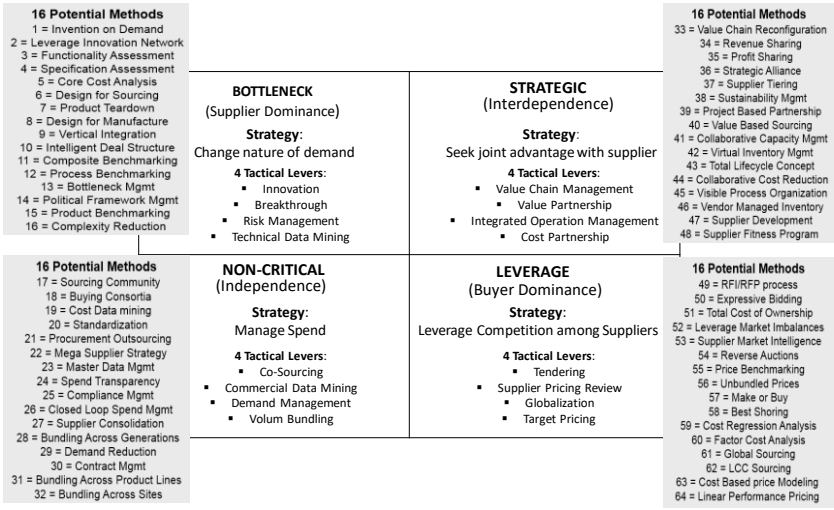


Figure 1.6. Purchasing chessboard

The reviewed activities and techniques for strategic sourcing focus strongly on cost savings targets through applying spend analysis, supply market analysis and positioning techniques. They have been criticized for approaching strategic sourcing as a tactical spend management process rather than as a process of strategic importance to the organization (Cox, 2014, 2015). Furthermore, the analyses do not consider all of the variables, which are required for assessing and evaluating the complexity of supply market, the value of purchasing categories, the power of suppliers against buyers, and strategic sourcing alternatives (Cox, 2014, 2015).

In summary, although the concept of strategic sourcing is fairly well recognized, managers are still challenged by many barriers to its implementation. The main problem is the *lack of practical instruments* (i.e., tools and techniques) to implement the value-driven management approach to strategic sourcing, while at the same time preparing companies for fact-based decision-making by delivering data management and data analytics capabilities. This is the problem that we address with our PhD research, as we will explain in the next section.

## 1.3 Research Goal and Solution Approach

To address the above organizational challenges, our research goal is defined as below:

***Research goal:*** *"develop a modeling approach that enables companies 1) to drive fact-based decision-making with respect to procurement data management and*

*procurement analytics"; and 2) to implement strategic sourcing toward achieving value-driven targets.*

Our research is performed in three iterations that produce intermediate research results and further refine and elaborate them towards achievement of our research goal.

**Iteration 1:** This iteration focuses on the systemic view, conceptual basis and foundation theories which will be used to develop the proposed modeling approach. Iteration 1 includes two studies as:

- **Study 1:** The first study aims at designing a conceptual basis to develop the proposed approach. The objective of this study is "to develop a conceptual solution for i) enabling centralization of procurement data; and ii) enabling the systemic exploration and evaluation of strategic sourcing alternatives".

- **Study2:** The second study targets the specification of a modeling discipline to develop the proposed approach. The objective of this study is "to define a modeling discipline which can provide (1) the systemic viewpoints to interpret complex sourcing phenomena; and (2) the outside-box models to specify the value-driven interactions of an enterprise (as a system) with other actors in its ecosystem".

**Iteration 2:** This iteration focuses on developing the first draft of the proposed modeling approach. Iteration 2 includes one study as:

- **Study 3:** The third study aims at developing the first draft of the proposed modeling approach including a modeling language and a method. The objective of this study is "to design i) a systemic view on strategic sourcing with emphasis on value creation to realize strategic sourcing as value-driven management.; and ii) a conceptual modeling language for the exploration of strategic sourcing alternatives to achieve value-driven targets".

**Iteration 3:** This iteration focuses on developing the final and formal version of the proposed modeling approach. Iteration 3 includes one study as:

- **Study 4:** The last study targets the development of a formal domain-specific modeling technique including modeling language and modeling procedure. The objective of this study is "to design a new domain-specific modeling technique, which (i) provides an analytically rigorous modeling approach for strategic sourcing, and (ii) allows the model user

to focus on the systemic exploration of strategic sourcing alternatives to achieve strategic goals".

We apply *conceptual modeling* as our main solution approach to achieve the above research goal and objectives. Conceptual modeling is a technique used in several research and application fields in Information Systems (IS) such as requirements engineering, database and information system design, knowledge management and enterprise modeling. Conceptual modeling has also been introduced in the Strategic Management and Business Model Innovation literature as a technique to generate business models. Osterwalder and Pigneur (2013) argue that methods and artifacts of IS research, like conceptual modeling, may contribute to strategic management research in three areas: conceptualization, design and computer support.

Inspired by (Osterwalder and Pigneur, 2013), we define three major areas where conceptual modeling can contribute to strategic sourcing decision-making: 1) Conceptualization: a conceptual model can support the identification, formalization, and visualization of all concepts that are relevant for value-driven strategic sourcing, which also facilitates centralization of procurement data; 2) Designing: the development of a conceptual model can support the design of a model-based technique for generating and assessing strategic sourcing alternatives toward achieving value-driven targets; 3) Supporting: a conceptual model can be the basis for developing computer-aided design tools, which assist in automating the process of generating and assessing strategic sourcing alternatives.

The proposed conceptual modeling approach is characterized by four different perspectives: (i) a way of thinking (i.e., a conceptual foundation), (ii) a way of modeling (i.e., a modeling language and method to use it), (iii) a way of working (i.e., a model-based analysis approach), and (iv) a way of supporting (i.e., a computer-aided design tool) (Seligmann et al., 1989). The scope of our PhD research is limited to the first three perspectives, while for the fourth perspective a solution architecture will be proposed as part of future research.

## 1.4 Knowledge Base

In the following, we introduce the different knowledge domains that are involved in developing the proposed conceptual modeling approach.

**Enterprise Engineering (EE)** is a well-known modeling discipline to design and develop an enterprise as a system. The EE modeling discipline

contributes to decision-making by providing 1) both holistic and reductionist views of the enterprise as a system; 2) different modeling techniques to describe and measure the purpose, function and construction of enterprises according to a construction-function view (ontological-teleological view). In our PhD research, we will refine the EE modeling discipline into a Service-oriented Enterprise Engineering (SoEE) modeling discipline for strategic (sourcing) decision-making. The proposed modeling discipline provides (1) a holistic view on the ecosystem of the enterprise considering the interaction of the enterprise with other actors; (2) a modeling language to interpret the (complex) phenomena of value-driven strategic sourcing such as value creation, capability configuration, resource integration, actor interactions; and (3) the appropriate enterprise viewpoints and models to specify the contributions of the enterprise to other systems in an eco-system for value creation.

**System Theory** is a theoretical perspective that analyzes a phenomenon seen as a whole and not as simply the sum of elementary parts. The focus is on the interactions and on the relationships between parts in order to understand an entity's organization, functioning and outcomes. This perspective implies a dialogue between holism and reductionism (Mele, Pels and Polese 2010). The interpretation of complex emerging phenomena requires interdisciplinary approaches, and should synthesize both a reductionist view (analyzing elements and their relations) and a holistic view (capable of observing the whole) (Barile & Saviano, 2011; Polese et al., 2016). Systems theory is receiving increasing attention in service research due to its contribution to understanding complex emerging phenomena such as value co-creation, service exchange and service systems (Barile & Saviano, 2010). The (general) system theory (von Bertalanffy, 1969) later developed into: (i) 'open system theory' (OST), which focused on the dichotomy between the system and its environment; and (ii) the 'viable systems approach' (vSa), which adopts a behavioral approach to business and its interactions with its environment (Beer, 1984). A viable system is defined as a system that survives, that is both internally and externally balanced, and that has mechanisms and opportunities to develop and adapt, and hence to become more and more efficient within its environment (Beer, 1984). We apply the Viable Systems Approach (vSa) as a theoretical foundation for the envisioned SoEE modeling discipline to support strategic decision-making. The SoEE modeling discipline founded on vSa 1) includes both holistic and reductionist views on the ecosystem of the enterprise; 2) provides a dynamic and subjective view to interpret complex phenomena like value creation and resource integration and actor interactions; and 3) specifies the contributions of an enterprise (as system) to other systems (sub-systems and super-systems) in its ecosystem to achieve strategic goals.

**Service-Dominant (S-D) Logic** offers an alternative perspective to the traditional, goods-dominant (G-D) logic paradigm, and has been recognized as a potential theoretical foundation on which a science of service can be developed (Vargo, Lusch and Akaka 2010). Regarding the contribution of system theory to service research, we see the ecosystem of the enterprise as a service eco-system. A service ecosystem is defined as a viable system of service systems connected (internally and externally) by mutual value creation interactions that are realized through service exchanges. This service ecosystem concept can be further described by means of the Service-Dominant Logic (S-D Logic), which is an important theoretical framework for the study of service systems (Lusch & Vargo, 2006). The S-D logic is an economic worldview that emphasizes the co-creation of value by means of service exchange and resource integration based on interaction and networked relationships (Vargo & Lusch, 2008). Furthermore, as shown by Polese and Di Nauta (2013), the vSa is a methodology capable of synthesizing the cultural/philosophical approach of S-D logic (as a way of thinking) with its research ground, represented by Service Science (SS) and thus vSa represents a useful framework for the interpretation of the complex phenomena involved in S-D logic (Polese & Di Nauta, 2013). The S-D Logic views a service system as a dynamic value co-creation configuration of resources that is connected internally and externally to other service systems by value propositions through resource integration and service exchanges (Vargo & Akaka 2009). While the traditional view on (tactical) sourcing is more a 'goods-dominant' worldview of suppliers and buyers as senders and receivers of goods (hence procurement's focus on realizing cost savings), the value-driven management view on (strategic) sourcing matches better the value co-creation interpretation of provider-customer relationships as in S-D Logic (Eltantawy et al. 2014). Therefore, a service ecosystem perspective for strategic sourcing introduces a way of thinking about strategic sourcing in terms of S-D Logic.

**Capability Modeling** has been used in both academia and practice as a powerful communication tool among technology and business specialists to describe and represent what the business does without attempting to explain how, why, or where the business uses its capabilities (Loucopoulos, 2015). The existing capability-oriented modeling approaches are used in a wide variety of application contexts like strategic alignment, business development and transformation, enterprise architecture integration, requirement and change management, service-oriented architecture, information system developments, and project and portfolio management. In the context of enterprise modeling, a business capability is a particular ability or capacity that a business may possess or exchange to achieve a specific purpose or outcome (Homann, 2006). On the other hand, the notion

of capability has been studied in the field of Strategic Management as a means to understand competitive advantage. Originally, emphasis was given to the resource-based view (Helfat and Peteraf, 2003) and more recently to the concept of dynamic capability (Teece, 2009), which are two fundamental theories involved in strategic sourcing. The term 'capability' emphasizes the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment (Teece, Pisano and Shuen, 1997). In our PhD research, we introduce a new capability-oriented enterprise modeling technique to realize a more rigorous exploration and analysis of strategic sourcing alternatives. Furthermore, we identify three principles to which such a modeling technique should adhere: (i) it should be oriented towards modeling the organization's capabilities to (re)configure resources (e.g., assets and competencies) to deliver value and achieve strategic goals; (ii) it should provide a stable and overarching view for fostering dialogue amongst managerial decision makers (e.g., chief procurement officer, chief strategic officer and strategic sourcing manager) about strategic sourcing (Peeters, 2016); (iii) it should consider capability sourcing as a strategic process for organizing and fine-tuning the firm's value chain to ensure competitive advantage and survivability (Bain & Company, 2005); (Loftin and Lynch, 2011).

**Strategic Management** is the process of formulating and implementing strategies to accomplish long-term goals and sustain competitive advantage. Strategic management is all about gaining and maintaining competitive advantage (David 2001). Getting and keeping competitive advantage is essential for long-term success in an organization. The Resource-Based View (RBV), Dynamic Capability View (DCV), and Relational View Theory (RVT) theories of organization present different perspectives on how best to capture and keep competitive advantage and how best to manage strategically. In the following, we explain these organization's theories and their contribution to strategic sourcing, which we incorporate in the theoretical foundation of our envisioned conceptual modeling approach.

**Resource-Based View (RBV)** is a theory that argues that resources are heterogeneously distributed across firms and are imperfectly transferred between firms. Firms can obtain above-average returns if they can use their existing resources to sustain competitive advantage by exploiting opportunities in the market or neutralizing threats from competitors' so-called strategic resources. Strategic resources enable organizations to sustain competitive advantage, if the resources are Valuable, Rare, Inimitable, and Non-substitutable (VRIN). Valuable resources increase

revenues or decrease costs. Valuable common resources can lead to competitive parity but not to advantage. Non-value-adding resources lead to competitive disadvantage. Rare resources are those possessed uniquely by one organization or by a few others only. Valuable rare resources can provide, at best, temporary competitive advantage. Inimitable resources are those that competitors find difficult to imitate or obtain. Only valuable, rare and hard-to-imitate resources can provide more than temporary competitive advantage. Non-substitutable resources are resources that do not have a strategic equivalent. Valuable, rare, hard-to-imitate resources and non-substitutable resources provide a sustained competitive advantage. Applying the RBV to a capability can be used to analyze whether resources are strategic (VRIN) within a capability or not. This analysis results in a decision on making the capabilities based on VRIN resources or buying the capabilities based on non-valuable resources (Barney, 1991; 2002).

**Dynamic Capability View (DCV)** is a theory that refers to the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environment (Teece, 2009). The dynamic capability of an organization is defined as "the capacity of an organization to purposefully create, extend, and modify its resource base" (Helfat et al., 2009). The DCV has evolved from the RBV. The RBV proponents argue that VRIN resources can be a source of superior performance, and may enable the firm to achieve sustained competitive advantage. The DCV has lent value to the RBV arguments as it transforms what is essentially a static view into one that can encompass competitive advantage in a dynamic context (Ambrosini et al., 2009). The DCV can be used to analyze whether capabilities critically underpin competitive advantage that others cannot imitate and obtain (core capability) or not (non-core capability). This analysis results in a decision on making core capabilities or buying non-core capabilities.

**Relational View Theory (RVT)** argues that the resources generating competitive advantage can span firm boundaries and are embedded in inter-firm relations. Therefore, the sources of competitive advantage are not only the internal resources owned by a firm itself but also the external resources in the relational networks (Arya and Lin, 2007); (Dyer and Singh, 1998); (Lavie, 2006). The RVT contributes to critical sourcing decisions through a paradigm shift in procurement and supply management from a transaction-oriented to a relationship-oriented approach (Turkmen, 2013). The relational view suggests that relation-specific assets, knowledge-sharing routines, complementary resources, capabilities, and effective governance between alliance partners can determine inter-organizational competitive advantages (Dyer and Singh, 1998).

Summarizing these three strategic management theories, we can state that, according to the RBV, only VRIN resources can provide a sustainable competitive advantage. The RVT adds to this that strategic sourcing should not only consider firm-level resources and capabilities, but also inter-firm level resources and capabilities based on networked relationships as the source of sustainable competitive advantage. Finally, according to the DCT, firms should also have the capability to continuously reconfigure their (VRIN) resource base to sustain their competitive advantage.

As a theoretical foundation for our intended conceptual modeling approach, we will create a mapping between service ecosystem concepts grounded in S-D Logic and vSa and strategic sourcing concepts derived from RBV, RVT, and DCT. We further develop our conceptual modeling approach as a SoEE modeling discipline for supporting the value-driven strategic sourcing of capabilities. Hence, 'capability' will be the central concept in the conceptualization underlying the envisioned modeling approach.

## 1.5 Research Methodology

This research employs the Design Science Research (DSR) methodology, which is an overarching research methodology for designing new artifacts such as constructs, models, methods and instantiations of these (Hevner, et al. 2004). DSR aims at the scientifically rigorous creation of new artifacts that solve problems relevant to practice and that contribute new knowledge which was acquired through the artifact's development and evaluation process (Hevner et al. 2004). DSR artifacts include constructs, models, methods, instantiations and design theories (Gregor and Hevner 2013). In this respect, the conceptual modeling approach that we develop includes (i) a new conceptualization, its semantic definition and meta-model which can be considered as a collection of constructs and models; (ii) a supporting method, and (iii) models and views as instantiations obtained through application of the modeling technique in case studies.

The DSR process model consists of six research steps (Peffers et al., 2007): (1) problem identification and motivation, (2) definition of solution objectives, (3) design and development, (4) demonstration, (5) evaluation, and (6) scholarly communication (see figure 1.7). Throughout our three iterations and four research studies, we ran through the different steps of this research process model. Below we summarize the activities performed in each of these steps across our different research iterations.

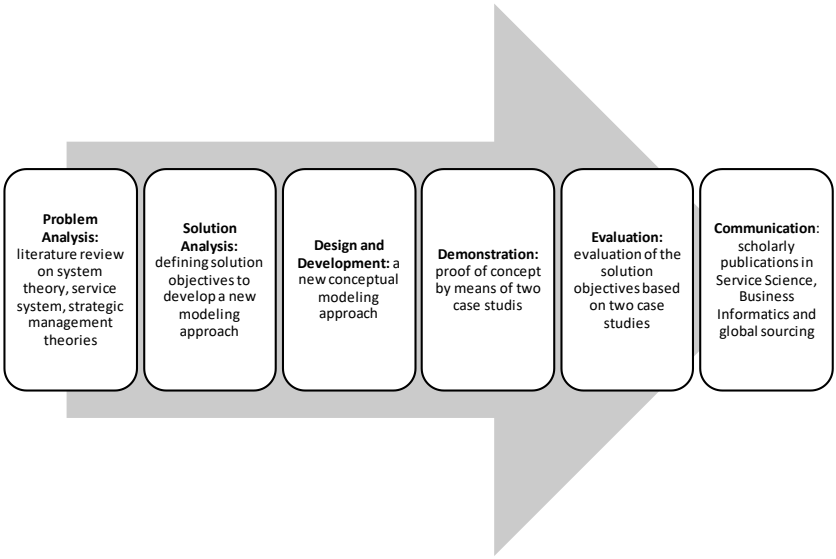


Figure 1.7. DSR Methodology Process (Peffers et al., 2007)

**Problem Identification and Motivation.** We conducted a literature review of theoretical and conceptual studies in four different domains: (i) procurement and supply management (e.g., strategic sourcing, tactical spend management and value-driven management); (ii) systems theory (e.g., viable systems approach); (iii) service science (e.g., service-dominant logic); and (iv) strategic management (e.g., resource based view, dynamic capability theory and rational view theory) to define the research problem and justify the value of working towards a solution. We define the research problem as the lack of practical instruments (i.e., tools and techniques) to implement strategic sourcing by addressing two organizational challenges, fact-based decision-making and value-driven management, in today's practice of strategic sourcing.

**Definition of Solution Objectives.** As a solution to the identified problem, we propose the design of a new conceptual modeling approach for strategic sourcing which should enable companies 1) to drive fact-based decision-making with respect to procurement data management and procurement analytics; and 2) to implement strategic sourcing toward achieving value-driven targets.

**Design and Development.** We design and develop a new conceptual modeling approach for systemic exploration of strategic sourcing alternatives. Such modeling approach realizes the contribution of conceptual modeling to

strategic management in three areas: conceptualization, design and computer support.

**Demonstration.** We used two case studies to demonstrate the use of our modeling approach for conceptualizing, designing, exploring, and analyzing strategic sourcing alternatives to achieve value-driven targets. These two cases are i) a case study of IT outsourcing in a large university hospital; and ii) a case study of sustainable procurement in a global materials technology company.

**Evaluation.** The goal of this phase is to observe and measure how well the proposed modeling approach supports implementing value-driven strategic sourcing. We reflect upon the case-study demonstration to evaluate concrete solution requirements that are defined based on the solution objectives defined in step 2.

**Communication.** The results of the PhD research are presented at conferences and submitted for publication in peer-reviewed journals within academic disciplines such as System Sciences (Rafati and Poels, 2013); (Rafati and Poels, 2017a), Service Science (Rafati and Poels, 2016); (Rafati and Poels, 2017b), Strategic Sourcing (Rafati and Poels, 2015), and Domain-Specific Modeling (Rafati, Roelens and Poels, 2017).

## 1.6 Structure of the PhD Dissertation

This PhD dissertation is a *paper-based dissertation* consisting of six chapters. The current chapter 1 is an introduction, which provides an overall view of the PhD research in terms of objectives, solution approach, methodology, and the relationship between the research presented in chapters 2, 3, 4 and 5. These four chapters are papers, which are published (i.e., chapter 2), accepted (i.e., chapters 3 and 4) or under review with international journals (i.e., 5). Chapter 6 is a conclusion, which provides a summary of the PhD research, its limitations, suggestions for future research, and an overview of research contributions and publications. Furthermore, an outline of a solution architecture for the way of supporting is presented in an appendix.

### Chapter 1. Introduction

The introduction clarifies the research context (section 1.1), problem description (section 1.2), research objectives and solution approach (section 1.3), knowledge base (1.4), and research methodology (section 1.5). Furthermore, it provides an overview of the structure of this dissertation (1.6).

### Chapter 2. Towards Model-Based Strategic Sourcing

This chapter focuses on the first research objective to develop a conceptual solution for enabling the centralization of procurement data and the systemic exploration of sourcing alternatives. From a service ecosystem perspective as a holistic view on strategic sourcing, a model-driven approach is proposed to explore sourcing alternatives based on a common language that enables companies to achieve procurement data management and analytics competencies for fact-based decision-making. This chapter is published in a Lecture Notes in Business Information Processing (LNBIP) volume containing the post-conference proceedings of the Global Sourcing of Information Technology and Business Processes workshop held in 2015 (Rafati and Poels, 2015).

### Chapter 3. Service-Oriented Enterprise Engineering: A modeling discipline based on the viable systems approach (vSa) for strategic sourcing decision-making

While chapter 2 presents a first iteration and overview of the solution design, chapter 3 presents a further iteration and elaboration of the solution design based on a theoretical foundation. This chapter clarifies the contribution of enterprise modeling to strategic sourcing decision-making by helping in conceptualization, design and exploration of multiple strategic options for better decision-making. In this chapter, we explore a solution approach that refines the existing Enterprise Engineering (EE) modeling discipline into a Service-oriented Enterprise Engineering (SoEE) modeling discipline, by founding it on a novel application of the Viable Systems Approach (vSa) towards strategic (sourcing) decision-making. The research of this chapter introduces a foundation (i.e., theories, viewpoints, views and models) for the research presented in the chapters 4 and 5. This chapter has been accepted as a paper for publication in the International Journal of Information Systems in the Service Sector (IJISSS) (Rafati and Poels, 2017a).

### Chapter 4. Value-Driven Strategic Sourcing Based on Service-Dominant Logic

Chapter 4 addresses the second research objective to design i) a systemic view on strategic sourcing with emphasis on value creation to realize strategic sourcing as value-driven management; and ii) a conceptual modeling language for the exploration of strategic sourcing alternatives to achieve value-driven targets. To help realize the new paradigm of value-driven strategic sourcing, this chapter describes the further development of the new conceptual modeling approach for exploring and evaluating

strategic sourcing alternatives based on a systemic view of value co-creation. In particular, this chapter strengthens the theoretical basis introduced in chapter 3 by constructing a mapping between service ecosystem concepts grounded in Service-Dominant Logic and the Viable Systems Approach and strategic sourcing concepts derived from the Resource-Based View Theory of competitive advantage, the Dynamic Capability Theory, and the Relational View Theory of cooperation and competition. Apart from presenting the strengthened theoretical foundation of the new conceptual modeling approach, this chapter also demonstrates by means of a case-study of sustainable procurement in a global materials technology company how a model-based approach helps implementing value-driven strategic sourcing. The case-study provides a proof-of-concept of the potential utility of our approach as it addresses specific problems with the company's current procurement practices. This chapter has been accepted as a paper for publication in the INFORMS Service Science journal (Rafati and Poels, 2017b).

### Chapter 5. Designing a domain-specific modeling technique for value-driven strategic sourcing

Building upon chapters 3 and 4, chapter 5 presents a final iteration of the solution design. This chapter focuses in particular on the third research objective to develop an analytically rigorous value-driven management approach for strategic sourcing. The research of this chapter aims to develop a capability-oriented enterprise modeling technique founded on the S-D Logic, which focuses on the systemic exploration of sourcing alternatives and emphasizes the delivery of value to achieve desired outcomes. This chapter is under a second round of review with the Enterprise Modelling and Information Systems Architectures (EMISA) journal (Rafati, Roelens and Poels, 2017).

### Chapter 6. Conclusion and Future Research

The conclusion gives an overview of the PhD research and provides an outlook on future research based on the limitations of the research. Furthermore, this chapter includes a summary of the contributions and publications. An outline of a solution architecture for the way of supporting is presented in an appendix.

## References

Aberdeen Group (2014). The CPO's Agenda for 2014... and Beyond, Technical report.

Ambrosini, V., Bowman, C., Collier, N. (2009) Dynamic capabilities: An exploration of how firms renew their resource base, British Journal of Management, vol. 20, no. S1, pp. S9-S24.

Andersen, P. H., & Rask, M. (2003). Supply chain management: new organisational practices for changing procurement realities. Journal of Purchasing and Supply management, 9(2), 83-95.

Arya, B. & Lin, Z. (2007). Understanding collaboration outcomes from an extended resource-based view perspective: the roles of organizational characteristics, partner attributes, and network structures. Journal of Management, 33(5), 697-732.

Bain & Company (2005). Capability Sourcing / Outsourcing/ Offshoring, http://www.bain.com/consulting-services/performance-improvement/capability-sourcing.aspx

Barile, S., & Saviano, M. (2011). Foundations of systems thinking: the structure-system paradigm.

Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of management, 17(1), 99-120.

Barney, J. B. (2002). Gaining and sustaining competitive advantage.

Beer, S. (1984). The viable system model: Its provenance, development, methodology and pathology. Journal of the operational research society, 35(1), 7-25.

Caniëls, M. C., & Gelderman, C. J. (2007). Power and interdependence in buyer supplier relationships: A purchasing portfolio approach. Industrial Marketing Management, 36(2), 219-229.

Chen, I. J., Paulraj, A., & Lado, A. A. (2004). Strategic purchasing, supply management, and firm performance. Journal of operations management, 22(5), 505-523.

Cooper, M. C., & Ellram, L. M. (1993). Characteristics of supply chain management and the implications for purchasing and logistics strategy. The international journal of logistics management, 4(2), 13-24.

Cox, A. (2001). The power perspective in procurement and supply management. Journal of Supply Chain Management, 37(1), 4-7.

Cox, A. (2004). The art of the possible: relationship management in power regimes and supply chains. Supply chain management: an international journal, 9(5), 346-356.

Cox, A. (2014). Improving Procurement Competence. Technical report, IIAPS.

Cox, A. (2015). Power Positioning & Sourcing Portfolio Analysis. Technical report, IIAPS.

Cox, A. (2015). Sourcing portfolio analysis and power positioning: towards a "paradigm shift" in category management and strategic sourcing. Supply Chain Management: An International Journal, 20(6), pp.717-736.

Cox, A., Ireland, P., Lonsdale, C., Sanderson, J., & Watson, G. (2002). Supply chains, markets and power: mapping buyer and supplier power regimes.

David, F. R. (2011). Strategic management: Concepts and cases. Peaeson/Prentice Hall.

Dhawan, R. (2010). Procurement analytics, the CIPS conference, Australia, Technical report.

Dhawan, R., Walters D., Bhattacharjya J. (2011). Procurement Models for the Future, the SMART Supply Chain Conference, Australia, Technical report.

Dyer, J. H. & Singh, H. (1998). The relational view: cooperative strategy and sources of interorganizational competitive advantage. Academy of Management Review, 23(4), 660-679.

Ellram, L. M., & Carr, A. (1994). Strategic purchasing: a history and review of the literature. Journal of Supply Chain Management, 30(1), 9-19.

Ellram, L. M., & Liu, B. (2002). The financial IMPACT of supply management. SUPPLY CHAIN MANAGEMENT REVIEW, V. 6, NO. 6 (NOV./DEC. 2002), P. 30-37: ILL.

Eltantawy, R., Giunipero, L., & Handfield, R. (2014). Strategic sourcing management's mindset: strategic sourcing orientation and its implications. International Journal of Physical Distribution & Logistics Management,44(10), 768-795.

Finch, G., Davidson, S., Kirschniak, C., Weikersheimer, M., Reese, C., Shockley, R. (2014). Analytics: The speed advantage; Why data-driven organizations are winning the race in today's marketplace, IBM Global Business Services.

Frynas, J. G., & Mellahi, K. (2015). Global strategic management. Oxford University Press, USA.

Gelderman, C. J. (2003). A portfolio approach to the development of differentiated purchasing strategies. Technische Universiteit Eindhoven.

Gregor, S., & Hevner, A. R. (2013). Positioning and presenting design science research for maximum impact. MIS quarterly, 37(2).

Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capability lifecycles. Strategic management journal, 24(10), 997-1010.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., & Winter, S. G. (2009). Dynamic capabilities: Understanding strategic change in organizations. John Wiley & Sons.

Hevner, R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. MIS quarterly, 28(1), 75-105.

Homann, U. (2006). A business-oriented foundation for service orientation. Microsoft Developer Network.

IBM Smarter Commerce (2013). Procurement: Optimizing savings and mitigating risk in a complex world, Technical report.

Kamann, D. J. F., & Bakker, E. F. (2004). Changing supplier selection and relationship practices: a contagion process. Journal of Purchasing and Supply Management, 10(2), 55-64.

Kraljic, P. (1983). Purchasing must become supply management. Harvard business review, 61(5), 109-117.

LaValle, S., Hopkins, M., Lesser, E., Shockley, R., Kruschwitz, N. (2010). Analytics: the new path to value; How the smartest organizations are embedding analytics to transform insights into action, IBM Global Business Services.

Lavie, D. (2006). The competitive advance of interconnected firms: An extension of the resource-based view. Academy of Management Review, 31(3), 638-658.

Loftin, R., Lync, R., & Calhoun, J. (2011). The Sourcing Canvas: A Strategic Approach to Sourcing Decisions, p. 13. Accelare Inc., USA.

Loucopoulos, P., Stratigaki, C., Danesh, M. H., Bravos, G., Anagnostopoulos, D., & Dimitrakopoulos, G. (2015). Enterprise Capability Modeling: Concepts, Method, and Application. In 2015 International Conference on Enterprise Systems (ES) (pp. 66-77). IEEE.

Lusch, R. F., & Vargo, S. L. (2006). Service-dominant logic: reactions, reflections and refinements. Marketing theory, 6(3), 281-288.

Marr, B. (2013). From Data to Decisions. FIVE STEPS TO EVIDENCE- BASED MANAGEMENT. Chartered Professional Accountants of Canada. Technical report.

Mele, C., Pels, J., & Polese, F. (2010). A brief review of systems theories and their managerial applications. Service Science, 2(1-2), 126-135.

Osterwalder, A., & Pigneur, Y. (2013). Designing business models and similar strategic objects: the contribution of IS. Journal of the Association for information systems, 14(5), 237.

Paulraj, A., Chen, I. J., & Flynn, J. (2006). Levels of strategic purchasing: impact on supply integration and performance. Journal of Purchasing and Supply Management, 12(3), 107-122.

Peeters, F. (2016). A Conceptual Framework for Visual Representations and Schematic Descriptions at the level of Strategic Management, Master of Science in de Toegepaste Economische Wetenschappen, Handelsingenieur, Ghent University.

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A design science research methodology for information systems research. Journal of management information systems, 24(3), 45-77.

Polese, F., & Di Nauta, P. (2013). A viable systems approach to relationship management in SD logic and Service Science. 73(2), 113-129.

Polese, F., Tommasetti, A., Vesci, M., Carrubbo, L., & Troisi, O. (2016). Decision-making in smart service systems: A viable systems approach contribution to Service science advances. In International Conference on Exploring Services Science (pp. 3-14). Springer, Cham.

Rafati, L., & Poels, G. (2013). Service Oriented Enterprise Engineering: Applying Viable System Approach (vSa) in Enterprise Engineering for Sourcing Decision Making. In Enterprise Distributed Object Computing Conference Workshops (EDOCW), 2013 17th IEEE International (pp. 124-129). IEEE.

Rafati, L., & Poels, G. (2015). Towards Model-Based Strategic Sourcing. In International Workshop on Global Sourcing of Information Technology and Business Processes (pp. 29-51). Springer International Publishing.

Rafati, L., & Poels, G. (2016). Service-dominant strategic sourcing: value creation versus cost saving. In International Conference on Exploring Services Science (pp. 30-44). Springer International Publishing.

Rafati, L., & Poels, G. (2017a). Service Oriented Enterprise Engineering: a modeling discipline based on the viable systems approach (vSa) for strategic sourcing decision-making. The International Journal of Information Systems in the Service Sector (IJISSS).

Rafati, L., & Poels, G. (2017b). Value-Driven Strategic Sourcing Based on Service-Dominant Logic. INFORMS Service Science journal.

Rafati, L., Roelens, B., & Poels, G. (2017). Designing a domain-specific modeling technique for value-driven strategic sourcing. Submitted to The International Journal of Enterprise Modelling and Information Systems Architectures (EMISA).

Schuh, C., Kromoser, R., Strohmer, M. F., Pérez, R. R., & Triplat, A. (2009). The Purchasing Chessboard™ (pp. 55-207). Springer Berlin Heidelberg.

Seligmann, P. S., Wijers, G. M., & Sol, H. G. (1989). Analyzing the structure of IS methodologies, an alternative approach. In Proceedings of the First Dutch Conference on Information Systems (pp. 1-2). Amersfoort, The Netherlands, EU.

Teece, D. (2009). Dynamic capabilities and strategic management. United States, New York: Oxford University Press.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic management journal, 509-533.

Turkmen, H. (2013). Scientific review of the relational view theory and its contribution to critical sourcing decision-making (Master's thesis, University of Twente).

Van Weele, A. J. (2009). Purchasing and supply chain management: Analysis, strategy, planning and practice. Cengage Learning EMEA.

Vargo, S. L., & Akaka, M. A. (2009). Service-dominant logic as a foundation for service science: clarifications. Service Science, 1(1), 32-41.

Vargo, S. L., & Lusch, R. F. (2008). From goods to service (s): Divergences and convergences of logics. Industrial marketing management, 37(3), 254-259.

Vargo, S. L., Lusch, R. F., & Akaka, M. A. (2010). Advancing Service Science service science with Service-Dominant Logicservice-dominant logic. In Handbook of service science (pp. 133-156). Springer US.

Von Bertalanffy, L. (1969). General system theory: foundations, development, applications (Revised Edition).

# 2

# Towards Model-based Strategic Sourcing

**Summary:** This chapter focuses on the first research objective to develop a conceptual solution for enabling the centralization of procurement data and the systemic exploration of sourcing alternatives.
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# Towards Model-based Strategic Sourcing

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**Abstract.** Strategic sourcing recognizes that procurement is not just a cost function, but supports the firm's effort to achieve its long-term objectives. Strategic sourcing has become a critical area of strategic management that is centered on decision-making regarding an organization's procurement activities such as spend analysis, capability sourcing, supplier selection and evaluation, contract management and relationship management. Many companies face challenges in obtaining the benefits associated with effective strategic sourcing. From an organizational perspective, procurement data management is a core organizational challenge for chief procurement officers (CPOs) for fact-based strategic sourcing decision-making. To address this challenge, we define research objectives to design a holistic view on strategic sourcing orientations and to develop a conceptual basis for enabling centralization of procurement data and enabling the systemic exploration of sourcing alternatives. From a service ecosystem perspective as a holistic view on strategic sourcing, we define a model driven approach to explore sourcing alternatives based on a common language (C.A.R.S) that enables companies to achieve procurement data management and analytics competencies for fact-based decision-making.

**Keywords:** model based strategic sourcing, strategic sourcing and procurement, service-dominant conceptual modeling, procurement data management, procurement analytics, strategic sourcing decision-making, fact-based decision-making.

## 2.1 Introduction

Procurement has gained importance in supply chain management due to factors such as globalization, increased added value in the supply chain, and accelerated technological change. Vice versa, the growing importance of supply chain management has led to an increasing recognition of the strategic role of procurement [1]. Procurement has evolved from mere buying into strategic sourcing [2]; [3] and has recently been recognized as a critical driving force in the strategic management of supply chains [4]; [5]; [6]. Strategic sourcing recognizes that procurement is not just a cost function, but supports the firm's effort to achieve its long-term objectives [7]. Strategic sourcing has become a critical area of strategic management that is centered on decision-making regarding an organization's procurement

activities such as spend analysis, capability sourcing, supplier selection and evaluation, contract management and relationship management.

Because of the increasing significance of procurement, strategic sourcing decisions become more important. Sourcing decisions are strategic decisions at the management level about finding opportunities for and delivering sustainable savings; choosing the right sourcing alternatives like outsourcing, insourcing and co-sourcing (i.e., the typical make-versus-buy decisions) to achieve (sustained) competitive advantage; selecting the right suppliers and evaluate their strategic and performance dimension for long-term and short-term partnerships; identifying solutions for mitigating supplier risk, improving supplier governance and enforcing supplier compliance. These decisions are critical for various procurement decision-makers such as chief procurement officers (CPOs), chief strategic officers (CSOs), strategic sourcing managers, category managers, product managers, purchasing managers, contract managers and supplier/customer relationship managers.

This chapter demonstrates how a model-based approach that we characterize as "service-dominant conceptual modeling" can support companies to achieve two key competencies, procurement data management and analytics, which allow moving the company toward fact-based strategic sourcing decision-making. The chapter is organized as follows: Section 2 describes the results of our literature review on fact-based decision-making in strategic sourcing and subsequently elaborates on our research objectives; Section 3 introduces the proposed approach to achieve these research objectives; Section 4 discusses the research methodology, which is Design Science Research; Section 5 introduces the theoretical foundation of the research as "the way of thinking"; Section 6 defines a strategic sourcing conceptualization and viewpoints as "the way of modeling"; Section 7 presents a model-based approach for exploring strategic sourcing alternatives as "the way of working"; and Section 8 outlines "the way of supporting" the proposed model-based strategic sourcing approach; Finally, Section 9 concludes the chapter.

## 2.2 Procurement Data Management and Analytics

To drive fact-based decision-making, organizations require two critical competencies, data management and data analytics. The data management competency is the ability to address issues of data architecture, extraction, transformation, movement, storage, integration, and governance. The data analytics competency is the ability to analyze data for answering key business questions through applying advanced techniques such as modeling

(e.g. statistical, contextual, quantitative, predictive, cognitive, other emerging models), deep computing, simulation, data mining, and optimization. Procurement analytics uses procurement data systematically through techniques from applied analytical disciplines to drive strategic sourcing decision-making for planning, management, measurement and learning. Advanced procurement analytics provides the fuel for an organization to make better sourcing decisions faster [8]; [9].

Many companies face challenges in obtaining the benefits associated with effective strategic sourcing. From an organizational perspective, procurement data management is a core organizational challenge for CPOs and CSOs [10]; [11]. A number of businesses have insufficient accurate and timely information about their spending patterns and suppliers. Most businesses are challenged with spend analysis and need to manage vast volumes of internal and external supplier data due to the disparate nature of systems and data sources [10]; [11]. With a large and increasingly global supply base and scattered data, most companies are overwhelmed with supplier information management and challenged to apply that information for procurement analytics to drive fact-based decision-making [12]; [13].

Based on our literature review, we have analyzed the observed challenge in obtaining procurement data management and analytics competencies by identifying problems at different organizational layers of procurement and strategic sourcing (Fig. 1). The first organizational layer is the application layer that consists of various software applications and information systems such as Accounts Payable, ERP and SAP applications; corporate purchasing cards; e-Procurement and e-Auctions systems; and online RFx (i.e. RFI, RFP and RFQ) applications to support operational procurement activities. Our review indicates that, due to the disparate nature of these applications, procurement data is often scattered across disconnected and diverse systems and data sources. The second layer is the process layer that consists of key procurement activities for strategic sourcing such as spend management, sourcing management, supplier selection and evaluation, contract management and relational management. Here our review learns that not all procurement processes are adequately supported by applications resulting in data that is not available in electronic form for analysis. Further, as decision-making within these processes could be better supported, there is an opportunity to integrate analytics into procurement processes to enable accurate and quick action. The third organizational layer is the data layer, which should be the core layer in the architecture for managing procurement data such as spends data, sourcing data, supplier data, contract data and relational data. Our review indicates that there is a lack of platform to consolidate all sources of data from the application layer and the process

layer to enable creative discovery and a lack of shared operational data store to accelerate the ability to ingest and analyze procurement data. The fourth, analytics layer of procurement includes techniques for spend analysis, cost-benefit analysis, market analysis, demand analysis, capability analysis and performance analysis, risk analysis and value chain analysis. This layer thus focuses on analyzing the procurement data and identifying the insights most likely to create a positive business impact. Here, due to the lack of advanced analytical techniques (e.g. descriptive, diagnose, predictive and prescriptive), tools and skills, procurement data cannot be translated into insights that can inform decision-making. Finally, the last layer is the decision layer that uses the insights derived from procurement data to create value for the organization. Here the need is felt to use visualization techniques to quickly understand and act on data for fact-based decision-making [8]; [9]; [10]; [14].

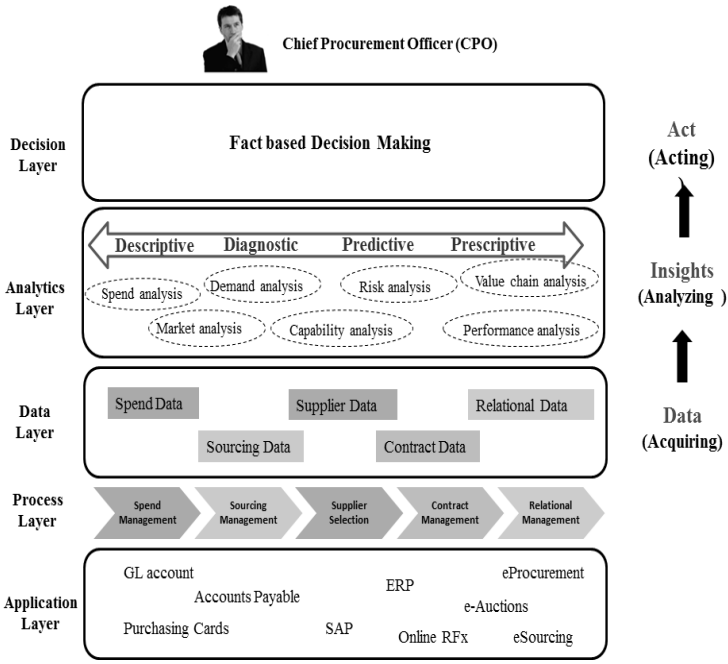


Figure 2.1. Organizational layers of procurement and strategic sourcing

To address the above organizational challenge and enable companies to obtain competencies with respect to procurement data management and procurement analytics, our research objectives have been defined as below:

**Objective 1:** Design a holistic view on strategic sourcing

**Objective 2:** Develop a conceptual basis for enabling centralization of procurement data

**Objective 3:** Develop a conceptual basis for enabling the systemic exploration and evaluation of strategic sourcing alternatives

The first research objective is designing a holistic view on the multidimensional phenomenon of strategic sourcing. Eltantawy et al. (2014) [15] distinguish four strategic sourcing orientations: learning, performance, planning, and the relational orientation. The learning orientation focuses on exploiting opportunities for new capabilities and products through capability and resource analysis. This means learning about how a firm's internal capabilities and resources can be combined with external (supplier) capabilities and resources to create competitive advantage. The performance orientation focuses on exploiting opportunities for value creation and cost saving through cost-benefit analysis, spend analysis, value chain analysis, demand analysis, and market analysis in order to achieve bottom-line results (operational goals). The planning orientation focuses on defining sourcing objectives through strategic analysis in order to achieve long-term strategic goals. Finally, the relational orientation focuses on managing the supply base and structuring the supply network through strategic and performance analysis to maintain beneficial long-term and short-term relationships. A holistic view on strategic sourcing is needed to integrate these various strategic sourcing orientations, which is a prerequisite to develop solutions for the centralization of procurement data.

The second research objective is elaborating this holistic view into a conceptual basis for enabling the centralization of procurement data. Integration of procurement data from disparate sources and getting the data in the right form for analysis is a perennial challenge in organizations. A lot of time is wasted trying to collate data from various systems and cleansing and organizing it. A common language and model of procurement data facilitates such centralization that is required for efficient and effective data architecture, storage, extraction, integration, governance, and hence enabling companies to obtain competency in procurement data management.

The third research objective is a further elaboration of our solution for enabling a systemic exploration and evaluation of strategic sourcing alternatives. A systemic exploration is a prerequisite for identifying multiple strategic sourcing alternatives and choosing the right sourcing alternative. We define strategic sourcing alternatives according to the four strategic sourcing orientations as performance alternatives, learning alternatives,

relational alternatives and planning alternatives. Performances alternatives are multiple options about spend costs, captured value (profit) and perceived value for what and by whom. Learning alternatives are various options based on the actor's abilities, capacities and assets to achieve (sustainable) competitive advantage by participation in a value network. Planning alternatives are options about sourcing objectives for operational, strategic, short-term and long-term goals. Finally, relational alternatives are procurement options for choosing suppliers for long-term and short-term partnerships and finding new customers to seize the market. Such systemic exploration is required for effective use of procurement data to compare and choose the right sourcing alternatives and support companies to obtain competency in procurement analytics.

## 2.3 Service-Dominant Conceptual Modeling

We present in this chapter a model-based strategic sourcing approach, which we characterize as *service-dominant conceptual modeling*, as the proposed solution approach for achieving our research objectives. The main properties of our solution approach can be described as follows:

- **Service ecosystem perspective as a holistic view on strategic sourcing orientations**: As will be explained in section 5, we propose a service ecosystem perspective as a holistic view on complex sourcing interactions such as resource integration, capability configuration, service exchange, value creation and capture, innovation, competitive advantage, profitability and sustainability. The proposed view integrates various strategic sourcing orientations, which is a prerequisite to develop solutions for centralization of procurement data and systemic exploration of sourcing alternatives.
- **Strategic sourcing conceptualization for procurement data modeling:** We propose the construction of a conceptualization of strategic sourcing that can be used as a language for modeling procurement data. We designed the strategic sourcing conceptualization by referring to Service-Dominant Logic as the foundation theory of our service ecosystem perspective as will be explained in section 5. Different kinds of procurement data (e.g. spend cost data, sourcing data, supplier data, contract data and relational data) can be identified based on the core procurement concepts and their attributes and relations. We believe that such identification through the proposed conceptualization based on an holistic view of strategic sourcing will help developing solutions for procurement data centralization, integration and standardization, thus enabling companies to achieve procurement data management competency.
- **Conceptual modeling as a way of exploring strategic sourcing alternatives:** We propose conceptual modeling as a technique for

exploring strategic sourcing alternatives. We introduce conceptual models as schematic descriptions [16] of sourcing alternatives and apply the proposed conceptualization as a common language for describing these models. The exploration of the alternatives is systemic as the underlying conceptualization of the models offers a holistic view of strategic sourcing according to the various orientations (i.e. learning, planning, performance and relational). Through the proposed conceptual modeling of strategic sourcing alternatives, procurement data can be identified for evaluating the sourcing alternatives, which enables companies to achieve procurement analytic competency by applying model-based analytical techniques and tools.

The solution approach is described in the rest of the chapter according to the four different perspectives proposed by Seligmann et al. (1989) [17]: as a way of thinking (i.e. principles for a systemic view of strategic sourcing) which addresses the first research objective, as a way of modeling (i.e. conceptualization of strategic sourcing) which addresses (partially) the second research objective, as a way of working (model-based exploration of strategic sourcing alternatives) which addresses the second and third research objectives, and as a way of supporting (model-based analytical techniques and tools) which we present as future research to further address the third research objective.

## 2.4 Research methodology

The research methodology that was applied to develop our solution approach was the Design Science Research Method (DSRM), which is the standard research methodology used in the Information Systems discipline for designing new artifacts that solve unsolved problems or improve upon existing solutions. Design science research artifacts include constructs, models, methods and instantiations of these [18]. Referring to the DSRM process model we distinguish the following research phases [19]: 1) **Problem Analysis Phase**: we conducted a literature review of theoretical and conceptual studies in various procurement and strategic sourcing domains to explore the research problem, justify the value of a solution, and define the research objectives. 2) **Solution Analysis Phase:** state-of-the-art Service Science research contributions to Strategic Sourcing [20]; [15] and Information Systems research contributions to Strategic Management [21] were investigated to shape a solution approach that has the potential to address the research problem. 3) **Design and Demonstration Phase**: we designed a model-based approach that can be characterized as *service-dominant conceptual modeling* to achieve the research objectives. We developed a proof-of-concept case based on a literature review in the healthcare domain to demonstrate the use of the proposed approach for

exploring strategic sourcing alternatives in an outsourcing scenario; 4) **Evaluation Phase:** the goal of this phase is to observe and measure how well the proposed approach supports companies to achieve procurement data management and analytics competencies for fact-based strategic sourcing decision-making. This evaluation will be performed through conducting case-study research. The evaluation phase is the next level of our research as we aim at translating our conceptual solution into a practical solution through the application of the envisioned tool support (part of our ongoing research). The current chapter is mainly focused on the first level of research (conceptual solution) through problem formulation, solution definition, design and demonstration, and a minimal scenario-based evaluation of the proposed conceptual solution.

In the remainder of this chapter, the emphasis is on the results of our Design Science Research study, which we present according to the four perspectives of Seligmann et al. (1989) [17] as discussed in the previous section.

## 2.5 Way of thinking: Service ecosystem

A systemic view on complex sourcing interactions (e.g. resourcing, capability configuration, service exchange and innovation, sustainability, value co-creation) is needed to integrate various strategic sourcing orientations (e.g. learning, planning, performance and relationship management orientations). Without such overview, it is difficult identifying the right procurement data and exploring various sourcing alternatives.

The interpretation of complex emerging phenomena is greatly facilitated by a system view that synthesizes both a reductionist perspective (i.e. analyzing elements and their relations) and a holistic perspective (i.e. being capable of observing the whole) [22]. The Viable Systems Approach (vSa) is a Systems Theory that is linked to complexity theories and has been developed as a behavioral approach to interpret business and its interactions with the environment [23]; [24]. A viable system is defined as a system that survives, that is both internally and externally balanced, and that has mechanisms and opportunities to develop and adapt, and hence to become more and more efficient within its environment [23]; [24]. The vSa is also increasingly getting attention in service research due to their contribution to understanding complex phenomena of the service (eco)system such as resource integration, value co-creation, service exchange and win-win interactions [25]; [26]. A service ecosystem is defined as a system of service systems connected (internally and externally) by mutual value creation interactions realized through service exchanges [27]. This ecosystem view is

founded on Service-Dominant Logic (S-D Logic), which is an important theoretical framework for the study of service systems [28]; [29]. The S-D Logic views (Fig. 2) a service system (SS) as a dynamic value co-creation configuration of resources, with at least one operant resource, that is connected internally and externally to other service systems by value propositions through service exchanges [30]. It highlights a paradigm shift away from the Goods-Dominant Logic (G-D Logic) in the service science. This paradigm shift from the G-D Logic to the S-D Logic implies a change in the service perspective from a static view to a dynamic view, which is formalized in the vSa as a structure-system approach [31]; [32]. According to the vSa, the complex phenomena of a service system (e.g. resource integration, service exchange, value co-creation) can be observed from a dual perspective focusing on a structure-based view (StBV) or a systems-based view (SyBV). The StBV is a static and objective perspective that is useful for describing and measuring a phenomenon by focusing on its components and relations. The SyBV is a dynamic and subjective perspective that is useful for interpreting the dynamic nature of a phenomenon by focusing on its interactions [33].

Consequently, we apply a *service ecosystem perspective (founded on S-D Logic)* as a system-structure view *(according to vSa)* on complex strategic sourcing interactions at micro levels (e.g. dyadic exchange encounter), meso levels (e.g. local), and macro levels (e.g. global) [34]. According to this perspective, vSa provides a structure-system view on strategic sourcing to describe and interpret its static and dynamic nature (e.g. sourcing components, relations and interactions). Moreover, S-D Logic provides a framework for thinking more clearly about the service system and its role in competition [15] and survivability [35]. The traditional view on (tactical) sourcing was a G-D Logic view that suppliers and customers were merely senders and receivers of goods. On the contrary, today's view on (strategic) sourcing derives from value co-creation as a central premise to the S-D Logic [15].

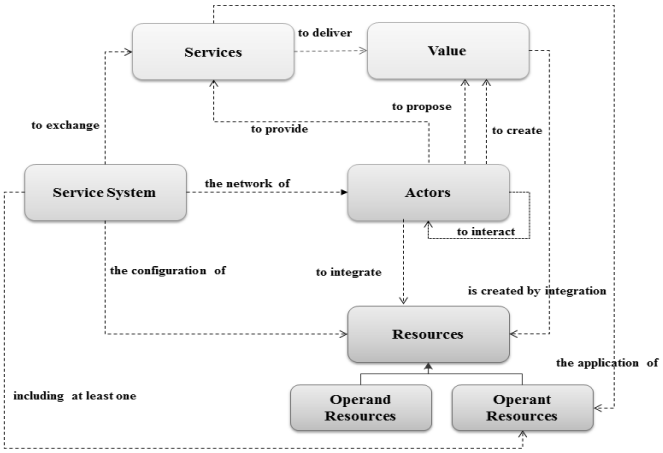


Figure 2.2. S-D logic concepts and relations

A service ecosystem perspective of strategic sourcing introduces a way of thinking about strategic sourcing in terms of S-D Logic. We observe a clear similarity between S-D Logic concepts (fig. 2) and strategic sourcing concepts, as defined below in Table.1 [20]; [36]; [37]; [38]; [39]; [40].

Table 2.1. S-D logic and strategic sourcing mapping of concepts

| S-D Logic Concepts | Strategic Sourcing Concepts |
|---|---|
| **Operand Resources** as usually tangible, static and passive resources that must be acted on to be beneficial, e.g., natural resources, goods, and money [30]; [41]. | **Resources** as the firm's assets that require action to make them valuable and beneficial for the firm to sustain competitive advantage. Strategic resources enable organizations to sustain competitive advantage, if the resources are Valuable, Rare, Inimitable, and Non-substitutable (VRIN) [42]; [43]. |
| **Operant Resources** as usually intangible, dynamic and active resources that act upon other resources to create benefits, e.g., knowledge, skills [30]; [41]. They are the essential component of differentiation and the fundamental source of competitive advantage [20]. | **Competencies** are the firm's specific strengths that allow a company to gain competitive advantage. *Threshold competencies* are needed to meet the necessary requirements to compete in a given market and achieve parity competitive advantage, whereas *distinctive competencies* allow the firm to |

| | |
|---|---|
| | achieve sustainable competitive advantage [44]. |
| **Service System** as a configuration of resources (at least one operant resource) that is capable of providing benefit to other service systems and itself [30]. The ability to configure best in class operant resources from different organizations increases the ability to gain competitive advantage or increase viability. | **Capability** is a configuration of the firm's resources and competencies that makes the firm able to achieve and sustain competitive advantage. *Dynamic capabilities* are the firm's capacities and abilities to reconfigure its resource base internally and externally to achieve the sustainable competitive advantage [45]. Dynamic capability act on operational capabilities [46]. *Operational capabilities* can be broken into technical, administrative, and governance capabilities for producing and selling a defined (and static) set of products and services [47]. |
| **Service** is the application of operant resources for the benefit of another party [30]; Service is the fundamental basis of value creation through economic exchange. *Competitive advantage* is a function of how one firm exchanges its services to meet the needs of the customer relative to how another firm exchanges its services" [20]. *Surviving* is a function of how the firm exchanges its services to be able to survive and thrive in its surrounding environment" [35]. Service is the primary source of competitive advantage and survivability. However, "the only true source of sustainable competitive advantage and survivability is the operant resources that make the service possible" [20]. | **Service** is the application of competencies to achieve competitive advantage or survivability. *Competitive advantage* is the ability to create more economic value than competitors. It is a firm's profitability that is greater than the average profitability for all firms in its industry. Furthermore, *sustained competitive advantage* is a firm maintaining above average and superior profitability for a number of years [44]. The primary objective of strategic sourcing is to achieve a sustained competitive advantage (in a commercial domain) or survivability (in a noncommercial domain) which in turn results in superior profit or long-term viability. |
| **Actors** are engaged in the services exchange as value co-creators through *actor-to-actor (A2A) relations* [48] at the micro, meso, micro level [49]; [34]. They are essentially doing the same thing: creating value for themselves and others through resource integration [50]. An actor can only offer a value | **Supply chain members** as the focal firm, buyers, suppliers, internal customers and external customers are able to create value in the supply network through sourcing relations like supplier-buyer relationship and customer- provider relationship [15]. |

| | |
|---|---|
| proposition concerning some services and cannot solely create value for the beneficiary actor [51]; [41]. | |
| **Value** is an increase in the viability (survivability, well-being) of the system. Value comes from the ability to act in a manner that is beneficial to a party [52]. A *value proposition* establishes connections and relationships among actors [51]; [41]. The process of co-creating value is driven by ***value-in-use*** (actualization), but mediated and monitored by ***value-in-exchange*** (capturing) [35]. | **Perceived value** is defined by customers, based on their perceptions of the usefulness of the product on offer. **Exchange value** is realized when the product is sold. It is the amount paid by the buyer to the producer for the perceived value [53]. Strategic sourcing derives from value co-creation, which in the provider role serves as value proposition to customers, in the supplier role serves as value facilitation to customers, and in the customer role serves as value actualization [15]. |

As a result, to create a systemic procurement and strategic sourcing view, we consider the firm's organization as a system of interconnections and interdependencies (e.g. service exchange, capability configuration, resource integration and value creation), both internally (sub-systems) and externally (supra-systems) balanced, that has mechanisms (e.g. outsourcing, global sourcing and co-sourcing) and opportunities (e.g. learning, reconfiguration, seizing and sensing) to achieve (sustainable) competitive advantage and survivability. Therefore, we define sourcing as a strategic process for organizing and fine-tuning the focal firm's capabilities and resources internally and externally through A2A interactions (e.g. resource integration, capability configuration and service exchange) with suppliers, buyers, internal and external customers, at the different sourcing levels (e.g. local, international and global) to achieve (sustainable) competitive advantage or survivability, which in turn results in value as superior profit or long-term viability.

## 2.6 Way of modeling: The C.A.R.S conceptualization

Conceptual modeling is our proposed approach for exploring strategic sourcing alternatives in the four strategic sourcing orientations or decision areas of learning, performance, planning and relational management. Conceptual modeling [54] is a technique used in several research and

application fields in Information Systems such as requirements engineering, database and information system design, knowledge management and enterprise modeling. Conceptual modeling has also been introduced in the Strategic Management and Business Model Innovation literature as a technique to generate business models [55]. To create conceptual models that describe sourcing alternatives, a domain-specific modeling language [16] for strategic sourcing is needed. Such language is defined by a conceptualization of the strategic sourcing domain and associated viewpoints that specify conventions for constructing and using different sourcing views. A view is a representation (i.e. conceptual model) of a system from the perspective of one or more decision makers to address specific concerns [56].

We introduce the C.A.R.S (Capability – Actor – Resource – Service) conceptualization as a language for strategic sourcing modeling. There is a clear mapping between the C.A.R.S concepts and core concepts of S-D Logic as we apply them in the way of thinking to strategic sourcing (Fig. 3). The C.A.R.S concepts capability, resource and competency are interpreted as their corresponding S-D Logic concepts, i.e. service system, operand resource and operant resource. We chose to retain the more specific strategic sourcing terminology instead of employing general S-D Logic terminology, though the meaning of the concepts is derived from S-D Logic. C.A.R.S further employs the service concept to interpret the primary objective of strategic sourcing that is competitive advantage or survivability. Furthermore, the actor notion is used to describe the role of the focal firm, suppliers, buyers and customers in a supply network for value co-creation. The C.A.R.S concepts are defined as follows:

- ***Capability*** is *'What the actor Can do'* for competitiveness and survivability. The capability notion can illustrate the abilities of firm, buyer and supplier to achieve long-term objectives. The capability of an actor represents its potential long-term effects on the achievement of sourcing objectives.
- ***Actor*** is *'Who is the Resource Integrator'* that provides service, proposes value, creates value and captures value.
- ***Resource base*** is *'What the actor Has'* that is capable to create value. The resource base notion includes tangible and static resources (e.g. goods), as well as intangible and dynamic resources (e.g. competencies and skills), hence both ***resources*** (i.e. S-D Logic operand resources) and ***competencies*** (i.e. S-D Logic operant resources) are included in the resource base.
- ***Service*** is *'What the actor Does'* that is exchanged with other actors for competitiveness and survivability. The service notion can illustrate the performance dimension of actors to achieve operational objectives

(bottom-line results). Performance of an actor represents short-term effects on the achievement of sourcing objectives.

The C.A.R.S conceptualization is extended by considering viewpoints (Fig. 3) that relate to different strategic sourcing orientations and associated decision-making areas and decision-makers. The ***value creation viewpoint*** focuses on the firm's profitability that is derived by the participation of its network members to co-create value. The value creation viewpoint's concern is performance-oriented sourcing decisions about determining how much cost is being spent, with which suppliers, for what and by whom; how much value is perceived or captured, with whom, and for what. The ***capability sourcing viewpoint*** focuses on the firm's abilities (strategic dimension), its supplier's abilities and its customer's abilities to configure its resources and competencies internally and externally to achieve competitive advantage and to survive in a rapidly changing environment. The capability sourcing viewpoint's concerns are a) learning-oriented sourcing decisions to choose the right sourcing alternatives like outsourcing, insourcing and co-sourcing (make-versus-buy decisions) to achieve (sustained) competitive advantage; b) planning-oriented sourcing decisions about identifying sourcing objectives (e.g. cost saving, mitigating risk, ensuring delivery availability, enforcing compliance, driving innovation and making long-term partnership) and aligning these objectives with long-term organizational goals. The ***resource based viewpoint*** focuses on the firm-specific strengths (superior resources and core competencies) that are capable of creating value and allow a firm to gain competitive advantage. The resource based viewpoint's concern is learning-oriented sourcing decisions about integrating superior resources and turning into a specific benefit. Finally, the ***supply base viewpoint*** focuses on the firm's interactions with suppliers and internal and external customers to achieve long-term or short-term partnerships. This viewpoint's concern is relational-oriented sourcing decisions a) to select the right suppliers and evaluate their strategic and performance dimensions for long term and short-term partnerships; b) to find new customer to create more value and innovation.

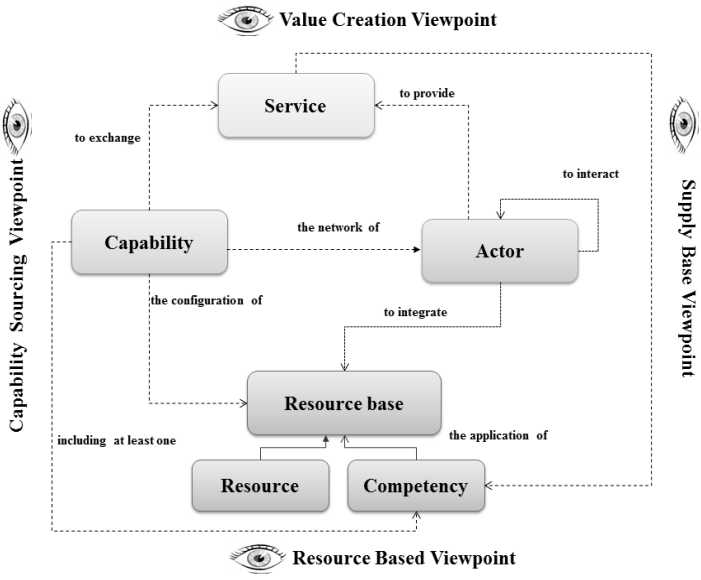


Figure 2.3. C.A.R.S conceptualization and viewpoints

The purpose of the C.A.R.S conceptualization and its viewpoints is to support strategic-sourcing decision-makers by offering a common language to model procurement data such as *spend data*, *sourcing data*, *supplier data*, *contract data* and *relational data* that reside in disparate systems and data sources. The capability notion, its attributes and other supplementary concepts defined in the capability sourcing viewpoint can be used to model the (strategic) sourcing data about outsourced, insourced and co-sourced capabilities, operational, organizational and technical capabilities and also data about capacities to leverage the existing resource base, to reconfigure the existing resource base, to integrate the resources, to develop new products and capabilities, to absorb the external resource base and to take advantage of market opportunities (adapting). The service notion, its attributes and other supplementary concepts defined in the value creation viewpoint can be used: a) to model the performance (operational) data about the spend cost, the total cost of ownership, the transaction cost, the captured value (profit) and the perceived value; b) to model the contract (operational) data about the quality of service, the service level agreements and the service delivery time, the contract's clauses, RFx (e.g. RFI, RFQ, RFP) and KPIs for evaluating supplier performance. The actor notion, its attributes and other supplementary concepts of the supply base viewpoint can be used to model the relational data about the suppliers and their classification such as registered, approved, active, partner, strategic partner, undesirable and blocked and also data about the (strategic and non-strategic) customers. The

resource notion, its attributes and other supplementary concepts defined in the resource-based viewpoint can be used to model sourcing data about the internal and external resource base, interconnected resources, composite resources, threshold and distinctive competencies and VRIN resources.

The next section illustrates an instantiation of C.A.R.S based on an outsourcing scenario, employing a model driven approach as way of working.

## 2.7 Way of working: model driven approach

We propose a model driven approach to explore strategic sourcing alternatives in various orientations (e.g. learning, planning, performance and relational) for three distinct purposes: descriptive, predictive or prescriptive. In this paper, the proposed approach has been defined and limited by focusing on the upstream procurement activities (Fig.4) from spend analysis to contracting- as the Source to Contract (S2C) process- that include spend analysis, sourcing management and relationship management.

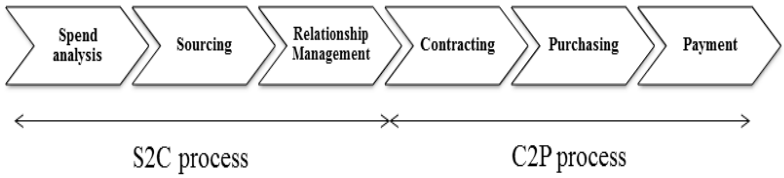


Figure 2.4. Source to Contract (S2C) process Vs. Contract to Pay (C2P) process

According to the first step of S2C process, *category spend management* is a main sub-process of spend analysis to determine the category baseline spend costs and then identify potential cost saving opportunities. A category is a grouping of resources or services that have similar supply and usage characteristics to meet business objectives. In the second step, *capability sourcing* is a core sub-process of sourcing management to achieve sourcing goals and objectives. Capability sourcing is a course of action to execute strategic sourcing goals through gaining access to best-in-class capabilities in the value chain to achieve sourcing objectives such as increasing quality, capturing saving, mitigating risk, ensuring delivery availability, enforcing compliance, driving innovation and making long-term partnership [38]; [39]; [40]; [57]. Finally, in the last step, *supplier lifecycle management* is a sub process of relationship management for supplier discovery, supplier engagement, supplier qualification, supplier performance management, and supplier classification and supplier risk assessment to achieve sourcing objectives such as supply base reduction, optimization and rationalization. Referring to

the S2C process and its sub-processes, we define the model driven exploration based on the C.A.R.S conceptualization in three executive steps as below:

1. ***Spend exploration*** to determine how much cost is being spent, with whom, and for what.
2. ***Sourcing exploration*** to identify sourcing objectives and choose the right sourcing model alternatives (e.g. outsourcing, co-sourcing and insourcing) to achieve objectives through capability sourcing
3. ***Supply base exploration*** to identify, evaluate and qualify of suppliers for long time or short time partnership.

We take a hypothetical case for illustrating our model-based exploration through a literature review [58]; [59]; [60] on strategic sourcing in the healthcare domain. Healthcare costs are increasing and hospitals are facing fierce competition to provide high quality services, continued lower operating margins, increased risks and potentially once-in-a-lifetime health care reform. With this backdrop, there is an increasing focus on supply chain management as a means to minimize risk, optimize operating costs, improve revenue, improve operating margins and hence enable the hospital to better serve the patient. Now more than ever, hospitals need strategic sourcing in order to survive within the sector. Strategic sourcing can play a key role in creating a more efficient hospital by decreasing the total cost of ownership of resources (e.g., capital equipment) through tracking the sales prices of equipment sold by suppliers; differentiating the hospital's services through hiring specialists and purchasing or renting equipment; improving supply chain management through decreasing negotiation times in the new vendors contracts by providing the necessary information to streamline the process; defining and reviewing the Preferred Supplier List; obtaining QDC objectives (Quality-Delivery-Cost) for all projects; managing strategic long-term relationships with the global suppliers. We focus our example to find cost saving opportunities in "Healthcare Information Management". The proposed model-driven approach should be able to support decision makers to answer the business questions as below through three executive exploration steps (e.g. spend exploration, sourcing exploration and supply base exploration) based on the C.A.R.S conceptualization.

- How much is being spent on "information system management" by the hospital?
- What could be the right sourcing model (e.g. outsourcing, co-sourcing and insourcing) of "information system management" for saving cost in the hospital?
- What should be the hospital's resource base that enables the hospital to have a core "information system management" capability to achieve sustainable competitive advantage?

- Who is the preferred provider for "information system management" in the hospital?

*Step 1: Spend exploration based on the C.A.R.S conceptualization*

In the first step, the value creation view (Fig.5) as a descriptive representation illustrates 1) how much cost is being spent on "information system management" (as a category of healthcare information management) to improve the hospital operational efficiency; 2) how much value is being perceived by the end users of information systems; 3) what is the value proposition of the IT department (as the internal service provider) to improve the hospital operational efficiency; and 4) how much profit is being captured by the hospital through improving operational efficiency. Value as "*What the actor Perceives*" and profit as "*What the actor Captures*" are two supplementary concepts in the value creation viewpoint. Consequently, Total Cost of Ownership (TCO), Net Perceived Value (NPV) and Net Captured Value (NCV) are operational metrics to measure the cost, value and profit. The profit of improving operational efficiency as the captured value by hospital is determined after perceiving value by beneficiary actor (users) as "NCV = NPV - TCO" [61]. Here, the cost of "information system management" is more than its profit that is being captured by hospital. Hence, there is the opportunity for saving cost in "information system management" through a right sourcing decision-making.

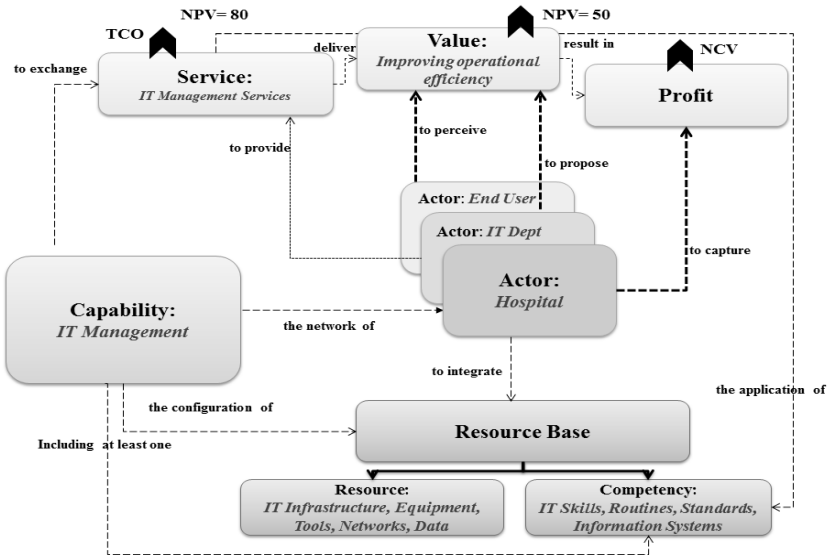


Figure 2.5. A value creation view

***Step 2: Sourcing exploration based on the C.A.R.S conceptualization***

In the second step, the capability sourcing view (Fig.6) as a predictive representation shows what could be the right sourcing model of "information system management" for saving cost in the hospital. Referring to the view, the right sourcing model of "information system management" could be an outsourcing model. Two metrics for choosing the right sourcing models are 1) the strategic metrics such as operational capabilities (e.g. technical, administrative, organizational) and dynamic capability (e.g. leveraging and reconfiguration); and 2) the operational metrics such as Production Costs (PC) and transaction costs (TC) of service. The hospital's ability to leverage the existing resources and competencies for "information system management" is a non-core capability that results in a parity competition, not competitive advantage. Therefore, the "information system management" can be outsourced to a preferred supplier in the value network based on the low transaction costs. Dynamic capability as "*the actor's capacity and ability to alter its resource base*" and operational capability as "*the actor's capacity and ability to configure its resource base*" are two supplementary concepts in the capability sourcing view. Operational capabilities constituted by valuable resources and distinctive competencies are critically underpinning competitive advantage that others cannot imitate and obtain. These core operational capabilities are deeply embedded in the firm and therefore difficult to transfer and likely to be performed internally. Capabilities involved by non-valuable resources and threshold competencies

are non-core operational capabilities, which can be outsourced without any serious compromise to the firm competitive position.

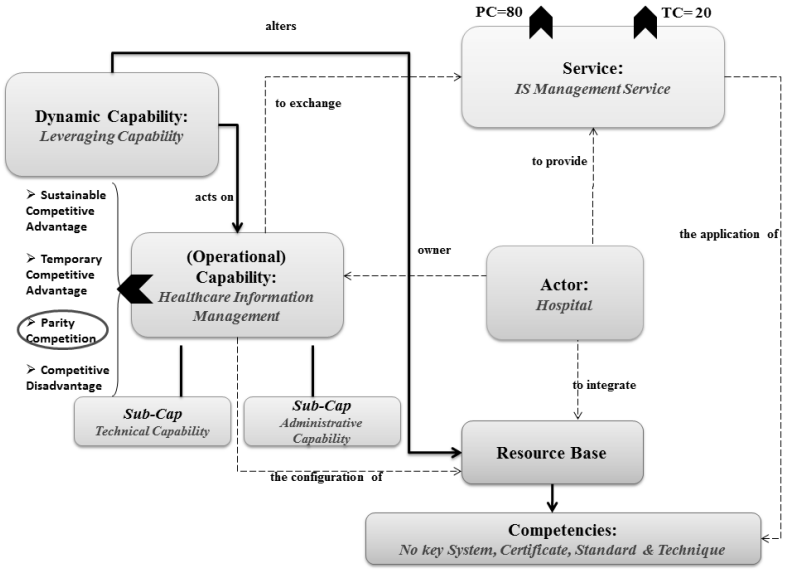


Figure 2.6. A capability sourcing view

Furthermore, in this step, the resource based view (Fig.7) as a prescriptive representation illustrates what should be the hospital's resource base to have a core capability in "healthcare information management" to achieve sustainable competitive advantage as a long-term goal. Referring to the view, the hospital needs a knowledge creation and integration capability to manage its information. This capability as an interconnected operant resource is the hospital's ability to create, absorb, acquire and integrate information through internal and external networks. This interconnected operant resource is constituted by technological competence (e.g. technological expertise), network competence (e.g. the ability of network management execution) and quality management competence (e.g. the ability of quality management execution) that are Composite Operant Resources (CORs). These resources are a composition of IT infrastructure and systems, individual skills (e.g. IT security, CRM) and quality audit routines and policies as the Basic Operant Resources (BORs). By integration of composite operant resources (CORs), the hospital is able to achieve a temporary competitive advantage and by integration of basic operant resources (BORs), the hospital is able to achieve parity competitive but no advantage. The hospital is able to achieve a sustainable competitive advantage through integrating interconnected operant resources (IORs) as a

combination of BORs. Valuable, Rare, Inimitable, and Non-substitutable (VRIN) attributes are metrics to evaluate the actor's resource base to achieve (sustainable) competitive advantage. Valuable common resources can lead to competitive parity but no advantage such as basic operant resources. Non-value-adding resources lead to competitive disadvantage. Rare resources are those possessed uniquely by one organization or by a few others only. Valuable rare resources can provide, at best, temporary competitive advantage such as composite operant resources. Inimitable resources are those that competitors find difficult to imitate or obtain. Non-substitutable resources are resources that do not have a strategic equivalent. Only valuable, rare, hard-to-imitate and non-substitutable resources can provide sustained competitive advantage such as interconnected operant resources [62].

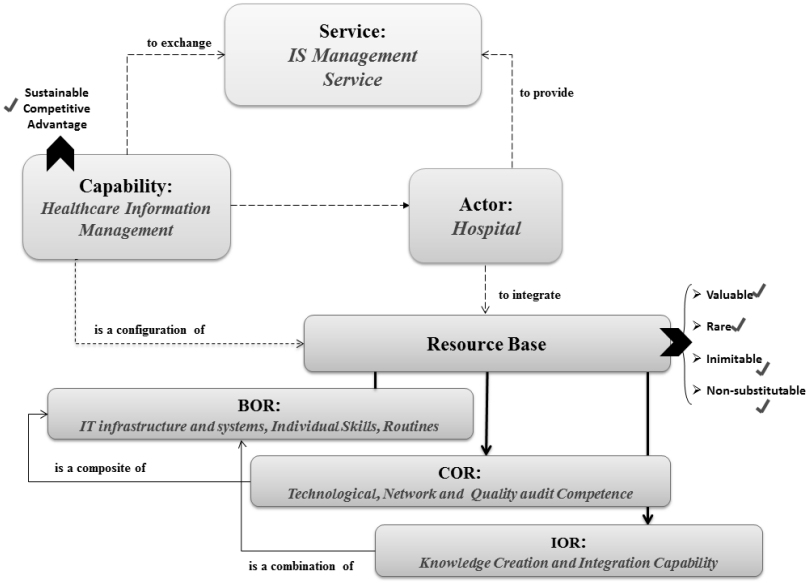


Figure 2.7. A resource based view

*Step 3: Supply base exploration based on the C.A.R.S conceptualization*

In this step, the supply base view (Fig.8) as a descriptive-predictive representation illustrates 1) what are the service providers operations and capabilities in "information system management"; and 2) who can be a preferred provider for long-term partnership in an outsourcing contract. Referring to the view, the service provider B with the high-level capabilities (e.g. information quality management, documentation and cost reduction) and the high-level performance (e.g. the cost of service, the delivery time of service and the quality of service) can be a candidate for long-term relationship. Two measurements are defined for supplier selection and evaluation as operational and strategic metrics [63]. Operational metrics are indicators related to the performance dimension of a supplier (i.e. quality, cost and delivery time). Strategic metrics are indicators related to the capability dimension of suppliers such as technical, managerial, and operational capabilities. Consequently, service providers characterized by high-level performance and high-level capability are strategic providers, which the firm needs to develop a long-term relationship with. Service providers with a high-level performance and a low-level capability are candidates for further development to improve their capabilities. Service providers with a low-level performance and a high-level capability are unable to use their capability efficiently. Service providers with low-level performance and capability are candidates for "pruning".

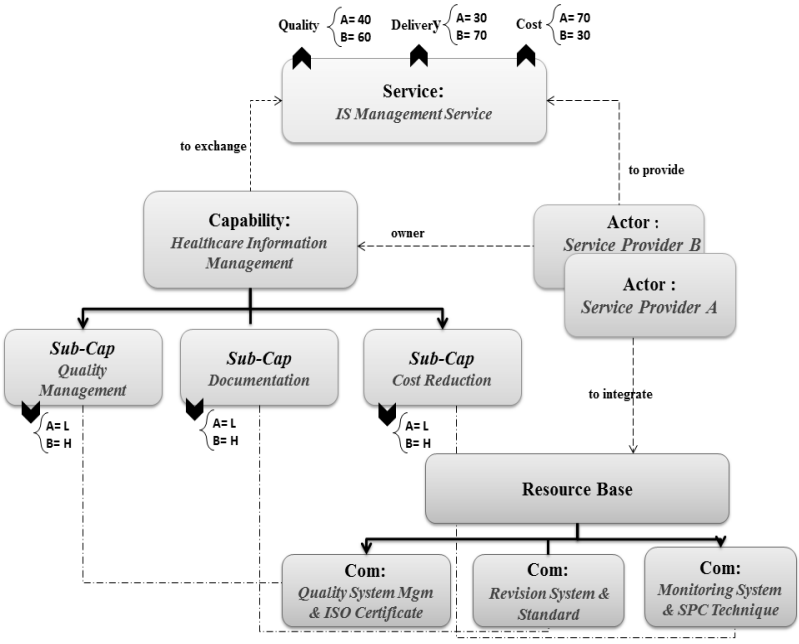


Figure 2.8. A supply based view

The purpose of model driven exploration based on the C.A.R.S conceptualization is a systemic representation (descriptive, predictive and prescriptive) of the procurement data to explore sourcing alternatives and enabling companies to achieve procurement analytic competency by applying model-based analytical techniques as way of supporting.

## 2.8 Way of supporting: model based analytical tools

Procurement analytics is the process of using advanced techniques such as modeling, deep computing, simulation, data mining, and optimization to derive actionable insights and outcomes from procurement data. Analytical techniques for procurement and strategic sourcing have ranged from simple weighted scoring models to complex mathematical programming approaches. These approaches may include 1) mathematical techniques such as AHP, TCO, and linear programming; 2) artificial intelligence techniques such as neural networks, software agent and fuzzy set theory; and 3) complex techniques based on a single analysis method like cluster analysis and principal component analysis or involve combined methods like AHP with linear programming [64]. The analytical techniques used are usually performance outcome based techniques for evaluating “point-in-time”

procurement data [65]. Although, these approaches have their own relative advantages, the procurement analytics needs to involve more than the consideration of current operational characteristics. Strategic sourcing decision-making needs to incorporate tangible, intangible, strategic, and operational factors into any analysis [66]. Furthermore, the lack of reliable data, intelligent tools and analytics skills to interpret data are other important issues in the procurement analytics.

A model based analytical technique can be integrated into our approach to support the way of modeling (C.A.R.S conceptual modeling) and the way of working (model driven approach) for enabling fact-based decision-making. Such analytical technique based on C.A.R.S conceptualization would be capable of 1) extracting the most data from applications and operations (i.e. application and process layers in Fig. 1) to deliver outcomes that matter; 2) integration the procurement analytics into procurement processes; 3) considering tangible, intangible, strategic, and operational metrics into any (descriptive, predictive and prescriptive) analysis based on the historical procurement data; and finally 4) visualizing insights and results derived from procurement data.

## 2.9 Conclusion

Companies are acting in an increasingly volatile, uncertain, complex and ambiguous world. Hence, more and more they expect from the chief procurement officers (CPOs) to develop long-term and short-term plans in supply chain management. Generating and measuring savings, safeguarding quality, ensuring delivery availability and enhancing value creation, making partnership and innovation will be remained the top priorities of CPOs in the supply chain management until 2017 [11]. Leading companies need to transform their supply network from static, isolated and internally focused to externally collaborative to achieve the today's procurement objectives and priorities. To create a new business model of supply network, organizations should adopt a strategic sourcing approach that includes initiatives designed to drive above priorities. By applying a systemic view (service ecosystem) on the supply network, we consider the strategic sourcing as a strategic process for fine-tuning the organization's capabilities and resources internally and externally through interactions with suppliers, buyers, internal and external customers to achieve procurement and sourcing objectives. According to this systemic view, a model driven approach has been defined to explore sourcing alternatives based on a common language (C.A.R.S) that enables fact-based decision-making through procurement data management and analytics competencies. As future work, we will evaluate the proposed model-based strategic sourcing

around important sourcing trends such as shared service centers, business process outsourcing and global sourcing.

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## References

1. Anderson, P.H., Rask, M.: Supply chain management: new organizational practices for changing procurement realities. Journal of Purchasing and Supply Management 9 (2), 83–95, (2003).
2. Ellram, L.M., Carr, A.S.: Strategic purchasing: a history and review of the literature. International Journal of Physical Distribution and Materials Management 30 (2), 10–18, (1994).
3. Cooper, M.C., Ellram, L.M.: Characteristics of supply chain management and the implications for purchasing and logistics strategy. International Journal of Logistics Management 4 (2), 13–24, (1993).
4. Chen, I.J., Paulraj, A., Lado, A.: Strategic purchasing, supply management and firm performance. Journal of Operations Management 22 (5), 505–523, (2004).
5. Ellram, L.M., Liu, B.: The financial impact of supply management. Supply Chain Management Review 6 (6), 30–37, (2002).
6. Paulraj, A., Chen, I.J., Flynn, J.: Levels of strategic purchasing: Impact on supply integration and performance, Journal of Purchasing and Supply Management, Vol.12, pp107-122, (2006).
7. Weele, A.: Purchasing and Supply Chain Management. Analysis, Startegy, Planning and Practise. 5th edition. Cengage Learning EMEA. Hampshire, (2010).
8. Finch, G., Davidson, S., Kirschniak, C., Weikersheimer, M., Reese, C., Shockley, R.: Analytics: The speed advantage; Why data-driven organizations are winning the race in today's marketplace, IBM Global Business Services, (2014).
9. LaValle, S., Hopkins, M., Lesser, E., Shockley, R., Kruschwitz, N.: Analytics: the new path to value; How the smartest organizations are embedding analytics to transform insights into action, IBM Global Business Services, (2010).
10. Procurement: Optimizing savings and mitigating risk in a complex world, Technical report, IBM Smarter Commerce, (2013).
11. The CPO's Agenda for 2014... and Beyond, Technical report, Aberdeen Group, (2014).
12. Dhawan R., Walters D., Bhattacharjya J.: Procurement Models for the Future, the SMART Supply Chain Conference, Australia, (2011).
13. Dhawan R.: Procurement analytics, the CIPS conference, Australia, (2010).
14. Butner B.: Sourcing in a demanding economic environment, IBM Global Business Services, (2009).

15. Eltantawy, R., Giunipero, L., Handfield, R.: Strategic Sourcing Management's Mindset: Strategic Sourcing Orientation and its Implications. International Journal of Physical Distribution and Logistics Management, 21 pages, (2014).
16. Thalheim, B.: The science and art of conceptual modeling. In A. Hameurlain et al., editor, TLDKS VI, number 7600 in LNCS, pages 76–105. Springer, Heidelberg, (2012).
17. Seligmann, P.S., Wijers, G.M., Sol, H.G.: Analyzing the structure of IS methodologies, an alternative approach, Proceedings of the First Dutch Conference on Information Systems, Amersfoort, the Netherlands, (1989).
18. March, S.T., Smith G.F.: Design and natural science research on information technology. Decision Support Systems, 15(4), 251–266, (1995).
19. Peffers, K., Tuunanen, T., Rothenberger, M., Chatterjee, S.: A design science research methodology for information systems research. Journal of Management Information Systems, 24(3):45–77, (2007).
20. Lusch, R.F., Stephen, L., Vargo, S.L., Matthew, O.: Competing through service: Insights from service-dominant logic. Journal of Retailing, 83(1), 2-18, (2007).
21. Osterwalder, A., Pigneur, Y.: Designing business models and similar strategic objects: the contribution of IS, Journal of the Association for Information Systems: Vol. 14: Iss. 5, Article 3, (2013).
22. Von Bertalanffy, L.: General System Theory, (1969).
23. Beer, S.: Brain of the Firm, The Penguin Press, London, (1972).
24. Beer, S.: The Viable System Model: Its Provenance, Development, Methodology and Pathology. The Journal of the Operational Research Society. 35(1), 7-25. (1984).
25. Ng, I.C.L., Parry, G., Maull, R., McFarlane, D.: Complex engineering service systems: A grand challenge. In Ng, I. C. L., Parry, G., Wild, P., McFarlane, D., & Tasker, P. (Eds.), Complex engineering service systems. New York, NY: Springer. doi:10.1007/978-0-85729-189-9_23, (2010).
26. Barile, S., Polese, F.: "Smart service systems and viable service systems", in Service Science, Vol. 2 No. 1/2, (2010).
27. Vargo S.L., Lusch R.F.: From repeat patronage to value co-creation in service ecosystems: A transcending conceptualization of relationship. J. Bus. Marketing Management 4(4):169–179. (2010).
28. Maglio, P., Spohrer, J.: Fundamentals of service science. J. Acad. Marketing Sci. 36(1):18–20, (2008).
29. Vargo, S.L., Lusch, R.F., Akaka, M.A.: Advancing service science with service-dominant logic: Clarifications and conceptual development. Maglio PP, Kieliszewski JA, Spohrer JC, eds. Handbook of Service Science (Springer, New York), 133–156, (2010).
30. Vargo, S.L., Akaka, M.A.: Service-dominant logic as a foundation for service science: Clarifications. Service Sci. 1(1):32–41, (2009).
31. Barile, S., Saviano, M.: A New Perspective of Systems Complexity in Service Science, in coll. with BARILE S., in Impresa, Ambiente, Management, vol.3, n.3, (2010).
32. Barile, S., Polese, F.: Linking the viable system and many-to-many network approaches to service-dominant logic and service science, in International Journal of Quality and Service Science, Vol. 2 No. 1, (2010).

33. Barile, S., Saviano, M.: Foundations of systems thinking: the structure systems paradigm, in Aa.Vv., Contributions to theoretical and practical advances in management. A Viable Systems Approach (VSA), International Printing, (2011).
34. Vargo, S.L., Akaka, M.A.: Value Co-creation and Service Systems (Re)formation: A Service Ecosystems View, INFORMS Service Science 4 (3), 207-17, (2012).
35. Vargo, S.L., Maglio, P.P., Akaka M.A.: On value and value co-creation: A service systems and service logic perspective. Eur. Management J. 26(3):145–152, (2008).
36. Dobrzykowski, D., Tran, O., Tarafdar, M.: Value Co-Creation and Resource Based Perspectives for Strategic Sourcing. Strategic Outsourcing: An International Journal, 3(2), 106-127, (2010).
37. Mele, C., Della Corte, V.: Resource-based view and Service-dominant logic: Similarities, differences and further research, jbm - Journal of Business Market Management, Vol. 6, Iss. 4, pp. 192-213, (2013).
38. Rafati, L.: Capability sourcing: a service-dominant logic view. Proceedings of the 8th Mediterranean Conference on Information Systems, (2014).
39. Rafati, L., Poels, G.: Introducing service-oriented organizational structure for capability sourcing, 5th International Conference Exploring Services Science, IESS 2014 Geneva, Switzerland, Lecture Notes in Business Information Processing Volume 169, (2014).
40. Rafati, L., Poels, G.: Capability Sourcing Modeling: A high-level conceptualization based on Service-Dominant Logic. Lecture Notes in Business Information Processing for ASDENCA 2014 - CAiSE2014, Greece, (2014).
41. Poels, G.: The resource-service-system model for service science. International conference on Advances in conceptual modeling: applications and challenges. Lecture Notes in Computer Science. 6413. p.117-126, (2010).
42. Barney, J.: Firm resources and sustained competitive advantage. Journal of Management, 17 (1), 99–120, (1991).
43. Barney, J.: Gaining and sustaining competitive advantage. 2nd Ed. Upper Saddle River, NJ: Prentice Hall, (2002).
44. Hill, C., Jones, G.: Strategic Management: an integrated approach. Tenth edition, Cengage Learning, (2012).
45. Helfat, C., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., Winter, S.: Dynamic Capabilities: Understanding Strategic Change in Organizations. Malden, MA: Blackwell, (2007).
46. Zollo, M., Winter, S.G.: Deliberate Learning and the Evolution of Dynamic Capabilities, Organization Science 13(3): 339–51, (2002).
47. Teece, D.: A dynamic capabilities-based entrepreneurial theory of the multinational enterprise. Journal of International Business Studies 01/2014; 45(1), (2014).
48. Vargo, S.L., Lusch, R.F.: It's all B2B...and beyond: Toward a systems perspective of the market. Indust. Marketing Management 40(2):181–187, (2011).
49. Akaka, M.A., Vargo, S.L., Lusch, R.F.: An exploration of networks in value cocreation: A service-ecosystems view. Rev. Marketing Res. 9(Special issue):13–50, (2012).
50. Wieland, H., Polese, F., Vargo, S.L, Lusch, R.F: Toward a Service (Eco) Systems Perspective on Value Creation. 12 International Journal of Service Science, Management, Engineering, and Technology, 3(3), (2012).

51. Cardoso, J., Lopes, R., Poels, G.: Service systems: concepts, modeling, and programming. Springer Briefs in Computer Science, (2014).
52. Vargo, S.L., Lusch, R.F.: Service-dominant logic: Looking ahead. Presentation at the Naples Forum on Service, June 14–17, Isle of Capri, Italy, (2011).
53. Bowman, C., Ambrosini, V.: Value Creation versus Value Capture: Towards a Coherent Definition of Value in Strategy. British Journal of Management, Vol. 11, 1–15, (2000).
54. Olive, A.: Conceptual Modeling of Information Systems, Springer Verlag Berlin, (2007).
55. Teece, D.: Business models, business strategy and innovation. Long Range Planning, 43, 172-194, (2010).
56. IEEE Recommended Practice for Architectural Description of Software-Intensive Systems, IEEE, New York, IEEE, (2000).
57. Loftin, R., Lync, R., Calhoun, J.: The Sourcing Canvas: A Strategic Approach to Sourcing Decisions, Accelare Inc. pp. 13, (2011).
58. Cortada, J.W., Gordon, D., Lenihan, B.: The value of analytics in healthcare, from insights to outcomes, IBM Global Business Services, (2012).
59. Brennan, C.D.: Integrating the healthcare supply chain. Healthcare Financial management, Jan, 52(1), 31-34, (1998).
60. Chakraborty, S., Dobrzykowski, D.: Linking service-dominant logic and healthcare supply chain, (2013).
61. Golnam, A., Viswanathan, V., Moser C.I., Ritala, P., Wegmann, A.: Designing Value-Oriented Service Systems by Value Map. Business Modeling and Software Design. Lecture Notes in Business Information Processing Volume 173, pp 150-173, (2014).
62. Madhavaram, S., Hunt, S.D.: The service-dominant logic and a hierarchy of operant resources: developing masterful operant resources and implications for marketing strategy. Journal of The Academy of Marketing Science, 36(1), 67-82, (2008).
63. Ashutosh, S., Pratap, K.M.: Evaluation of supplier capability and performance: A method for supply base reduction, Journal of Purchasing and Supply Management, Volume 12, Issue 3, Pages 148-163, (2006).
64. Chen, Y.J.: Structured methodology for supplier selection and evaluation in a supply chain Information Sciences, 181, pp. 1651–1670, (2011).
65. Narasimhan, R., Talluri, S., Mendez, D.: Supplier Evaluation and Rationalization via Data Envelopment Analysis: An Empirical Examination. J Supply Chain Management: A Global Review of Purchasing and Supply 37(3): 28-37, (2001).
66. Sarkis, J., and Talluri, S.: A model for strategic supplier selection, Journal of supply chain management 38 (4), 18-28, (2002).

# 3

# Service-Oriented Enterprise Engineering: A Modeling Discipline Based on the Viable Systems Approach (vSa) for Strategic Sourcing Decision-Making

**Summary:** This chapter clarifies the contribution of enterprise modeling to strategic sourcing decision-making by helping in conceptualization, design and exploration of multiple strategic options for better decision-making. In this chapter, we explore a solution approach that refines the existing Enterprise Engineering (EE) modeling discipline into a Service-oriented Enterprise Engineering (SoEE) modeling discipline, by founding it on a novel application of the Viable Systems Approach (vSa) towards strategic (sourcing) decision-making.

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# Service-Oriented Enterprise Engineering

## A Modeling Discipline Based on the Viable Systems Approach (vSa) for Strategic Sourcing Decision-Making

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**Abstract.** Strategic Sourcing as a critical area of strategic management is centered on decision-making towards achieving value-driven targets. Many companies face challenges in obtaining the benefits associated with effective strategic sourcing decision-making. Enterprise modeling can contribute to strategic sourcing decision-making by helping in the conceptualization, design and exploration of multiple strategic options for better decision-making. In this research, we explore a solution approach that refines the existing Enterprise Engineering (EE) modeling discipline into a Service-oriented Enterprise Engineering (SoEE) modeling discipline, by founding it on the novel application of the Viable Systems Approach (vSa) towards strategic (sourcing) decision-making. The proposed modeling discipline provides (1) the systemic viewpoints to interpret complex sourcing phenomena; and (2) the outside-box models to specify the value-driven interactions of an enterprise (as a system) with other actors. Finally, to operationalize the modeling discipline we introduce the conceptual basis (C.A.R.S) of a modeling language to apply the SoEE viewpoints and develop the related models for supporting strategic sourcing decision-making. The paper elaborates on preliminary ideas presented at the SoEA4EE 2013 workshop (Rafati & Poels, 2013).

**Keywords:** Service-Oriented Enterprise Engineering, Value-driven Strategic Sourcing, Strategic Sourcing Decision-Making, Viable Systems Approach, Service-Dominant Logic.

## 3.1 Introduction

Strategic management as the art and science of formulating, designing and evaluating strategic options and alternatives enables an organization to achieve its long-term objectives. Strategic management deals with survival and competitiveness in the long-term. At the strategic management level, decision-makers deal with complex, non-routine problems. Strategic sourcing has become a critical area of strategic management that is centered on decision-making regarding an organization's procurement activities such as spend analysis, choosing sourcing strategies, supplier selection and evaluation. Many companies face challenges in obtaining the benefits

associated with effective strategic sourcing decision-making. A common language and a stable overarching view are needed to define and articulate concepts that facilitate the description and interpretation of objects of strategic interest and that improve the strategic discussions and enhance related decision-making (Lohse, Biolsi, Walker, & Rueter, 1994; Eppler & Ge, 2007; Lengler & Eppler, 2007; Clark & Brennan, 1991). From an Information System (IS) research perspective, enterprise modeling provides a unique opportunity to contribute to strategic management research by helping in the conceptualization, design and exploration of multiple strategic options, much in the way it has contributed to better decision-making with respect to information technology and information systems (Osterwalder & Pigneur, 2013). Here, our opportunity-driven research question is *how enterprise modeling can support decision-makers at the strategic management level for strategic sourcing?*

In this research, we explore a solution approach that refines the existing Enterprise Engineering (EE) modeling discipline (Dietz, 2006) into a Service-oriented Enterprise Engineering (SoEE) modeling discipline, by founding it on the novel application of the Viable Systems Approach (vSa) (Barile & Saviano, 2011) towards strategic (sourcing) decision-making. We show that the vSa foundation of the proposed modeling discipline allows for (1) viewing an enterprise as a viable system that survives through value creation interactions internally and externally with other systems in an ecosystem; and (2) focusing on the ecosystem of the enterprise as a system of viable systems, particular considering value-driven interactions among its sub-systems and its supra-systems. The proposed SoEE modeling discipline founded on vSa provides (1) the appropriate viewpoints to interpret complex sourcing phenomena such as value creation, capability configuration, resource integration and actor interactions; and (2) the related models to specify the interaction of an enterprise (as a system) with other actors (as sub-systems and super-systems) for value creation to achieve strategic sourcing outcomes like sustainable competitive advantage, survivability and long-term partnership. Finally, to operationalize the modeling discipline we introduce the conceptual basis of what can become a simple graphical modeling language for strategic managers to apply the SoEE viewpoints and develop the related models for supporting strategic sourcing decision-making. The language, called Capability-Actor-Resource-Service (C.A.R.S) was developed using concepts from the well-known Service-Dominant Logic (S-D Logic) (Lusch & Vargo, 2006), which fits well with the introduced service ecosystem perspective on value-driven strategic sourcing. Example models are provided as part of an IT outsourcing case-study we conducted at a large university hospital.

Our research methodology was Design Science Research (Hevner, Park, & Ram, 2004), which is the standard research methodology used in the Information Systems discipline for designing new artifacts that solve unsolved problems or improve upon existing solutions. Referring to the DSRM process model we distinguish the following research phases 1) Problem Analysis Phase: we conducted a literature review of value-driven strategic sourcing to define key requirements for strategic sourcing decision-making; 2) Solution Analysis Phase: we defined solution objectives and contributions by introducing an enterprise modeling discipline to support strategic (sourcing) decision-making according to the requirements specified in the problem analysis phase; 3) Design Phase: we developed a conceptual basis for applying models and views of the proposed modeling discipline toward strategic sourcing decision-making; and 4) Demonstration Phase: we used a case-study in the healthcare domain to illustrate and evaluate the use of our modeling approach for strategic sourcing decision-making.

Preliminary ideas regarding our solution approach are presented in (Rafati & Poels, 2013). The current paper differs from the previous one in important aspects. First, the theoretical basis of the modeling discipline that is founded on vSa is expanded and a new type of models (i.e., outside-box models) for SoEE is introduced. Second, the modeling discipline itself, only roughly outlined in the previous paper, is formalized. Third, a proof-of-concept demonstration using a healthcare case-study is added.

The paper is organized as follows: Sect. 2 describes the results of our literature review of value-driven strategic sourcing and defines key requirements for supporting strategic sourcing decision-making. Sect. 3 introduces the proposed SoEE modeling discipline (as a set of theory, viewpoints and models) based on applying vsSa towards strategic decision-making; Sec 4 explains the contributions of the proposed modeling discipline for value-driven strategic sourcing; Sect. 5 defines C.A.R.S as a conceptual basis for applying models of the proposed modeling discipline to support the making of strategic sourcing decisions; Sect. 6 presents a proof-of-concept demonstration of the proposed modeling discipline by means of a case-study of IT outsourcing in a large university. Finally, Sect. 7 concludes the paper.

## 3.2 Strategic sourcing

Strategic sourcing as a sub-process of procurement (Figure 1) starts with spend analysis and ends with payment and is composed of two distinct phases: sourcing and purchasing. The sourcing phase encompasses the source-to-contract (S2C) sub-process of procurement with three executive

steps: 1) spend analysis to collect and analyze spend data and then identify potential opportunities for cost reduction; 2) strategic sourcing to select the most appropriate go-to market sourcing strategies and then selection and evaluation of suppliers in alignment with the strategic goals of the firm; and 3) contract management for controlling and tracking the formal and legal agreements with suppliers to fully exploit the value of the contract arrangements. The purchasing phase encompasses the purchase-to-pay (P2C) sub-process of procurement with three executive steps: 1) the purchase requisition; 2) the purchase order and order confirmation; 3) the delivery notification and invoice payment (Weele, 2010; Butner, 2008).

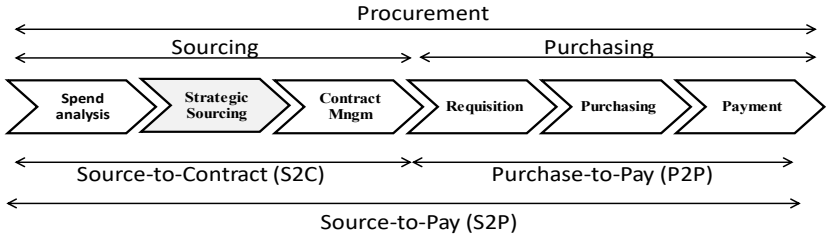


Figure 3.1. Procurement process

In today's practice, procurement is strongly driven by a tactical spend management process aimed at cost saving targets, which is not able to support organizations in achieving strategic objectives like sustainable competitive advantage, value creation and long-term partnerships (Cox & Ireland, 2015); (Cox, 2015). A paradigm shift from a tactical way of thinking about sourcing to a more strategic way of thinking is promoted by Cox through focusing on value-driven targets (Cox & Ireland, 2015). According to the strategic thinking by Cox, sourcing is a cross-functional process that focuses on "leverage value for money trade-offs", not just "tactical cost savings" (Cox, 2015). For value-driven management, strategic sourcing decision-makers like the chief procurement officer (CPO) should consider both the demand and supply bases for value creation to support the firm to achieve its strategic objectives.

Although strategic sourcing is fairly well recognized, managers are still challenged by many barriers to its development and management (Kocabasoglu & Suresh, 2006). Based on the benefits that Osterwalder and Pigneur (2013) attribute to conceptual modeling in support of strategic management, we derive several opportunities for enterprise modeling to contribute to strategic sourcing decision-making. First, an enterprise model can support the identification, formalization, and visualization of the

concepts that are relevant for value-driven strategic sourcing. Furthermore, the development of an enterprise model can support the design of a technique for generating and assessing strategic sourcing alternatives. Finally, an enterprise model can be the basis for developing computer-aided design tools, which assist in automating the process of designing strategic sourcing alternatives.

Based on our literature review of value-driven strategic sourcing (Rafati & Poels, 2015; 2016), key requirements of enterprise modeling to support (value-driven) strategic sourcing decision-making are:

- **Req.1**. A holistic view of the ecosystem of the enterprise considering the interaction of the enterprise with other actors (e.g., supplier, buyer, internal customer and external customer) in the value chain to achieve long-term objectives like sustainable competitive advantage, survivability and long-term partnership;
- **Req.2**. A language to interpret the (complex) phenomena of value-driven strategic sourcing such as value creation, capability configuration, resource integration, actor interactions;
- **Req.3**. The appropriate viewpoints and models to specify the contributions of enterprise to other systems (e.g., demanding, supplying and marketing) in an eco-system for value creation.

In the next section, we introduce an enterprise modeling discipline that can support strategic (sourcing) decision-making according to the requirements mentioned above.

## 3.3 Service-Oriented Enterprise Engineering

The only meaningful way to study an enterprise is viewing it as a system (Von Bertalanffy, 1969). Hence, the current discipline to design and develop the enterprise known as Enterprise Engineering (EE) is a domain of knowledge, concepts, theory and associated methodology for the architecture, design, implementation and (operational) management of enterprises, which are viewed as systems (Dietz & Hoogervorst, 2011). According to the EE discipline, there are two perspectives on the enterprise (as a system), each with its own value, its own purpose, and its own type of model (Figure 2): the teleological and the ontological one. The teleological perspective is about the function and the (external) behavior of a system. The corresponding type of model is the black-box model. This perspective is adequate for the purpose of using or controlling a system. The ontological perspective is about the construction and operation of a system for the purpose of building and changing a system, the corresponding type of model is the white-box model (Dietz, 2006; Dietz & Hoogervorst, 2008).

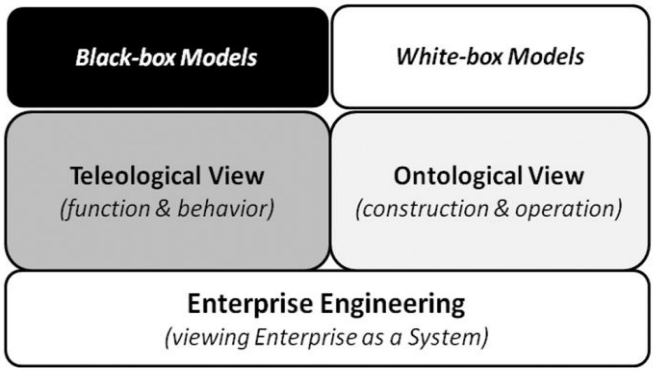


Figure 3.2. EE as an enterprise modeling discipline

For positioning different existing enterprise modeling approaches (Figure 3), we refer to the system development continuum (SDC) devised by (Pombinho, 2015) based on the teleological and ontological views of the enterprise.

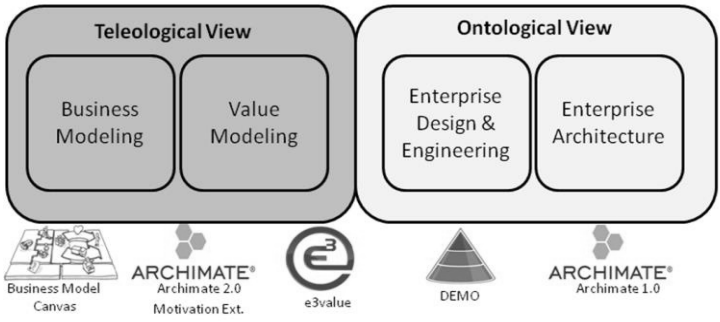


Figure 3.3. Positioning of reference approaches along the SDC (Pombinho, 2015)

The Teleology group of approaches contains business modeling approaches like business model canvas (Osterwalder & Pigneur, 2010) and value modeling approaches such as e3value (Gordijn & Akkermans, 2003) and VDML (Berre, De Man, & Lindgren, 2013) which emphasize explaining and modeling the purposes and goals of a given system. The Ontology group includes enterprise design and engineering approaches like DEMO (Dietz, 2006) and enterprise architecture modeling approaches such as ArchiMate (The Open Group, 2013) which focus on how a system is constructed and how its components behave collectively. Note that this positioning of modeling

approaches is not entirely strict and is only based on greater affinity with one of the sides on the main duality. For example, business modeling is a teleological-rooted discipline that may extend into ontological aspects (Pompano, 2015; Pombinho, Aveiro, & Tribolet, 2015).

The existing EE discipline contributes to support of decision-making by providing:

- Both holistic and reductionist views on the enterprise as a system that is a set of different elements so connected or related as to perform a unique function not performable by the elements alone;
- Different modeling approaches (e.g., e3value, ArchiMate, DEMO) to describe and measure the purpose (e.g., value and goals), the function (e.g., capabilities and services) and the construction (e.g., processes and resources) of enterprises according to a construction-function view that doesn't have the ability, however, to interpret the evolutionary dynamics like the enterprise's abilities and capacities for resources integration and resource configuration, service exchange, value creation and actor interactions;
- The white-box models to illustrate a (direct) conceptualization of a concrete system such as a DEMO model of an organization, a BPMN model of a workflow, and a UML object diagram of a software system, which are useful for building and changing the enterprise and its supporting systems;
- The black-box models to show the function and the (functional) behavior of a system like a business capability model or heatmap of an organization, which are useful for management and controlling of the enterprise.

To specify the EE contribution for strategic decision-making, a holistic view of the ecosystem of the enterprise is needed, not only on the enterprise as system **(Req.1)**. Furthermore, a modeling language is required to interpret the complex phenomena (e.g., value co-creation) which could not be easily described through a construction-function view **(Req.2).** Finally, the enterprise models and views are needed not only to show the enterprise's functions (black-box models) and the enterprise's constructions (white-box models), but also to represent the enterprise's interactions with other actors in an ecosystem to achieve strategic goals **(Req.3)**.

From a decision-making perspective, complexity refers to a particular combination of multiplicities and autonomies in a given context. A system is a phenomenon that can generate chaos, complexity or simply complication, depending on the interpretative capacity of the observer (decision-maker), not on the characteristics of the phenomenon. In other words, a system cannot be examined and understood as a single phenomenon, but it should

be contextualized within the framework of interconnections and interdependences with the external environment, from which the same system derives the degree of complication or complexity of its representation (Saviano & Berardi, 2009). The interpretation of complex emerging phenomena requires interdisciplinary approaches, and should synthesize both a reductionist view (analyzing elements and their relations) and a holistic view (capable of observing the whole) (Barile & Saviano, 2011; Polese, 2016). Systems theory is receiving increasing attention in service research due to its contribution to understanding complex emerging phenomena such as value co-creation, service exchange and service systems (Barile & Saviano, 2010). The (general) system theory later developed into: (i) 'open system theory' (OST), which focused on the dichotomy between the system and its environment; and (ii) the 'viable systems approach' (vSa), which adopts a behavioral approach to business and its interactions with its environment (Beer, 1984). To meet the mentioned requirements (section 2), we refine the general EE discipline to a service-oriented enterprise modeling (SoEE) discipline for strategic decision-making. We define SoEE as a modeling discipline founded on the Viable Systems Approach (vSa) that can support strategic decision-making in term of interpreting the complex phenomena like resources integration, capabilities configuration, services exchange, actor interaction and value creation (Figure 3). In particular, SoEE based on vSa is envisioned to be designed as an enterprise modeling approach that meets the requirements identified in section 2, in order to support strategic sourcing decision-making (Figure 4). It is the grounding in vSa that offers the potential to meet these solution requirements, as explained in what follows.

First, a viable system is defined as a system that survives, that is both internally and externally balanced, and that has mechanisms and opportunities to develop and adapt, and hence to become more and more efficient within its environment (Beer, 1984). According to vSa, a service ecosystem is defined as a viable system of service systems connected (internally and externally) by mutual value creation interactions realized through services exchange and resources integration (Spohrer, Barile, & Polese, 2010; Pels, Barile, Saviano, & Polese, 2014). The SoEE modeling discipline founded on vSa includes *both holistic and reductionist views on the ecosystem of enterprise as a service eco-system* **(Req.1)**. The SoEE views an enterprise as a viable system (service system) that is an organization based on interconnections and interdependence among its internal components (sub-systems) and the components of other systems (supra-systems) to evolve, develop and improve over time its conditions of survival.

Second, the viable systemic paradigm provides a conceptual distinction between 'structure' and 'system'. The advantages of the "Structure-System"

view of viable systems include a more effective ability to show the evolutionary dynamics of an enterprise. A structure is a set in which the elements are qualified as components recognized as having the capacity to contribute to perform specific functions. The passage from structure to system involves a passage from the static to the dynamic, as the focus moves from individual components and relationships to a holistic view of the observed reality. In defining structure and system, the terms relation and interaction are used with great emphasis. With reference to the structure, it can be conceived as an environment in which the components are in relation. Regarding the system, it can be conceived as the components interact. The concept of relation has a static nature and can be qualified as objective, requires an environment of reference and it is not dependent on what emerges from activating the relation itself. The concept of interaction requires a context, has a dynamic nature and depends on the observer (decision-maker) and what is observed from the observer's specific perspective of the investigation of reality (Barile & Saviano, 2011; Polese, 2016). vSa offers general reference schemes that are useful in interpreting the concept of complexity, highlighting its systemic (dynamic) nature (Barile, Pels, Polese, & Saviano, 2012). The SoEE modeling discipline founded on vSa provides *a dynamic and subjective view to interpret the complex phenomena like value creation and resource integration and actor interactions* **(Req.2)**. The structure-system paradigm of SoEE based on vSa is a useful scheme for investigating emerging (complex) phenomena by focusing on a structure-based view (StBV) or a systems-based view (SyBV) according to the nature of the phenomenon. The StBV is a static and objective perspective that is useful for describing and measuring a phenomenon. The SyBV is a dynamic and subjective perspective that is useful for interpreting the system dynamics. In other words, any (complex) phenomenon can be described by objectively focusing on its static components (parts) and relationships; however, to understand its dynamics, the phenomenon's context of interaction must be interpreted.

Finally, the vSa as a governance approach investigates the general implications of complexity for decision-making. The viable system in its behavioral qualification is characterized by the identification of two distinct logical areas: that of decision-making and operations (Polese, 2016). The vSa redefines the initial distinction between decision and action, specifying that in organizations it is always possible to identify two decisional areas: the governing body, deputed to the strategic decisions (decision-making), and the operational structure, deputed not only to executive operations, but also to operational decision-making related to problem solving. However, while problem solving refers to routine problems that characterize the management purpose, decision-making characterizes the purpose of the

government body and is essential for the viable development of the system, especially when operating in complex conditions (Golinelli, 2010). From an enterprise modeling perspective, white-box and black-box models are useful models for describing and measuring the enterprise' constructions (e.g., process, activity, applications, data and information) and the enterprise's functions and purposes (e.g., capability, services, value and goal) for problem-solving and (operational) decision-making. However, for strategic decision-making in term of interpreting complex phenomena (e.g., value creation, resource integration and actor interactions), the SoEE discipline (as third contribution) defines also *outside-box models to specify the contributions of an enterprise (as system) to other systems (sub-systems and super-systems) in its ecosystem to achieve strategic goals* **(Req.3).**

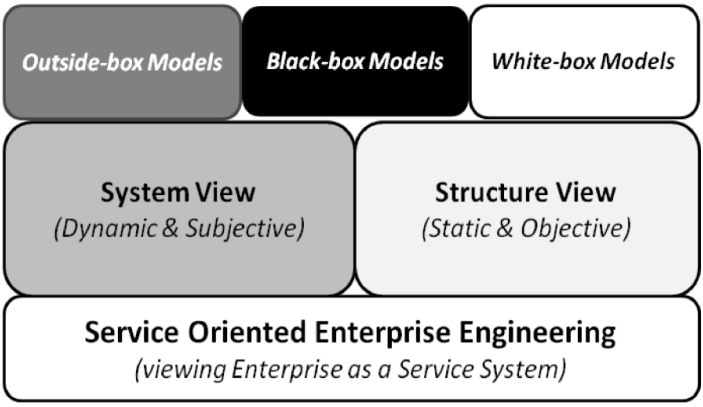


Figure 3.4. The envisioned SoEE modeling discipline

In the following section, we synthesize the contributions of the SoEE modeling discipline for strategic sourcing (as a critical area of strategic management) decision-making.

## 3.4 The contribution of SoEE in value-driven strategic sourcing

In the previous section, we introduced the SoEE founded on vSa as a modeling discipline for supporting strategic sourcing decision-making. We also discussed how the vSa foundation provides the potential to meet the solution requirements specified in section 2. In this section, we elaborate further on the contributions of the proposed SoEE modeling discipline for supporting strategic sourcing decision-making in relation to our solution requirements.

Strategic sourcing as a critical area of strategic management is a cross-functional process that goes beyond tactical cost savings and focuses on the 'value for money' of those assets that are critical for the value chain of the organization (Cox, 2015). For value-driven management, a thorough understanding of the entire value chain (supply side and demand side) is needed to achieve the strategic goals of an organization. The SoEE *provides a reductionist view of internal components of enterprise (e.g. internal actors, capabilities and resources) and also a holistic view of the components of other systems (e.g., external actors, supply-side capabilities and resources, demand-side capabilities and resources) which are able to deliver value to achieve long-term sourcing objectives* **(*Contribution 1*).**

To realize value-driven strategic sourcing, decision-makers need to interpret the complex sourcing phenomena like value creation, resource integration, capability configuration, and service exchange and actor interactions in a value ecosystem, which are not perceived only by a construction-function view. The SoEE *offers a dynamic and subjective view to interpret the complex sourcing phenomena depended on the decision-maker and what is perceived from the decision-maker's specific perspective of the investigation of reality* ***(Contribution 2).***

Referring to the procurement process (Figure 1), sourcing decision-making is a strategic decision-making like enhancing value creation, fostering long-term partnership, sustaining competitive advantage and survivability considering the complex sourcing phenomena like value creation, resource integration, capability configuration, and service exchange and actor interactions. While, the purchasing decision-making is a tactical and operational decision-making that refers to routine problem solving like cost-saving, performance tracking and monitoring, process and document verification. For strategic sourcing decision-making, the SoEE *suggests the outside-box (conceptual) models (e.g. supplier-buyer dependency model) to specify the interaction of enterprise (as system) with other systems (e.g., demanding, supplying, and marketing)* ***(Contribution 3).***

The proposed modeling discipline (SoEE) provides (only) a set of theory, views and model types for strategic (sourcing) decision-making. However, the decision-maker needs a modeling approach for applying the proposed systemic view and outside-box models toward strategic sourcing decision-making. In the next section, we introduce the C.A.R.S conceptual basis as a language (i) to interpret complex sourcing phenomena; and (ii) to develop sourcing outside-box models to facilitate (value-driven) strategic sourcing decision-making.

## 3.5 The C.A.R.S conceptual basis of a SoEE modeling approach for strategic sourcing

From the SoEE holistic view, we see the ecosystem of the enterprise as a service eco-system. The service ecosystem concept can be described by means of the Service-Dominant Logic (S-D Logic), which is an important theoretical framework for the study of service systems (Lusch & Vargo, 2006). The S-D logic is an economic worldview that emphasizes the co-creation of value by means of service and resource integration based on interaction and networked relationships (Vargo & Lusch, 2008). Furthermore, as shown by Polese and Di Nauta (2013), the vSa is a methodology capable of synthesizing the cultural/philosophical approach of S-D logic (as a way of thinking) with its research ground, represented by Service Science (SS) and thus vSa represents a useful framework for the interpretation of the complex phenomena involved in S-D logic (Polese & Di Nauta, 2013). The S-D Logic views a service system as a dynamic value co-creation configuration of resources that is connected internally and externally to other service systems by value propositions through resource integration and service exchanges (Vargo & Akaka, 2009). While the traditional view of (tactical) sourcing is more a 'goods-dominant' worldview of suppliers and buyers as senders and receivers of goods (hence procurement's focus on realizing cost savings), the value-driven management view of (strategic) sourcing matches better the value co-creation interpretation of provider-customer relationships as in S-D Logic (Eltantawy, Giunipero, & Handfield, 2014). Therefore, a service ecosystem perspective for strategic sourcing introduces a way of thinking about strategic sourcing in terms of S-D Logic. We observe a clear similarity between S-D Logic concepts (i.e., operand resource, operant resource, service system, service, actor and value) and (value-driven) strategic sourcing concepts (i.e., asset, competency, capability, service, actor and value), as defined below:

- **Operand Resources** as usually tangible, static and passive resources are the enterprise's assets that must be acted on to be a valuable resource (Vargo & Akaka, 2009; Poels, 2010; Lusch, Vargo, & O'Brien, 2007).
- **Operant Resources** as usually intangible, dynamic and active resources are the enterprise's ***competencies*** that act upon other resources to create value (Vargo & Akaka, 2009; Poels, 2010; Lusch et al., 2007).
- **Service System** as a ***capability*** is the capacity and ability to (re)configure resources (assets and competencies) internally and externally that enables the enterprise to achieve its sourcing objectives (Helfat, Finkelstein, Mitchell, Peteraf, Singh, Teece, & Winter, 2007; Vargo & Akaka, 2009).

- **Service** is an application of resources (assets and competencies) for the benefit of another party, which is the fundamental basis of value creation through economic exchange (Vargo & Akaka, 2009).
- **Actors** are engaged in the service exchanges as value co-creators through actor-to-actor (A2A) interactions. Actors as ***buyers***, ***suppliers***, ***internal and external customers*** are able to create value through participation in a value network with various relationships like supplier-buyer relationship and customer- provider relationship in both the demand and supply sides of the value chain (Vargo & Lusch, 2011a; Eltantawy et al., 2014).
- **Value** is an increase in the viability of the enterprise (as a system) (Vargo & Lusch, 2011b; Cardoso, Lopes, & Poels, 2014) that can only be created by the participation of other systems (e.g. supplying, buying and marketing). In the context of strategic sourcing, value creation results in two desired outcomes, competitiveness (Lusch, et al., 2007) and survivability (Vargo, Maglio, & Akaka, 2008).

Given these similarities, we define strategic sourcing in terms of S-D Logic as a strategic process for organizing and fine-tuning the enterprise's resources, competencies and capabilities internally and externally through actor-to-actor interactions with suppliers, buyers, internal and external customers, in order to create value to achieve (sustainable) competitive advantage or survivability. We use the mapping between S-D Logic and strategic sourcing concepts to design a conceptual basis of SoEE as C.A.R.S (i.e., Capability – Actor – Resource – Service). The C.A.R.S conceptual basis is defined as follows (Figure 5):

- **Capability.** A capability describes what an actor can do to sustain viability in its ecosystem. The notion of capability has been studied in the field of Strategic Management as a means to understand competitive advantage. Originally, emphasis was given to the resource-based view (Helfat & Peteraf, 2003) and more recently to the concept of dynamic capability (Teece, Pisano & Shuen, 1997), which are two fundamental theories involved in strategic sourcing. The term 'capability' emphasizes the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment (Teece, Pisano and Shuen, 1997). More specifically, a capability is the capacity and ability of an actor to create value through service exchanges. In this context, a capability can be considered as the result of a specific configuration of resources, which need to be sourced. The capability of an actor represents its potential long-term effects on the achievement of sourcing strategic objectives.
- **Actor.** An actor is seen a resource integrator that provides services, proposes value, creates value and captures value (Vargo & Lusch, 2011).

This actor notion is used to describe the role of the enterprise, its suppliers, buyers and customers in a value network.

- **Resource.** The resource base describes what an actor has, which can be configured to provide capabilities and to support the creation of value (Vargo & Akaka, 2009). As such, the resource base includes tangible and static resources (assets), as well as intangible and dynamic resources (competencies).
- **Service.** A service describes what the actor does through the application of resources (Vargo & Akaka, 2009). Services can be exchanged with other actors to create value and to achieve sourcing objectives, competitiveness (Lusch, et al., 2007) and survivability (Vargo, et al., 2008). We use this notion in C.A.R.S to capture the performance of actors in achieving sourcing objectives (i.e., bottom-line results).

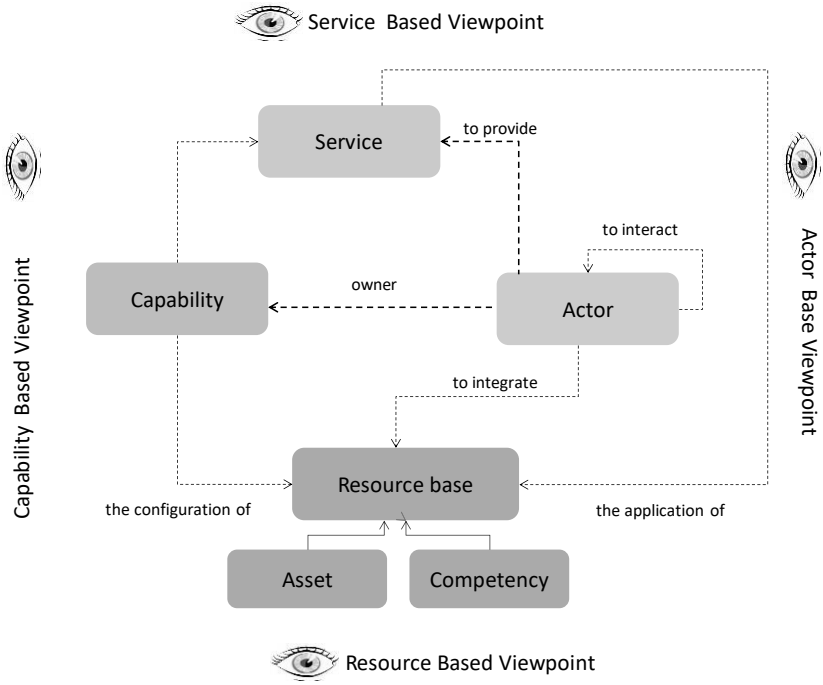


Figure 3.5. C.A.R.S conceptual basis

The C.A.R.S conceptual basis of the proposed SoEE modeling approach provides two views on the ecosystem of the enterprise as 1) a ***holistic view of*** interconnections and interdependence among external components (e.g., external capabilities, resources and actors) of super-systems (e.g., demanding, supplying and marketing); and 2) a ***reductionist view of*** interconnections and interdependence among internal components (e.g. internal capabilities, resources and actors) of sub-systems (e.g., financing,

operating, management). According to both holistic and reductionist views, we define the C.A.R.S viewpoints (as dynamic and subjective viewpoints on the complex sourcing phenomena), the related strategic sourcing decisions, and the outside-box sourcing models for strategic sourcing decision-making as in the table below:

Table 3.1. C.A.R.S viewpoints, decisions and models

| ***sourcing viewpoints*** *(dynamic and subjective)* | ***strategic sourcing decisions*** | ***outside-box sourcing models*** |
|---|---|---|
| **Capability based viewpoint** focuses on the abilities and capacities of sub-systems and super-systems with the aim of achieving viability (competitiveness and survivability) in an ecosystem | choosing the right sourcing alternatives (e.g., outsourcing, insourcing, co-sourcing, joint venture, strategic alliance, centralization-decentralization and globalization) | **Sourcing Portfolio Model** to explore various strategic sourcing alternatives and options of capabilities |
| **Resource based viewpoint** focuses on the specific strengths (i.e., superior resources and core competencies) of sub-systems and super-systems that are capable of value creation in an eco-system | Configuration of superior resources (as capabilities), application of superior resources (as services) and integration of superior resources (by actors) for turning them into a specific benefit | **Sourcing Positioning Model** to classify resources for setting strategies; also, we can use this model to classify capabilities (configuration of resources), actors (integration of resources) and services (application of resources) |
| **Actor based viewpoint** focuses on the interactions among actors of sub-systems and super-systems for value creation | (a) selecting the right actors and evaluating their strategic and performance dimensions for short-term and long-term partnerships; (b) finding new actors to increase the value co-creating potential in an ecosystem | **Sourcing Dependency Model** to specify the power of an actor against the power of other actors for buying or supplying in an ecosystem |

| | | |
|---|---|---|
| **Service based viewpoint** focuses on value co-creation by the participation of systems (sub or super) in an ecosystem to achieve sourcing desired outcomes (competitiveness and survivability) | Interpreting value co-creation (as a complex phenomenon) in an ecosystem in term of value proposition, value creation and value capturing by (sub or super) systems | **Sourcing Profile Model** to find opportunities for value creation in an ecosystem |

In the next section, we present a case-study of IT outsourcing in the healthcare industry as a proof-of-concept demonstration to illustrate and evaluate the use of the C.A.R.S systemic viewpoints and outside-box models for supporting strategic sourcing decision-making.

## 3.6 C.A.R.S proof-of-concept demonstration

We take an IT (out) sourcing case in the healthcare domain to demonstrate the feasibility the C.A.R.S systemic viewpoints and outside-box models for supporting strategic sourcing decision-making. The case-study was conducted at UZ Gent hospital, which is one of the largest hospitals in Belgium. The data collected for the case-study was obtained by interviews and document analysis. The IT (out) sourcing scenario described in this section is based on a thorough examination of existing business/working papers about the healthcare IT contracts and agreements of UZ Gent. Furthermore, we interviewed the chief information officer (CIO) of UZ Gent for a reality check of the developed scenario as well as for obtaining his feedback on our proof-of-concept demonstration of the C.A.R.S systemic viewpoints and outside-box models for supporting strategic sourcing decision-making for the considered scenario. In the following, based on the case-study data, we illustrate how a strategic sourcing decision-maker like the CIO can apply the proposed C.A.R.S sourcing viewpoints and outside-box models to make decisions about sourcing IT capabilities for the hospital.

Healthcare costs are increasing and hospitals are facing fierce competition to provide high quality services, continued lower operating margins, increased risks and potentially once-in-a-lifetime health care reform. With this backdrop, there is an increasing focus on supply chain management as a means to minimize risk, optimize operating costs, improve revenue, improve operating margins and hence enable the hospital to better serve the patient. Now more than ever, hospitals need strategic sourcing in order to survive within the sector. Strategic sourcing can play a key role in

creating a more efficient hospital. As IT becomes increasingly technologically complex in healthcare, well-designed partnerships with technology vendors and IT service providers are the critical factor to achieve value creation targets in a healthcare organization. Strategic sourcing plays a key role in creating a more efficient hospital through selecting the most appropriate go-to market strategy through selecting and evaluating the external suppliers in line with strategic goals. C.A.R.S as the conceptual basis of SoEE facilitates strategic sourcing decision-making for IT outsourcing in UZ Gent through:

a) ***Providing two (holistic and reductionist) views on the UZ Gent ecosystem*** including a holistic view of the capabilities, resources, actors and services of super-systems (e.g., hospital, supplying, demanding and consuming/marketing) and a reductionist view of the capabilities, resources, actors and services of sub-systems (e.g., managing, financing and operating). Super-systems refer to the systems which are involved in the value network of an organization or a focal firm. The supplying system comprises all the capabilities necessary to fulfil demand and focuses on an efficient supply by determining what the suppliers propose as value. The demanding system comprises all the capabilities to create demand by identifying what the buyers desire as value. Furthermore, the marketing system comprises all the capabilities to create demand by identifying what the customers perceive as value. Therefore, the CPO needs to manage the interactions between the organization's buyers, its suppliers and its internal and external customers by considering the resources, services, capabilities and relationships of supplying, demanding and marketing systems. From a holistic view (Figure 6), the demanding system as a super-system refers to the desired services and the desired value by buyers (e.g., general hospitals, university hospitals, medical research centers and laboratories). Moreover, the supplying system as a super-system refers to the provided services and the proposed value by suppliers (e.g., healthcare IT solution providers, business IT solution providers, ICT service providers and technology vendors). Furthermore, the marketing system refers to the requested services and the perceived value by customers (e.g., patients, clinical staffs, hospital staffs and end user). Finally, UZ Gent as a super-system refers to the exchanged services among super-systems and sub-systems and the captured value from market. From a reductionist view, UZ Gent includes sub-systems like managing, financing and healthcare operating which refer to internal services, capabilities, resources and actors (e.g. clinical staffs, hospital staffs and end user).

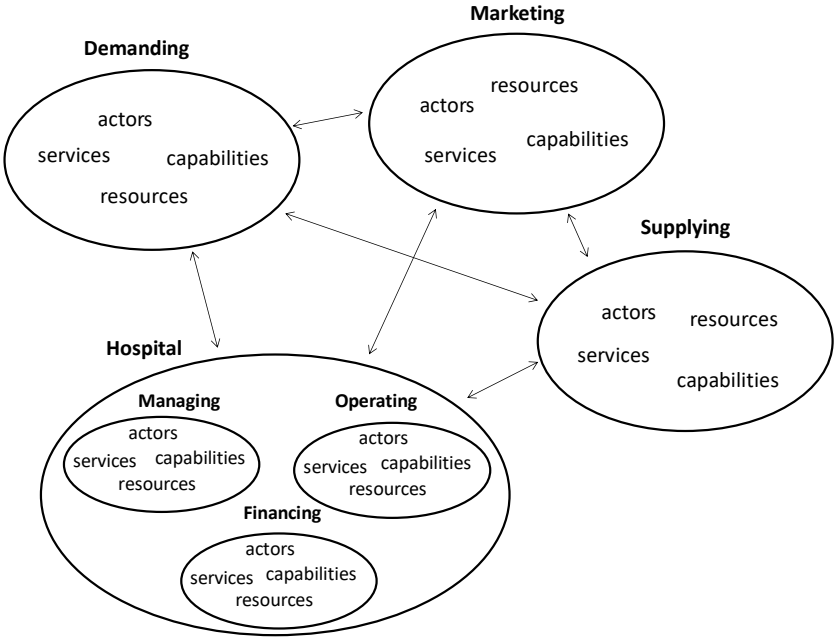


Figure 3.6. Super and sub systems in an ecosystem

***b)*** ***Systemic sourcing viewpoints and outside-box sourcing models*** to understand and interpret the complex sourcing phenomena like value creation, resource integrations, capability configurations, service exchanges and actor interactions to achieve strategic sourcing objectives of UZ Gent (e.g., fostering long-term partnership, sustaining competitive advantage and survivability) as below:

I. The **Service-based Viewpoint** focuses on value co-creation by participation of systems (e.g., demanding, supplying, marketing, managing, operation and financing) in the ecosystem of UZ Gent to achieve sourcing desired outcomes. From the service-based viewpoint, decision-makers can use the Sourcing Profile Model as an outside-box model to interpret value co-creation in term of the required capabilities, resources and services for value proposition, value perception and value capturing to find opportunities for IT outsourcing. Figure 7 shows the (both demand and supply side) sourcing profile model of UZ Gent focusing on core capabilities, resources, services and actors for value creation.

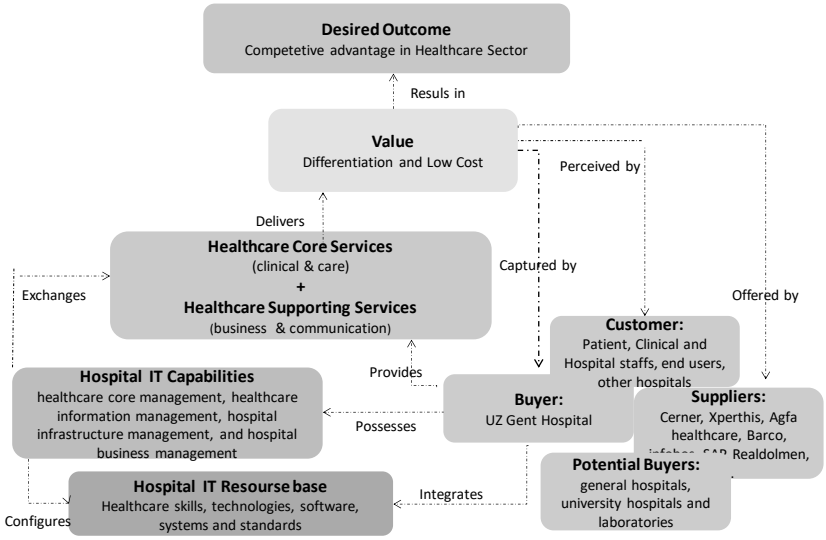


Figure 3.7. C.A.R.S profile model of UZ Gent

We further detail the sourcing profile model of UZ Gent as description (figure 8) in below:

| | |
|---|---|
| Desired outcome | competitive advantage in the healthcare sector |
| Value | differentiation (i.e., healthcare core services) and low costs (i.e., healthcare supporting services) |
| Exchange services | healthcare core services (i.e., including clinical services and care services) and healthcare supporting services (i.e., including business administration services and ICT communication services) |
| Customers | internal and external customers like patients, clinical staff, hospital staff, and other hospitals |
| Core capabilities | healthcare core management, healthcare information management, hospital infrastructure management, and hospital business management |
| Hospital IT resource base | Hospital and healthcare skills, technologies, software, systems and standards |
| Potential suppliers | (1) For the healthcare core services, potential suppliers are companies such as Cerner, Xperthis, Agfa Healthcare, Barco, Infohos, Carestream Healthcare, GE Healthcare, and Nexuz Healthcare<br>(2) For healthcare supporting services, potential suppliers are SAP, Oracle, Microsoft, EMC, Dimension Data, Realdolmen, HP, PHILIPS, Fujifilm, Dell and Siemens |
| Value proposition | (1) delivery of quality of care while capturing efficiency gains, providing timely access to the right information and intelligence, and offering integrated care (proposed by healthcare IT solution providers)<br>(2) increasing business management performance, supporting UZ Gent towards integrated business operations, simplifying the hospital IT infrastructure to help save money, and reducing the complexity of the hospital IT infrastructure through consolidation and virtualization (proposed by business IT solution providers) |
| Potential buyers | general hospitals, university hospitals, medical research centers and laboratories |

Figure 3.8. A description of C.A.R.S profile model of UZ Gent

II. The **Resource-based Viewpoint** focuses on the superior resources of UZ Gent ecosystem that are capable of value creation to achieve sourcing

objectives (competitive advantage in the healthcare sector). For the resource-based viewpoint, the decision-maker can apply the Sourcing Positioning Model as an outside-box model to classify resources (configuration of resources, application of resources, and integration of resources) for setting sourcing strategies. The positioning analysis of (configuration, integration, application) resources is based on two theory-based dimensions 1) the resource basis to determine the strategic degree of resources as valuable resources (V), rare resources (R), inimitable resources (I) and non-substitutable resources (N) for value creation (Barney 1991); and 2) The competition impact to determine the competitive degree of (the configuration of) resources as sustainable competitive advantage (SCA), competitive advantage (CD), temporary competitive advantage (TCA) or parity competition (PC) to create economic value (Hill and Jones, 1991). This analysis results in a 2 x 2 matrix as sourcing positioning model with four categories: (i) critical-strategic, (ii) strategic, (iii) critical-tactical, and (iv) tactical. Figure 9 represents a positioning model of the UZ Gent capabilities (resources configurations) that were identified in the sourcing profile model (fig 7).

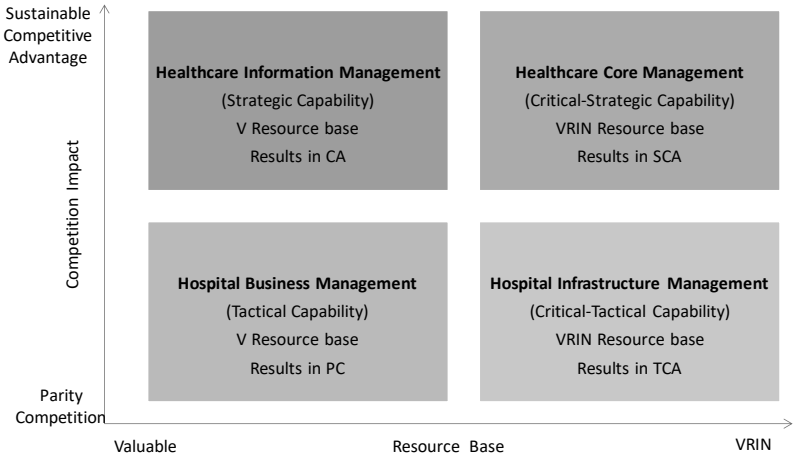


Figure 3.9. C.A.R.S positioning model of UZ Gent capabilities

According to the positioning model (Figure 9), we define the UZ Gent capabilities as below description (figure 10):

| | |
|---|---|
| *healthcare core management (a critical-strategic capability* | A configuration of VRIN resources and competencies (e.g., specialized healthcare skills, technologies, systems and standards) that is able to achieve a sustainable competitive advantage in the demand market |
| *healthcare information management (a strategic capability)* | A configuration of valuable resources and competencies such as healthcare skills, technologies, systems and standards that is able to achieve competitive advantage in the demand market |
| *hospital infrastructure management (a critical-tactical capability)* | A configuration of VRIN resources and competencies (e.g., hospital technologies, networks, and websites and data centers) that is able to achieve temporary competitive advantage in the demand market |
| *hospital business management (a tactical capability)* | A configuration of valuable resources and competencies (e.g. management information systems, business managerial skills and competencies), which results in parity competition in the demand market |

Figure 3.10. A description of C.A.R.S positioning model of UZ Gent capabilities

III. The **Actor-based Viewpoint** focuses on the interactions among actors of the UZ Gent ecosystem for value creation to achieve sourcing desired outcomes. For the actor-based viewpoint, the decision-maker uses the Sourcing Dependency Model as an outside-box model to determine the dependency between buyers and suppliers to shape relationship strategies in the supply market. Figure 11 takes as example the picture archiving service that is provided to UZ Gent by Agfa Healthcare, which is a specialized healthcare IT solution provider. The buyer-supplier dependency analysis classifies buyer-supplier dependency into four categories (buyer dominance, supplier dominance, interdependence and independence) based on (1) the critically and financial impact of service; and (2) the availability of alternative sources (buyers and suppliers) and their switching or searching costs. The relationship between UZ Gent and Agfa Healthcare is positioned as a "buyer dominance" relationship.

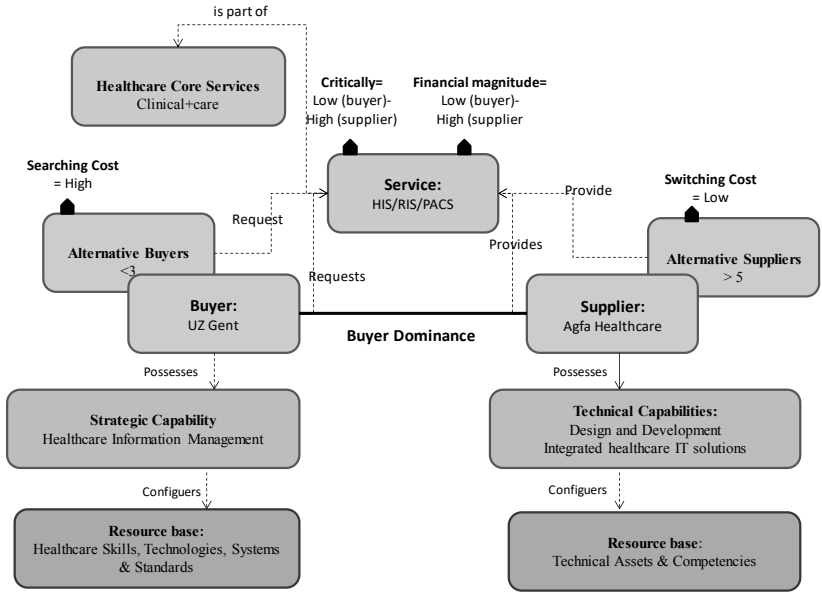


Figure 3.11. C.A.R.S dependency model of UZ Gent and Agfa Healthcare

The key concepts of the sourcing dependency model between UZ Gent and Agfa Healthcare (Figure 11) are described as below description (Figure 12):

| | |
|---|---|
| *Exchanged service* | the picture archiving service for a seamless linkage of digital images with information from clinical information systems and other databases in the hospital |
| *buyer* | UZ Gent |
| *Supplier (provider)* | Agfa Healthcare as a specialized healthcare IT solution provider |
| *The critically of service* | low-level criticality for UZ Gent<br>High-level criticality for Agfa Healthcare |
| *The financial impact of service* | low-level financial impact for UZ Gent<br>High-level financial impact for Agfa Healthcare |
| *Alternative suppliers* | Xperthis, Barco, Infohos, Carestream Healthcare, GE Healthcare, Nexuz Healthcare, and IBM Healthcare |
| *Alternative buyers* | one university hospital and two general hospitals |
| *Switching costs among suppliers* | low-level switching costs |
| *Searching cost for new buyers* | high-level searching costs |

Figure 3.12. A description of dependency model of UZ Gent and Agfa Healthcare

IV. The **Capability-based Viewpoint** focuses on the abilities and capacities within the UZ Gent ecosystem with the aim of achieving a competitive advantage in the healthcare sector. From the capability-based viewpoint, decision-makers can use the Sourcing Portfolio Model as an outside-box model for classifying and setting capability sourcing strategies. The sourcing portfolio model (Figure 10) classifies capability sourcing into 16 categories (Cox, 2014) based on two dimensions: (1) capability positioning (e.g. tactical capability, tactical-critical capability, strategic capability and strategic-critical capability) and (2) Dependency positioning (e.g. buyer dominance, supplier dominance, interdependence and independence). The sourcing portfolio model (Figure 13) suggests sourcing recommendations for capabilities located in different supply market circumstances (leverage, alliance, market and dependency) namely: build partnerships (for long-term collaboration) with suppliers for the alliance domain; make competition among suppliers for the leverage domain; change nature of demand for the dependency domain; and manage spend by focusing on functional efficiency internally and using very short-term agreements for the market domain.

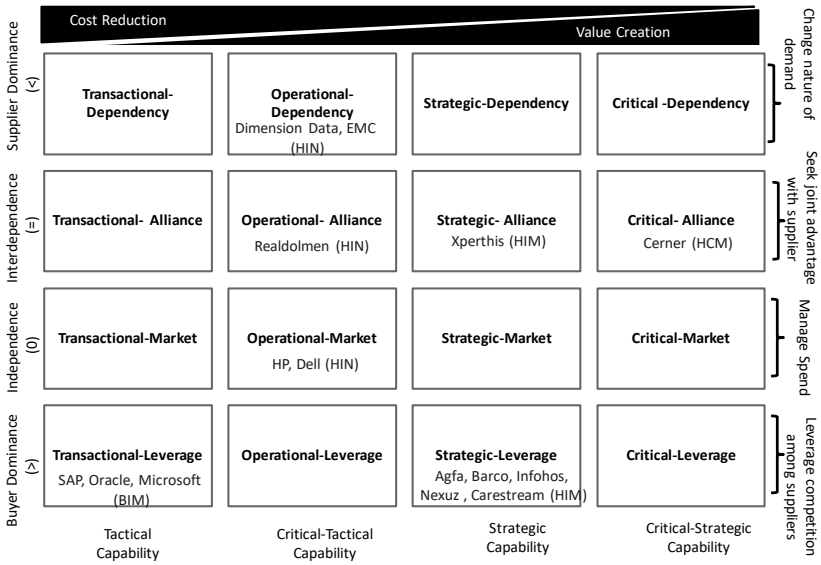


Figure 3.13. C.A.R.S sourcing portfolio model of UZ Gent capabilities

According to the sourcing portfolio model (Figure 13), possible strategies for IT sourcing of UZ Gent capabilities are recommended by Figure 14:

| | |
|---|---|
| healthcare core management capability (HCM) | ▪ Develop an integrated IT system in-house (i.e., insourcing),<br>▪ Maintain the strategic partnership with Cerner through long-term agreements for value creation |
| healthcare information management capability (HIM) | ▪ Exploit the buying power through market competition and short-term agreements with Agfa Barco, Infohos, Carestream, Nexuz, Healthcare<br>▪ Develop a strategic partnership with Xperthis through long-term collaborations |
| healthcare infrastructure management capability (HIN) | ▪ Exploit market competition through short-term agreements with HP and Dell<br>▪ Develop a strategic partnership with RealDolmen<br>▪ Accept the hospital's dependency on Dimension Data and EMC and the existence of a locked-in partnership |
| business information management capability (BIM) | ▪ realizing market competition through short-term agreements with SAP, Oracle and Microsoft |

Figure 3.14. Sourcing strategies based on the sourcing portfolio model

We used C.A.R.S viewpoints and related sourcing outside-box models (profile model, dependency model, positioning model and sourcing portfolio model) to interpret and represent the value-driven interaction of UZ Gent with other actors of its ecosystem by considering their capabilities, resources and services for value creation. The CIO of UZ Gent evaluated the C.A.R.S viewpoints and related sourcing outside-box models as having potential to support strategic sourcing decision-makers to achieve value-related targets (e.g., sustainable competitive advantage and long-term partnerships). According to the CIO's feedback, the C.A.R.S conceptual basis, viewpoints and outside-box sourcing models are able to provide a stable view that can improve the strategic sourcing discussions and enhance related sourcing decision-making. Using the approach, different alternative strategies for the strategic sourcing of IT services related to the hospital's capabilities were identified in a systematic and well-documented manner.

## 3.7 Conclusion

Strategic sourcing as a critical area of strategic management is a cross-functional process focuses on achieving value-driven targets like sustainable competitive advantage and long-term partnerships. Enterprise modeling can contribute to strategic sourcing decision-making by helping in the conceptualization, design and exploration of multiple strategic options. The key requirements for applying enterprise modeling to support (value-driven) strategic sourcing decision-making are (i) offering a holistic view of the ecosystem of enterprise; (ii) providing a language to interpret the (complex) phenomena of value-driven strategic sourcing; and (iii) allowing to build the appropriate enterprise models to specify the value-driven contributions of the enterprise to other systems. According to these requirements, we

proposed a service-oriented modeling discipline (SoEE) by refining an existing modeling discipline, i.e., enterprise engineering (EE), grounding it on the viable systems approach (vSa) to support decision-makers at the strategic management level for strategic sourcing. The vSa foundation of SoEE allows viewing an enterprise as a viable system focusing on its value-driven interactions among sub-systems and supra-systems in its ecosystem. Therefore, the proposed modeling discipline founded on vSa provides (i) a systemic view (dynamic and subjective) to interpret complex phenomena such as value creation, resource integration, capability configuration, service exchange and interactions between actors in term of (value-driven) strategic sourcing; and (ii) the outside-box models needed to represent the value-driven contribution of the enterprise to other systems of its ecosystem to achieve strategic sourcing objectives. By considering S-D Logic as the preferred theory of Service Science, we introduced C.A.R.S as a modeling approach (of SoEE) for applying the proposed systemic view and outside-box models for strategic sourcing decision-making. The C.A.R.S conceptual basis defined on S-D Logic includes four sourcing (systemic) viewpoints (e.g., capability based view, service based view, resource based view and actor based view) and four corresponding outside-box sourcing models (e.g., sourcing portfolio model, positioning model, dependency model and profile model) that support decision-makers in their value-driven strategic sourcing. The approach was demonstrated on an IT (out)sourcing scenario of large university hospital, resulting in suggested sourcing strategies for different vendors and suppliers. Positive feedback on the approach was obtained from the hospital's CIO.

The C.A.R.S conceptual basis for a SoEE modeling approach for supporting strategic sourcing decision-making as presented in this paper is a way of thinking for which we should further elaborate (ii) a way of modeling (i.e., a modeling language and method), (iii) a way of working (i.e., a model-based analysis approach) and (iv) a way of supporting (i.e., a computer-aided design tool). While this paper focused strongly on the Viable Systems Approach (vSa) to design a systemic view of strategic sourcing, in other publications we explored further Service Science thinking and SD-Logic as the conceptual basis of a new modeling and analysis language that helps organizations in exploring sourcing alternatives according to value-driven management (Rafati and Poels, 2014; 2015; 2016). The current paper thus complements our earlier work on a theoretical basis for C.A.R.S by adding a Systems Theoretic component to its development. For supporting the way of modeling, we developed a capability-oriented enterprise modeling technique (including a modeling language and a modeling method) for the systemic exploration of sourcing alternatives, which emphasizes the delivery of value to achieve desired outcomes (Rafati, Roelens and Poels,

2017). Finally, we define our future research as (1) a way of working to implement value-driven management in strategic sourcing focusing on analytical techniques with the aim of realizing fact-based decision-making; and (2) a way of supporting to develop a computer-aided design tool by an assessment of the ability of existing enterprise modeling tools to support the C.A.R.S technique.

Although this evaluation enabled us to demonstrate the potential utility of C.A.R.S as a SoEE modeling approach, we acknowledge that it is difficult to generalize the results based on the single case-study. Therefore, in future research, we will investigate the application scope of the proposed SoEE modeling approach by targeting different domains and different sourcing trends (such as shared service centers, sustainable procurement, IT outsourcing, offshoring and global sourcing).

## Acknowledgements

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## References

Barile, S., & Saviano, M. (2010). A new perspective of systems complexity in Service Science. Impresa, Ambiente, Management, 4(3), 375-414.

Barile, S., & Saviano, M. (2011). Foundations of systems thinking: the structure-system paradigm.

Barile, S., Pels, J., Polese, F., & Saviano, M. (2012). An introduction to the viable systems approach and its contribution to marketing. Journal of Business Market Management, 5(2), 54-78.

Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of management, 17(1), 99-120.

Beer, S. (1984). The viable system model: Its provenance, development, methodology and pathology. Journal of the operational research society, 35(1), 7-25.

Berre, A. J., De Man, H., & Lindgren, P. (2013). Business Model Innovation with the NEFFICS platform and VDML. In NGEBIS'2013 workshop at CAISE (pp. 24-30).

Butner, B. (2009). Sourcing in a Demanding Economic Environment. IBM Global Business Services.

Cardoso, J., Lopes, R., & Poels, G. (2014). Service systems: concepts, modeling, and programming. Springer International Publishing.

Clark, H. H., & Brennan, S. E. (1991). Grounding in communication. Perspectives on socially shared cognition, 13(1991), 127-149.

Cox, A. (2014). Sourcing Portfolio Analysis: Power Positioning Tools for Category Management & Strategic Sourcing. Earlsgate Press.

Cox, A. (2015). From Spend Management to Supply Management - Improving Category Management & Strategic Sourcing. Technical report, IIAPS.

Cox, A., & Ireland, P. (2015). Value Sourcing: From Spend Management to Supply Management, Kindle E-Book, Earlsgate Press, Stratford-upon-Avon.

Dietz, J. L. (2006). Enterprise ontology: theory and methodology. Springer Science & Business Media.

Dietz, J. L., & Hoogervorst, J. A. (2008, March). Enterprise ontology in enterprise engineering. In Proceedings of the 2008 ACM symposium on Applied computing (pp. 572-579). ACM.

Dietz, J. L., & Hoogervorst, J. A. (2011). Enterprise engineering manifesto. Advances in Enterprise Engineering I. LNBIP, 10.

Eltantawy, R., Giunipero, L., & Handfield, R. (2014). Strategic sourcing management's mindset: strategic sourcing orientation and its implications. International Journal of Physical Distribution & Logistics Management, 44(10), 768-795.

Eppler, M. J., & Ge, J. (2007). Communicating with diagrams: how intuitive and cross-cultural are business graphics? Università della Svizzera italiana.

Golinelli, G. M. (2010). Viable systems approach (VSA): Governing business dynamics. Cedam.

Gordijn, J., & Akkermans, J. M. (2003). Value-based requirements engineering: exploring innovative e-commerce ideas. Requirements engineering, 8(2), 114-134.

Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capability lifecycles. Strategic management journal, 24(10), 997-1010.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., & Winter, S. G. (2009). Dynamic capabilities: Understanding strategic change in organizations. John Wiley & Sons.

Hevner, V. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. MIS quarterly, 28(1), 75-105.

Hill, C., & Jones, G. (1991). Strategic Management. An Integrated Approach.

Kocabasoglu, C., & Suresh, N. C. (2006). Strategic sourcing: an empirical investigation of the concept and its practices in US manufacturing firms. Journal of Supply Chain Management, 42(2), 4-16.

Lengler, R., & Eppler, M. J. (2007, January). Towards a periodic table of visualization methods for management. In IASTED Proceedings of the Conference on Graphics and Visualization in Engineering (GVE 2007), Clearwater, Florida, USA.

Lohse, G. L., Biolsi, K., Walker, N., & Rueter, H. H. (1994). A classification of visual representations. Communications of the ACM, 37(12), 36-50.

Lusch, R. F., & Vargo, S. L. (2006). Service-dominant logic: reactions, reflections and refinements. Marketing theory, 6(3), 281-288.

Lusch, R. F., Vargo, S. L., & O'Brien, M. (2007). Competing through service: Insights from service-dominant logic. Journal of retailing, 83(1), 5-18.

Osterwalder, A., & Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons.

Osterwalder, A., & Pigneur, Y. (2013). Designing business models and similar strategic objects: the contribution of IS. Journal of the Association for information systems, 14(5), 237.

Pels, J., Barile, S., Saviano, M., & Polese, F. (2013). VSA and SDL contribution to strategic thinking in emerging economies.

Poels, G. (2010). The resource-service-system model for Service Science. Advances in Conceptual Modeling–Applications and Challenges, 117-126.

Polese, F., & Di Nauta, P. (2013). A viable systems approach to relationship management in SD logic and Service Science. 73(2), 113-129.

Polese, F., Tommasetti, A., Vesci, M., Carrubbo, L., & Troisi, O. (2016, May). Decision-making in smart service systems: A viable systems approach contribution to Service science advances. In International Conference on Exploring Services Science (pp. 3-14). Springer, Cham.

Pombinho, J. (2015). Value-oriented enterprise transformation—design and engineering of value networks (Doctoral dissertation, Ph. D. thesis, Universidade de Lisboa---Instituto Superior Técnico).

Pombinho, J., Aveiro, D., & Tribolet, J. (2015). Value-Oriented Specification of Service Systems: Modeling the Contribution Perspective. Business Law and Ethics: Concepts, Methodologies, Tools, and Applications: Concepts, Methodologies, Tools, and Applications, 374.

Rafati, L., & Poels, G. (2013). Service Oriented Enterprise Engineering: Applying Viable System Approach (vSa) in Enterprise Engineering for Sourcing Decision Making. In Enterprise Distributed Object Computing Conference Workshops (EDOCW), 2013 17th IEEE International (pp. 124-129). IEEE.

Rafati, L., & Poels, G. (2014). Capability sourcing modeling. In International Conference on Advanced Information Systems Engineering (pp. 77-87). Springer International Publishing.

Rafati, L., & Poels, G. (2015). Towards Model-Based Strategic Sourcing. In International Workshop on Global Sourcing of Information Technology and Business Processes (pp. 29-51). Springer International Publishing.

Rafati, L., & Poels, G. (2016). Service-dominant strategic sourcing: value creation versus cost saving. In International Conference on Exploring Services Science (pp. 30-44). Springer International Publishing.

Rafati, L., Roelens, B., & Poels, G. (2017). Designing a domain-specific modeling technique for value-driven strategic sourcing. Submitted to The International Journal of Enterprise Modelling and Information Systems Architectures (EMISA).

Saviano, M., & Berardi, M. (2009). Decision-Making Under Complexity. The Case of District SME. The Case of District SME, 1619-1643.

Spohrer, J., Barile, S., & Polese, F. (2010). System Thinking for Service Research Advances. Service Science, 1(2), 130-135.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic management journal, 509-533.

The Open Group. (2013). Archimate 2.1 Specification: Van Haren Publishing.

Van Weele, A. J. (2009). Purchasing and supply chain management: Analysis, strategy, planning and practice. Cengage Learning EMEA.

Vargo, S. L., & Akaka, M. A. (2009). Service-dominant logic as a foundation for service science: clarifications. Service Science, 1(1), 32-41.

Vargo, S. L., & Lusch, R. F. (2008). From goods to service (s): Divergences and convergences of logics. Industrial marketing management, 37(3), 254-259.

Vargo, S. L., & Lusch, R. F. (2011a). Service-dominant logic: Looking ahead. In Presentation at the Naples Forum on Service, June (pp. 14-17).

Vargo, S. L., & Lusch, R. F. (2011). It's all B2B... and beyond: Toward a systems perspective of the market. Industrial marketing management, 40(2), 181-187.

Vargo, S. L., Maglio, P. P., & Akaka, M. A. (2008). On value and value co-creation: A service systems and service logic perspective. European management journal, 26(3), 145-152.

Von Bertalanffy, L. (1969). General system theory: foundations, development, applications (Revised Edition).

# 4

# Value-Driven Strategic Sourcing Based on Service-Dominant Logic

**Summary:** This chapter addresses the second research objective to design i) a systemic view on strategic sourcing with emphasis on value creation to realize strategic sourcing as value-driven management; and ii) a conceptual modeling language for the exploration of strategic sourcing alternatives to achieve value-driven targets. To help realize the new paradigm of value-driven strategic sourcing, this chapter describes the further development of the new conceptual modeling approach for exploring and evaluating strategic sourcing alternatives based on a systemic view of value co-creation.
**Reference:** Rafati, L., Poels, G. Value-driven strategic sourcing based on Service- Dominant Logic. Accepted for Service Science Journal.

# Value-Driven Strategic Sourcing Based on Service-Dominant Logic

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**Abstract.** Currently, procurement is approached as a tactical process focused on spend management. The aim of this process is the identification of cost savings. A new paradigm of procurement is emerging that recognizes procurement as a value creation practice. This paradigm, referred to as value-driven strategic sourcing, lacks instruments for implementation. This paper presents a new conceptual modeling approach for exploring and evaluating sourcing alternatives that is based on a systemic view of value co-creation. Our approach, called C.A.R.S (which stands for Capability, Actor, Resource, and Service), is the result of a Design Science Research project. The paper presents the underlying conceptualization of C.A.R.S, which was constructed through a mapping between service ecosystem concepts grounded in Service-Dominant Logic and the Viable System Approach and strategic sourcing concepts derived from the Resource-Based View Theory of competitive advantage, the Dynamic Capability Theory, and the Relational View Theory of cooperation and competition. Apart from presenting the theoretical foundation of C.A.R.S, we also demonstrate by means of a case study of sustainable procurement in a global materials technology company how a model-based approach based on C.A.R.S helps implementing value-driven strategic sourcing. The case-study provides a proof-of-concept of the potential utility of our approach as it addresses specific problems with the company's current procurement practices.

**Keywords:** Service-Dominant Logic, Viable System Approach, strategic sourcing, capability sourcing, value co-creation, value-driven management.

## 4.1 Introduction

The increasing importance of supply chains and their management has resulted in an evolving view of procurement from a buying function to a key element in a strategic approach to supply chain management (Chen et al 2004), (Anderson and Rask 2013). The strategic role of procurement has been recognized through its sub-process of *strategic sourcing* as described in (Van Weele 2009), (Cox 2015). Fig. 1 depicts the starting of procurement with spend analysis and its ending with payment. Two distinct phases in procurement can be distinguished. The first phase is sourcing which involves the source-to-contract (S2C) process with three sequential activities: 1) spend analysis as the activity which collects and analyzes spend data and

identifies potential cost reduction opportunities; 2) the activity of strategic sourcing proper in which the best go-to-market sourcing strategy is decided on, to be followed by supplier evaluation and selection taking into account the strategic goals of the company; and 3) contract management which is the activity responsible for tracking and controlling the legal and formal agreements with suppliers in order to fully exploit contract arrangements. The second phase is purchasing which involves the purchase-to-pay (P2C) process with another three activities: 1) the requisition of the purchase; 2) purchase the placing of the purchase order and the receiving of its confirmation; 3) notifying the delivery and effectuating the payment.

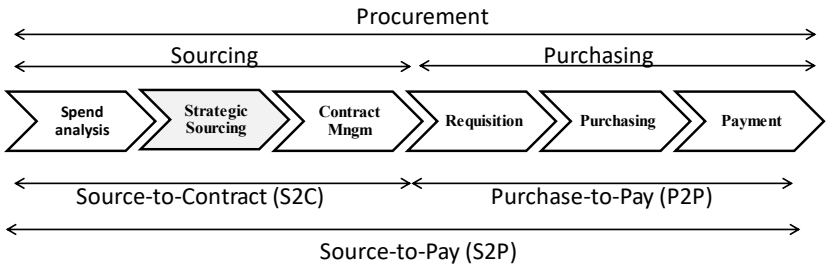


Figure 4.1. Procurement process

Approaches in use for strategic sourcing such as the purchasing chessboard approach (Schuh et al. 2009) put strong emphasis on achieving cost savings targets by means of spend analysis techniques and market positioning techniques (Kraljic 1983), (Cox 2001). A shortcoming of these approaches is that they implement strategic sourcing as a tactical spend management process instead of a strategic important process for the organization (Cox 2015). These approaches also assume that strategic sourcing is conducted on a project per project basis rather than as a continuous process. Typically, the strategic sourcing project involves segmenting purchase categories by the size of spend (e.g., using the spend cube analysis technique) and then creating 'category project teams' responsible for delivering cost savings within their assigned purchase category.

The unit of analysis in existing approaches to strategic sourcing is the individual firm and the focus is on the firm's transactions in supply management to achieve cost-saving targets. According to (Cox and Ireland 2015), organizations have to understand that strategic sourcing should be implemented as an end-to-end process, which enables to manage the flow of value within the company and between the company and its suppliers, customers, complementors and competitors. Cox (2015) introduced a new

(strategic) way of thinking for strategic sourcing as value-driven management that focuses on relationships (rather than transactions) in supply management to achieve value-driven targets. According to this strategic thinking, sourcing is a process that is implemented cross-functionally and that continuously evaluates trade-offs of value for money.

The strategic thinking of Cox recognizes that organizations are rarely interested in purchase items because of what they cost. Organizations need to source items in order to achieve their strategic goals commercially and operationally. To meet these goals, they need to understand the value embedded within the items of their purchase categories, and not just their price or cost of ownership. In other words, strategic sourcing requires an understanding of the entire value net. The value net comprises all interdependencies and relationships for joint value creation (i.e., 'co-creation') among the actors in a firm's network, enabling firms to compete and cooperate at the same time (Brandenburger and Nalebuff 2011).

Although the need for acquiring a deep understanding of an organization's value creation relationships is fairly well recognized, managers are still challenged by many barriers to its implementation (Kocabasoglu and Suresh 2006). The main challenge is the lack of practical instruments (i.e., tools and techniques) to implement the value-driven management approach to strategic sourcing (Cox 2015). Our research aims at addressing this challenge. After conducting a literature review and analysis of value-driven management in strategic sourcing, we specified the following requirements to help realizing value-driven strategic sourcing (Rafati and Poels 2016): *Creating a holistic view on the firm's value network (Req.1), emphasizing value co-creation (Req.2) by considering inter-firm interactions (Req.3), to support an organization in exploring strategic sourcing alternatives (Req.4) in order to better achieve its strategic goals.*

Our approach to meet these requirements is conceptual modeling (Thalheim 2012). The field of Conceptual Modeling can contribute to strategic sourcing decision-making in different ways. Based on Osterwalder and Pigneur (2013), we argue that a conceptual model can support the identification, formalization, and visualization of the concepts that are relevant for value-driven strategic sourcing. Furthermore, conceptual modeling can support the design of model-based techniques for generating and assessing strategic sourcing alternatives. Finally, a conceptual model can be the basis for developing computer-aided design tools, which assist in automating the process of designing strategic sourcing alternatives.

To build conceptual models for describing, exploring, and evaluating possible alternatives following value-driven strategic sourcing thinking, a new domain-specific modeling language for strategic sourcing is needed. Hence, in (Rafati and Poels 2016) we defined two research objectives:

- The design of a systemic view of strategic sourcing that focuses on the value co-creation relations that are embedded in the interactions between firms, like resource integration, capability configuration and service exchanges. *(referring to Req.1, Req.2, and Req.3)*
- The design of a conceptual modeling language that is based on the systemic view of strategic sourcing, to be used for exploring alternatives in strategic sourcing such that value-driven targets can be achieved. *(referring to Req.4)*

A systemic view on strategic sourcing recognizes that a firm is part of a value net of organizations that are linked through inter-firm relationships which aim at value co-creation. In this paper, we argue that such systemic view can be designed by taking a service ecosystem perspective of an organization. We introduce our proposed language called C.A.R.S (Capability – Actor – Resource – Service) and explain how we designed it through a mapping between service ecosystem concepts grounded in Service-Dominant Logic (Lusch and Vargo 2006), (service) systems thinking (Spohrer et al. 2010) and the Viable System Approach (Polese and Di Nauta 2013) and strategic sourcing concepts derived from the Resource-Based View Theory (Barney 1991) of competitive advantage, the Dynamic Capability Theory (Helfat et al. 2009), and the Relational View Theory (Dyer and Singh 1998) of cooperation and competition. We also demonstrate by means of a case study of sustainable procurement in a global materials technology company how a model-based approach based on C.A.R.S helps implementing value-driven strategic sourcing.

As the intended solution to our research problem is the creation of a new artefact, we engaged in Design Science Research (DSR) (Hevner et al. 2004). Section 2 describes our research process which followed the DSR methodology proposed in (Peffers et al. 2007). Section 3 presents the theoretical foundation for the design of the new modeling language. It presents a systemic view of strategic sourcing by viewing an enterprise as a service ecosystem focused on value creation. Section 4 presents C.A.R.S as domain-specific strategic sourcing modeling language. Section 5 presents a proof-of-concept (PoC) demonstration and evaluation of a C.A.R.S model-based approach to exploring and evaluating strategic sourcing alternatives by means of a sustainable procurement case-study. Finally, section 6 discusses our contribution and its implications for research and practice and outlines future research.

## 4.2 Research Methodology

DSR aims at the scientifically rigorous creation of new artifacts that solve problems relevant to practice and that contribute new knowledge which was acquired through the artifact's development and evaluation process (Hevner et al. 2004). DSR artifacts include constructs, models, methods, instantiations and design theories (Gregor and Hevner 2013). The C.A.R.S modeling language design presented in this paper is a new conceptualization of strategic sourcing according to the value-driven management perspective of Cox (2015) and can be regarded as a model that relates a set of constructs that we propose for describing value co-creation embedded in inter-firm relationships. It thus acts as a new way of modelling to implement the way of thinking of value-driven strategic sourcing. The language is the conceptual basis for a modelling and analysis approach to explore strategic sourcing alternatives, which provides for a new way of working in strategic sourcing, and can thus be seen as a method artifact. The focus of the paper is on presenting the underlying conceptualization of C.A.R.S (and thus also the theoretical foundation of our solution), whereas the C.A.R.S model-based approach will be illustrated through a case-study which involves an instantiation of the method to the case of sustainable procurement.

Our research process for designing the C.A.R.S conceptualization was guided by the DSR methodology of Peffers et al. (2007) and consists of six steps: (i) Problem identification and motivation through literature review on strategic sourcing; (ii) Definition of solution requirements and research objectives by an analysis of value-driven management in strategic sourcing through the lens of Service Science concepts and theories; (iii) Design and development of a modeling language for systemic exploration of strategic sourcing alternatives; (iv) PoC Demonstration and (v) Evaluation through a case-study; (vi) Scholarly communication within domains such as System Thinking (Rafati and Poels 2017), Service Science (Rafati and Poels 2016) and Strategic Management (Rafati and Poels 2015). Our research methods thus involved literature review, conceptual analysis and design, and application through case-study research.

For reporting the results of our research, we followed guidelines of Gregor and Hevner (2013) and were also inspired by an exemplar DSR study in Service Research (Teixeira et al. 2016). The introduction of this paper reports on steps (i) and (ii), which resulted from our prior research (Rafati and Poels 2016). The theoretical foundation for step (iii) is found in section 3, while the artifact itself is presented in section 4. Steps (iv) and (v) are presented in section 5, where we demonstrate how a C.A.R.S-based modelling approach works by applying it to a real case of sustainable procurement. This

application acts as a proof-of-concept of our solution. Referring to the FEDS framework for evaluation in DSR (Venable et al. 2016), the application of our DSR artifact in a case-study is a formative and naturalistic evaluation that fits into a 'human risk & effectiveness' evaluation strategy. Its aim is to demonstrate how a modelling and analysis approach for exploring strategic souring alternatives based on C.A.R.S can help implementing value-driven management thinking in a real procurement decision-making setting.

## 4.3 Theoretical Foundation - A Service Ecosystem View of Strategic Sourcing

To address the first research objective, we designed a systemic view of strategic sourcing that is focused on the co-creation of value based on networked relationships. We believe that interpreting complex emerging phenomena such as value co-creation is greatly simplified by a system view that provides a synthesis of on the one hand a reductionist perspective (i.e., analyzing elements and their relationships) and on the other hand a holistic perspective (i.e., the capability of observing the whole) (Von Bertalanffy 1972). We propose as systemic view of strategic sourcing a service ecosystem perspective founded on the Viable Systems Approach (vSa) (Polese and Di Nauta 2013) and Service-Dominant Logic (S-D Logic) (Vargo and Akaka 2009). For introducing the ecosystem concept, vSa was selected as it is a descriptive theory of adaptive systems. The S-D Logic is a foundational theory for Service Science that can be used to describe service exchanges. Together they allow to define the concept of service ecosystem.

As a systems theory, vSa is catching the attention of service researchers as it helps understanding complex phenomena like value co-creation. A viable system is "a system that survives, is both internally and externally balanced, and has mechanisms and opportunities to develop and adapt, and hence to become more and more efficient within its environment" (Beer 1984). We can thus define a service ecosystem as a viable system that is composed of service systems which are internally and externally connected by value co-creation relations that are realized through exchange of service (Vargo and Akaka 2012).

A further foundation for our ecosystem view is S-D Logic. This theory is recognized as the key theoretical foundation for Service Science, which is the discipline that studies service systems (Maglio and Spohrer 2008). In S-D Logic, a service system is defined as a dynamic value co-creation configuration of resources. A service system is related to other service systems by means of value propositions. These value propositions lead to

service exchanges between the involved service systems (Vargo and Akaka 2009). Whereas the traditional worldview of strategic sourcing is 'goods-dominant', meaning that sellers and buyers are senders and receivers of goods (which explains the focus on cost savings in the tactical view of procurement), value-driven management fits better the interpretation of value co-creation in terms of actor-to-actor relations as in S-D Logic (Eltantawy et al. 2014). Therefore, a service ecosystem perspective entails a systemic view of strategic sourcing founded on S-D Logic.

To design the envisioned service ecosystem view of strategic sourcing, we mapped S-D Logic concepts onto concepts relevant to strategic sourcing that we derived from three related Strategic Management theories: The Resource-Based View Theory (Barney 1991), the Relational View Theory (Dyer and Singh 1998), and the Dynamic Capability Theory (Helfat et al. 2009) (Table 1). According to the Resource-Based View Theory, only resources that are valuable, rare, inimitable and non-substitutable (VRIN) can provide a sustainable competitive advantage. The Relational View Theory adds to this that strategic sourcing should not only consider firm-level resources and capabilities, but also inter-firm level resources and capabilities based on networked relationships as the source of sustainable competitive advantage. Finally, according to the Dynamic Capability Theory, firms should also have the capability to continuously reconfigure their (VRIN) resource base to sustain their competitive advantage.

Table 4.1. Mapping of S-D Logic concepts and Strategic Management concepts relevant to strategic sourcing (partly based on (Rafati and Poels 2016))

| S-D Logic Concepts | Strategic Management Concepts |
|---|---|
| **Operand Resources:** Tangible, static and passive resources, like produced goods, money, and natural resources, that must be acted on to be beneficial (Vargo and Akaka 2009), (Poels 2010). | **Resources:** Assets of the firm for which action is required such that they can help the firm achieve sustainable competitive advantage. For this to happen, resources need to be Valuable, Rare, Inimitable, and Non-substitutable (VRIN) (Barney 1991). Sources of competitive advantage do not only come from internal resources (i.e., owned by the firm) but also from external resources in the value network (Dyer and Singh 1998). |
| **Operant Resources:** Intangible, dynamic and active resources, like knowledge and skills embodied in persons, that act upon other | **Competencies:** Specific strengths of a firm that allow gaining competitive advantage (Hill and Jones 2012). The sources of competitive advantage are not |

| | |
|---|---|
| resources to create benefits (Vargo and Akaka 2009), (Poels 2010). Operant resources are the fundamental source of competitive advantage and differentiation between firms (Lusch et al. 2007). | only from the firm-level competencies but also from the inter-firm level competencies (Dyer and Singh 1998). |
| **Service System:** A dynamic configuration of resources (including minimally one operant resource) with the capability of providing benefit to other service systems and itself (Vargo and Akaka 2009). | **Capability:** A configuration of resources and competencies by which the firm is able to achieve and sustain competitive advantage. *Dynamic capabilities* refer to the firm's capacities and abilities to reconfigure its resource base internally and externally to achieve sustainable competitive advantage (Helfat et al. 2009). The sources of competitive advantage are not only from internal capabilities but also by leveraging the complementary capabilities of an alliance partner (Dyer and Singh 1998). |
| **Service:** The application of operant resources for the benefit of another party (Vargo and Akaka 2009). Value co-creation is realized through the exchange of service. *Competitive advantage* is related to how the firm exchanges its services to meet customer needs compared to how other firms exchange their services (Lusch et al. 2007). Service is thus the primary source of competitive advantage. | **Service:** Activating competencies in order to achieve competitive advantage. *Competitive advantage* is observed when a firm creates more economic value than its competitors. This means that the firm's profitability is greater than the average profitability of its competitors. *Sustained competitive advantage* is observed when a firm maintains an above average and superior profitability for years (Hill and Jones 2012). For profit-seeking firms, the strategic sourcing aims at achieving sustained competitive advantage. |
| **Actors:** Value co-creators that are involved in service exchanges via *actor-to-actor (A2A) relations*. All actors show the same behavior; they create value for themselves and for others by means of resource integration. An actor on its owns cannot create value for another actor, but can offer a value proposition involving service | **Actors:** The players of the firm's value net are able to create joint value that enables firms to compete and cooperate at the same time. In the value net, a customer is a player (actor) that buys the focal firm's products and services. A supplier is a player (actor) that provides resources to the focal firm. A competitor is an alternative player (substitutor) from whom customers may purchase products and services or to whom |

| | |
|---|---|
| exchange to realize value co-creation (Vargo and Akaka 2012). | suppliers may sell their resources. A complementor is a player from whom customers buy complementary products and services or to whom suppliers sell complementary resources. All players (actors) bring their own (added) value to the firm network to create a total value (Brandenburger and Nalebuff 2011). Therefore, in a value net, the role of each player (actor) is that of value co-creator. |
| **Value:** The increase in the viability of the system. Viability can have different meaning depending on the nature of the system (e.g., profitability of profit-seeking firms, well-being of citizens for states). A *value proposition* leads to the creation of a relation between actors. Co-creating value is a process driven by *value-in-use* (i.e., value actualization), but mediated and monitored by *value-in-exchange* (i.e., value capturing) (Vargo and Akaka 2012). | **Perceived value:** The usefulness of the offered product as perceived by customers. *Exchange value* is realized at the moment of selling the product, being the amount paid by the buyer to the seller as valuation for perceived value (Bowman and Ambrosini 2000). Every value net has a total value, which is the sum of the added values of each player in the value net. *Added value* is what each player (actor) brings to the firm network to create a total value (Brandenburger and Nalebuff 2011). |

Given this mapping, we define strategic sourcing from a service ecosystem perspective as *a strategic process for organizing and fine-tuning the focal firm's resources, competencies and capabilities internally and externally through actor-to-actor interactions with its value net's players (e.g., suppliers, internal and external customers, competitors and complementors) for joint value creation in order to achieve (sustainable) competitive advantage*.

## 4.4 Artifact Description - The C.A.R.S Modeling Language

The second research objective involved the design of a modeling language for exploring strategic sourcing alternatives. This design is based on the theoretical foundation in the form of the systemic view of value-driven strategic sourcing that was presented in the previous section.

C.A.R.S is a new language for strategic sourcing modeling (Fig. 2). The modeling concepts (and their relationships) of C.A.R.S are directly derived

from S-D Logic concepts as they were mapped onto the concepts relevant to strategic sourcing (see table 1). C.A.R.S consists of the following concepts:

**Capability.** A capability describes what an actor can do to ensure competitiveness. More specifically, a capability is the capacity and ability of an actor to co-create value through service exchanges. In this context, a capability can be considered as the result of a specific configuration of resources (i.e., a service system in S-D Logic), which need to be sourced. Moreover, the capability notion refers both to internal capabilities of the firm and the complementary capabilities of partners within the value net. A capability has potentially a long-term effect on the achievement of strategic objectives. Therefore, value-driven Key Performance Indicators (KPIs) (e.g., KPIs for documentation and self-audit, quality management, and design and development) can be defined based on the capabilities of actors in the value net. These KPIs are related to functional abilities like the organizational, managerial, and technical ability to measure long-term effects in achieving strategic goals such as establishing long-term partnerships or developing a sustainable competitive advantage (Ellram 1990).

**Actor.** An actor is seen a resource integrator that provides services and co-creates value. This actor notion is used to describe the role of players in the focal firm's value net. Within this network, all players (actors) bring their own value (added value) to create a total value. Hence, the role of each player (as actor) is that of value co-creator.

**Resource.** The resource base describes what an actor has, which can be configured to exchange services and to support the creation of value. The resource notion refers both to the internal resources owned by the firm and the external (inter-firm level) resources within the firm's value net. As such, the resource base is composed of static resources, usually tangible (e.g., goods), and dynamic resources, usually intangible (e.g., skills and competencies). Figure 2 makes a distinction between assets and competencies, respectively the operand and operant resources in S-D Logic.

**Service.** A service is the application of resources by an actor. Services can be exchanged with other actors to create value and to ensure organizational competitiveness. We use this notion in C.A.R.S to capture the performance of actors in achieving sourcing objectives. Cost-down KPIs can be defined for strategic sourcing, based on actor performance in service exchanges. Such cost-saving KPIs are quantifiable performance metrics to measure short-term effects in achieving strategic goals. Examples of these metrics are the cost of a service, the quality of a service, the delivery time of a service, etc. (Ellram 1990).

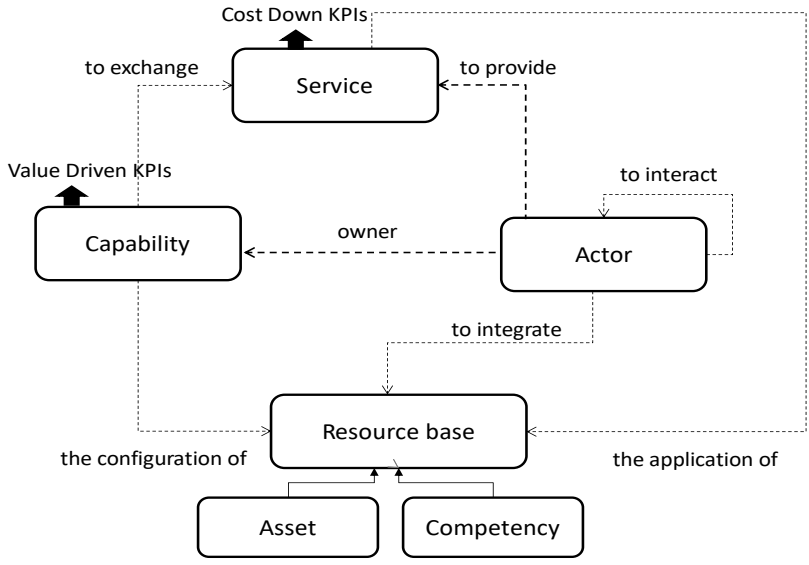


Figure 4.2. C.A.R.S modeling concepts

## 4.5 Application - A Case-Study of Value-Driven Strategic Sourcing

We first describe the case-study company and its approach to strategic sourcing. Next, we present our case-study intervention demonstrating the use of C.A.R.S. Afterwards we evaluate our intervention as a proof-of-concept for our proposed solution.

### 4.5.1 Sustainable Procurement at Umicore

Umicore is a multinational materials technology and recycling company headquartered in Brussels, Belgium. The company generates the majority of its revenues based on clean technologies such as recycling, emission control catalysts, and materials for rechargeable batteries. Umicore defines its vision on sustainable value creation as to develop, produce and recycle materials in a way that fulfills its mission which is “materials for a better life”

The group has two functions for purchasing: direct procurement and indirect procurement. Direct procurement refers to sourcing of third party services and goods that are part of, or used in manufacturing and production. Indirect procurement refers to sourcing of categories of goods and services that are supporting organizational processes. For indirect procurement, the

current approach can be characterized as tactical spend management. The main aim is to develop cost-effective sourcing strategies based on performance metrics like cost, quality and geographical location. Direct procurement, on the other hand, is clearly a value-driven process with ecological, social and economic sustainable value creation as pervasive value that drives all procurement decisions and activities. Sustainable procurement translates into goals of establishing long-lasting partnerships with suppliers, co-developing sustainable products and services, and tracking and reporting supplier performance based on sustainability metrics.

To operationalize its sustainable procurement goals, Umicore has set up a sustainable procurement charter for requesting all its suppliers to act more sustainably. The charter puts forward a number of principles in the fields of environment, labor practices and human rights, business integrity, and the supply chain of the suppliers. According to the annual report of Umicore's economic, social and environmental performance in 2015, Umicore's procurement teams first selected key suppliers of goods, services and raw materials based on criteria such as size, geographical location and the criticality of provided services and products. After this primary selection, 1,336 suppliers were invited to conform to the charter and 1,108 (83%) of these 1,336 suppliers replied that they could meet the terms of the charter. Umicore's procurement teams further identified 47 suppliers out of the 1,108 suppliers based on a risk assessment using operational metrics like critical dependency, geographical presence and spend costs. These suppliers were referred to EcoVadis, which is an independent sustainability-rating service provider, for an evaluation of their corporate social responsibility (CSR). EcoVadis provides sustainability ratings and a performance improvement tool for global supply chains by delivering scorecards to monitor supplier practices covering 150 purchase categories, 110 countries and 21 CSR indicators. EcoVadis assessed the sustainability performance of 40 suppliers by providing an overall score and a score for each of four sustainability categories: environment, labor practices, fair business practices and sustainable procurement. According to the result of this assessment, 22 companies have the score between 25 and 44, meaning that they are following basic steps to ensure sustainability. Among these companies, one company has the score of 20, representing a high risk in sustainability. Another 14 companies scored between 45 and 64, meaning that they have an appropriate sustainability management system, while 3 companies have higher scores than 64, showing that they have the most advanced practices on sustainability.

### 4.5.2 Application of C.A.R.S at Umicore

For direct procurement, Umicore's approach of sustainable procurement can be characterized as value-driven strategic sourcing. Umicore sustainable procurement focuses on value creation through three value drivers (i) cost reduction (e.g., energy cost, social cost and environmental taxes); (ii) risk mitigation (e.g., supply chain disruptions, brand damage from bad supplier practice); and (iii) revenue/growth generation (e.g., income from recycling and innovations in sustainable development). Sustainable procurement as value-driven strategic sourcing is defined as an annual project at Umicore. This project includes four phases: (1) inviting suppliers to adhere to the sustainable procurement charter after a primary selection based on performance metrics like size, geographical location and the critically of provided services and products; (2) providing suppliers that are willing to adhere to the sustainable procurement charter with a self-assessment questionnaire according to the charter principles; (3) selecting suppliers for CSR evaluation amongst those suppliers that returned the questionnaire, based on a risk assessment using operational metrics; and (4) evaluating supplier sustainability performance based on the CSR scorecards provided by EcoVadis.

Despite these efforts and intentions, we learned through an interview we had with our case-study partner, the director of the Umicore Brussels' regional procurement center, that sustainable procurement is not a systemic and integrated process at Umicore. Specific problems mentioned were (1) Applying the sustainable procurement selection as an annual project for the entire supply chain instead of exploring whenever needed sourcing alternatives for a specific service or supplier; (2) The use of operational performance metrics and self-assessment questions for supplier selection and evaluation that do not match well Umicore's long-term sustainability objectives; and (3) The use of generic CSR metrics that are defined for use in 25,000 companies in 110 countries, but that were not specifically defined for Umicore.

In the remainder of this section, we illustrate how a chief procurement officer (CPO) at Umicore can apply a model-based approach using C.A.R.S as a systemic, integrated and value-driven approach to explore strategies and recommendations in line with sustainable procurement at Umicore, hence addressing the aforementioned problems. Through this illustration, we also explain the different steps of the C.A.R.S modeling method with a focus on value-driven strategic sourcing of capabilities, i.e., choosing the right capability sourcing alternatives and right partners. The effective sourcing of capabilities, which are used to exchange services, is crucial to achieve

competitiveness for an organization across the value chain and within a changing environment.

The C.A.R.S modeling method has four steps: (i) Conduct a value net analysis; (ii) Determine the capability positioning; (iii) Determine the dependency positioning; and (iv) Identify capability sourcing options (see figure 3). We discussed with the director of Brussels' procurement center a sourcing scenario at Umicore in line with sustainable procurement. Using this scenario, we can demonstrate the C.A.R.S model-based exploration of strategic sourcing options. This sourcing scenario is based on the existing collaboration between Umicore as a materials technology leader and Prayon as a phosphate producer to jointly develop and produce phosphate-based cathode materials for use in rechargeable batteries. All models developed were based on information made available by Umicore (often freely available) and discussed with our case-study partner.


Figure 4.3. C.A.R.S modeling steps

***Step 1: Conduct Value Net Analysis***. The first step aims to increase the understanding of the value net to better assess opportunities for strategic sourcing. Our approach analyzes the value net by considering the required capabilities for value creation in order to achieve sustainability objectives. Figure 4 shows the *value net profile* model for the selected sourcing scenario. This model is a C.A.R.S model instantiation which shows that the development of a new sustainable product (i.e., phosphate-based cathode materials for use in rechargeable batteries) is a service that is able to deliver value which will result in a sustainable competitive advantage in the materials industry. The associated value of this new service is increasing growth in the materials market by offering a new type of cathode materials for use in new energy solutions for the automotive sector (e.g., hybrid, micro-hybrid and electric vehicles) and for enabling new applications such as stationary applications (e.g., solar and wind power storage systems). The total value co-created by participation of Umicore and Prayon is an aggregation of economic value (i.e., a high quality and cost-competitive product), environmental value (i.e., an environmentally friendly or eco-friendly product) and social value (i.e., occupational health and safety at workplaces and sites). For 'exchanging' this new service, meaning for developing the phosphate-based cathode materials, two core capabilities are

required: (i) An internal capability possessed by Umicore (i.e., developing cathode materials); and (ii) A complementary capability possessed by Prayon (i.e., developing phosphate materials). Both capabilities are configurations of internal and external resources (i.e., assets, competencies, skills, systems, standards, technologies). Furthermore, the resource base includes specific programs, competencies, systems, standards and practices for sustainability. If the capability of an actor involves such sustainability resources, then the actor has the potential to play sustainably in the value net.

According to our value net analysis based on the developed value net profile model, both the developing of phosphate materials and cathode materials, which are technical capabilities of respectively Prayon and Umicore, are defined as configurations of resources including sustainability resources like green infrastructures, green raw materials, sustainable development programs and plans (e.g., Horizon 2020, UN Agenda 2030), sustainable standards and principles (e.g., sustainable procurement charter), sustainable practices, and environmental management systems for prevention and controlling pollution. Hence, Prayon and Umicore are both able to act as sustainable players in the value net.

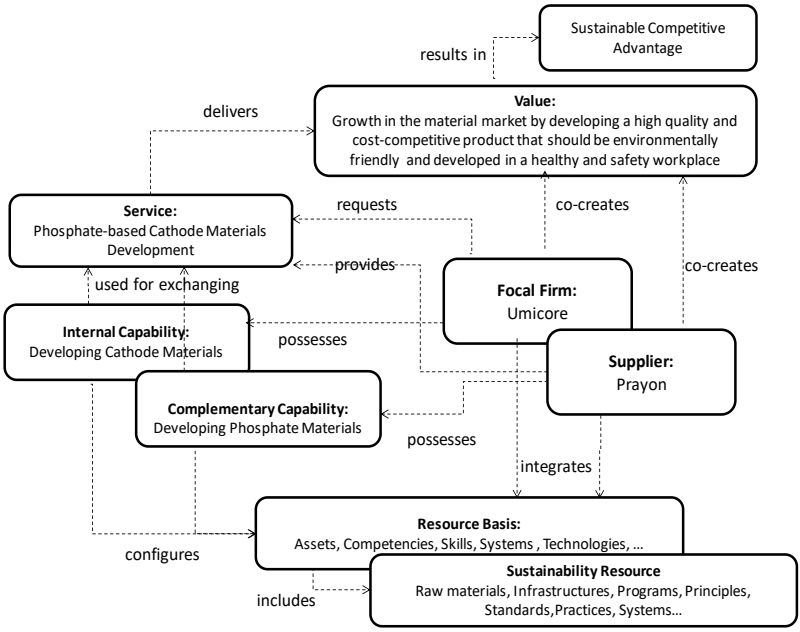


Figure 4.4. The value net profile of Umicore for the target service

***Step 2: Determine Capability Positioning:*** This second step aims to position the capabilities of the players in the value net to evaluate their strategic and

sustainability impacts. Following Cox's idea of criticality analysis (Cox 2015), we introduce the *capability positioning portfolio* focusing on the C.A.R.S capability and resource concepts. Two capability dimensions are used for positioning: (i) The strategic impact measured by a VRIN assessment of the available resource base to achieve the desired outcome, i.e., assessing whether the required resources are valuable, rare, inimitable, and non-substitutable; (ii) the sustainability impact measured by economic factors (e.g., cost, quality and delivery time), social factors (e.g., customer privacy, health and safety of staff and customer, satisfactory working environments and discrimination in employment), and environmental factors (e.g., resource consumption, recycling income, environmental taxes). This results in a 2 x 2 matrix as capability positioning portfolio model with four capability categories: (i) strategic sustainability capability, (ii) sustainability capability, (iii) strategic non-sustainability capability, and (iv) non-sustainability capability. The capability positioning portfolio model of Umicore (see figure 5) shows that the phosphate-based cathode materials developing capability, which combines the internal capability of Umicore (i.e., developing cathode materials) and the complementary capability of Prayon (i.e., developing phosphate material), is a configuration of VRIN resources with a high-level sustainability impact, hence can be positioned as a strategic sustainability capability that is able to achieve sustainable competitive advantage in the material market.

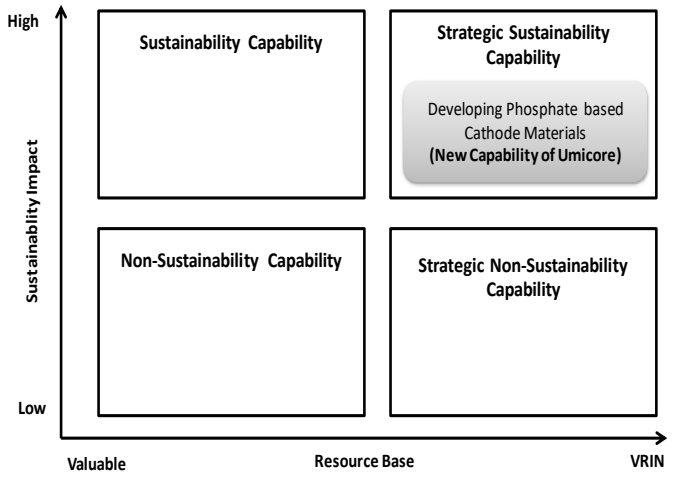


Figure 4.5. The capability positioning portfolio of Umicore for a specific capability

***Step 3: Determine Dependency Positioning:*** The purpose of the third step is to position the mutual dependency between buyers and suppliers to shape

relationship strategies in the value net. Inspired by Cox's power portfolio model (Cox, 2001), the *dependency positioning model* is a C.A.R.S model instantiation that is used to classify a buyer-supplier dependency into one of four possible categories (i) buyer dominance (buyer has more power than supplier), (ii) supplier dominance (supplier has more power than buyer), (iii) interdependence (high balanced power) and (iv) independence (low balanced power). The power of both parties is measured by (i) the essentiality of the exchanged service (Jacobs, 1974) and (ii) the criticality of the capability to exchange services. Applied to our case, the essentiality of a service is determined by the relative financial, environmental and social impact of the service for value creation to achieve sustainability objectives. The criticality of the capability to exchange services is determined by its resource base. The buyer-supplier dependency analysis (see figure 6) shows that the phosphate-based cathode materials development service is an essential service for both Umicore and Prayon with high-level financial, economic and environmental impacts which were measured by the metrics mentioned in the previous step. For both players, this essential service is exchanged by employing complementary strategic sustainability capabilities, which are developing cathode materials from Umicore's side and phosphate material developing from Prayon's side. As shown in the previous step, both contributing capabilities are based on a VRIN sustainability resource base. Based on our analysis, the relationship between Umicore and Prayon can be positioned as an "interdependence" relationship.

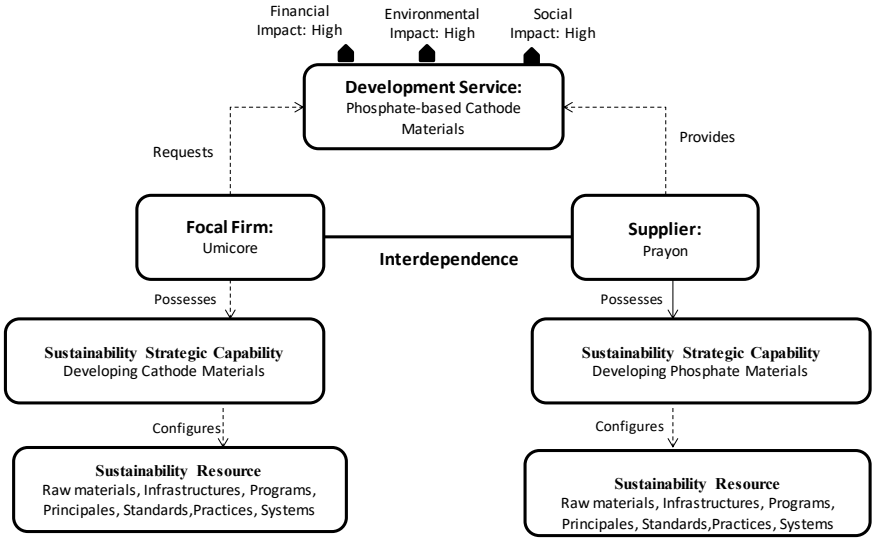


Figure 4.6. Dependency positioning model of Umicore and Prayon

***Step 4: Identify capability sourcing strategies:*** The goal of the last step in the modeling method is to develop a *capability sourcing portfolio analysis* model for classifying and setting capability sourcing strategies. The proposed model uses a 4 x 4 matrix to classify 16 capability sourcing categories. This classification is performed based on the results of the capability positioning (step 2) and the buyer-supplier dependency positioning (step 3). Capability sourcing portfolio analysis is inspired by the sourcing portfolio analysis of Cox (2015), which determines supply strategies based on two leveraging principles for exploring sourcing options: (i) Firms can move into supply markets with low complexity; and (ii) firms obtain an understanding of their current position and search for ways to exploit or balance existing relationships.

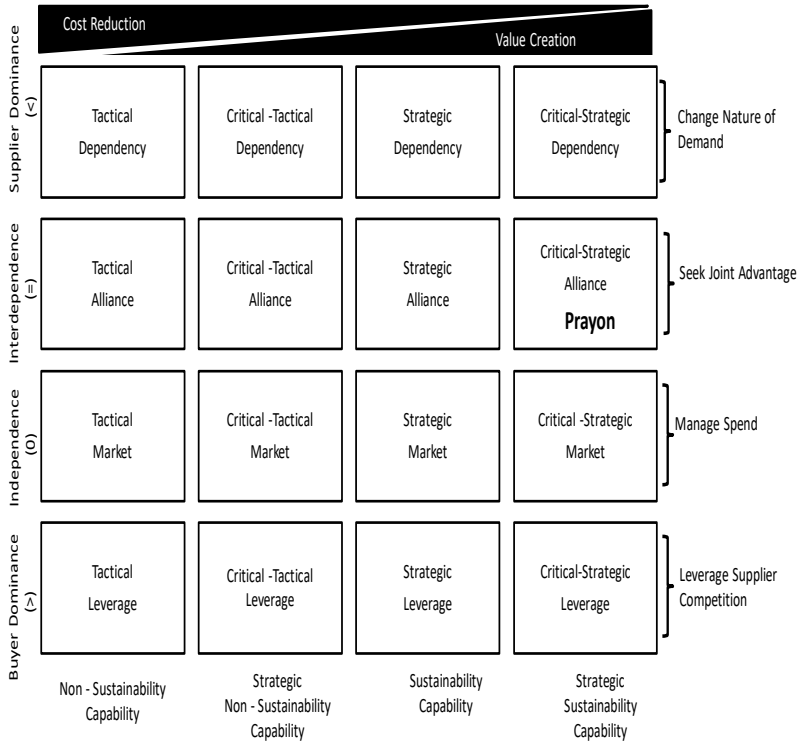


Figure 4.7. Capability sourcing portfolio analysis model as applied to the Prayon supplier

According to the previous analyses, Prayon is positioned into the Critical-Strategic Alliance cell of the model. Consequently, the possible strategies and options for Umicore for sourcing phosphate based cathode materials development as a strategic sustainability capability are:

- Stay in an alliance position with Prayon and establish a long-term strategic relationship by use of profit sharing and strategic alliance. A possible disadvantage of this option is the emergence of a lock-in partnership.
- Move to the leverage position (i.e., Critical-Strategic Leverage cell) and exploit Umicore's buying power through market competition and short-term agreements among available chemical companies in the market. However, this can have a negative impact on the creation of value. In general, for implementation of this strategy, the possible sourcing approaches are (i) Tendering by use of RFI/RFP processes; (ii) Globalization by global sourcing and low-cost country sourcing; (iii) Supplier pricing review by total cost of ownership; and (iv) Target pricing by cost regression analysis. It is clear that approaches (ii), (iii) and (iv) will not contribute to achieving sustainability objectives, while it is unsure that approach (i) will lead to the identification of a valuable alternative to Prayon, meaning with a similar complementary strategic sustainability capability.

### 4.5.3 Evaluation

With respect to the identified problems of current sustainable procurement practice at Umicore, our approach can be used as an ongoing process not only for supplier selection and evaluation but also for exploring sourcing alternatives related to a specific service or supplier (first problem). The proposed modeling approach measures the sustainability of value net players by considering both their performance and capability dimensions (second problem). In the case study, the C.A.R.S modeling method evaluated the sustainability performance of Prayon based on operational economic, social and environmental metrics like cost, recycling income and customer privacy. But in addition, the strategic sustainability of Prayon's developing phosphate materials capability was also determined based on its VRIN resources with high-level sustainability impact. Finally, the C.A.R.S modeling approach evaluates the sustainability of value net players according to the specific economic, social and environmental factors appropriate to a specific service in a business line (third problem). In the case study, the sustainability impact of Umicore and Prayon's joint phosphate-based cathode materials developing capability was evaluated based on relevant economic, social and environmental factors, which were specifically defined for the energy materials critical business line at Umicore.

## 4.6 Discussion, Conclusion and Future Research

To address the solution requirements (see section 1) for realizing value-driven strategic sourcing, we introduced C.A.R.S as a systemic and integrated modeling approach that provides a holistic view on the firm's value network (Req.1) emphasizing value co-creation (Req.2) by considering inter-firm interactions (Req.3). The proposed modeling approach supports CPOs in exploring strategic sourcing alternatives (Req.4) to achieve strategic goals. This was demonstrated in a case-study of sustainable procurement at Umicore, in which model-based analysis using C.A.R.S was applied to analyze a partnership with Prayon to develop phosphate-based cathode materials for rechargeable batteries. The analysis confirmed the strategic alliance with Prayon and identified an alternative (but probably less optimal) strategic sourcing alternative.

Referring to the DSR knowledge contribution framework of Gregor and Hevner (2013), the type of knowledge contribution we make with C.A.R.S is exaptation, where known solutions are extended to new problems. Value-driven management is a true innovation in strategic sourcing. Our solution uses knowledge from Service Science and Conceptual Modeling to address the problem of lack of instruments to implement value-driven management in strategic sourcing. We did so by designing a conceptual modelling language which was founded on a systemic view of strategic sourcing that was derived from a mapping of Service Science concepts to Strategic Management concepts. Again, referring to Gregor and Hevner (2013), the instantiation of the C.A.R.S-based modelling approach to the particular case-study at Umicore can be seen as a level 1 knowledge contribution type ('situated implementation of artifact'), whereas the C.A.R.S conceptualization itself is of level 2 ('nascent design theory'). The implication for research is the knowledge incorporated in the design of C.A.R.S, which provides a basis for further research into how conceptual modeling and service ecosystems thinking helps implementing value-driven strategic sourcing. The implication for practice is the development of a practical approach to implement value-driven strategic sourcing, which also requires further research as will be detailed next.

Our research is not without limitations. First, as C.A.R.S was only applied to one sourcing scenario and was not division-wide or company-wide implemented within Umicore, we have not provided evidence of its efficacy but only showed its potential in solving specific procurement problems related to sustainable procurement at Umicore. Second, although the case-study enabled us to demonstrate the potential utility of the C.A.R.S approach, we acknowledge that it is difficult to generalize the results based on a single

case study in a specific setting (i.e., sustainable procurement as value-driven strategic sourcing). Third, as our approach is work-in-progress and currently lacks software tools to support the modeling and analysis tasks, the case-study involved the active participation of the researchers and required extensive documentation on behalf of the case study organization. These limitations of the research need to be addressed by our future research.

In previous research, we have applied a preliminary version of the approach to an IT outsourcing case-study in a large hospital (Rafati and Poels 2016). Further case-studies are needed to explore the support for value-driven strategic sourcing in different domains (e.g., contracting services from public authorities), for different sourcing scenarios (e.g., actors being simultaneously buyer and supplier in a value co-creation process), for different sourcing trends (e.g., business process outsourcing, offshoring and global sourcing), and in different sourcing contexts (e.g., emerging economies, instable regulatory environments). This research can potentially result in adaptations to the modeling approach. It will also inform us on the boundaries of the application scope of C.A.R.S. We acknowledge that defining this application scope explicitly, e.g., through an axiomatization that emphasizes specific properties of C.A.R.S concepts depending on the application context, is a major research challenge and might require other research that extends the current case-study research.

Our future research plans also include the development of techniques to enable a more rigorous analysis of strategic sourcing options (e.g., using heuristic methods), which we identified as a main challenge in this field. Future research may, for instance, look into how to incorporate in the analysis sourcing strategies that allow recovering from disturbing or disruptive events which affect the sourcing of capabilities and the performance of value co-creation processes. Another future research idea is to strengthen the rigor of the analysis by means of game theoretic models, for instance by associating to the capability sourcing portfolio model a bi-matrix game model for which Nash equilibria can be calculated. Our immediate next research steps will be focused on the development of a more formal meta-model, semantics and a concrete syntax, views and models for C.A.R.S and a supporting modeling method and tools for value-driven strategic sourcing with C.A.R.S. Specifically needed are easy-to-use tools for model-based analysis of strategic sourcing alternatives that allow working with the different modeling, positioning and analysis techniques that were illustrated in this paper.

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## References

Anderson PH, Rask M (2003) Supply chain management: new organizational practices for changing procurement realities. Journal of Purchasing and Supply Management. 9(2): 83-95.

Barney JB (1991) Firm resources and sustained competitive advantage. Journal of Management. 17 (1): 99–120.

Beer S (1984) The viable system model: Its provenance, development, methodology and pathology. Journal of the operational research society. 35(1): 7-25.

Bowman C, Ambrosini V (2000) Value Creation versus Value Capture: Towards a Coherent Definition of Value in Strategy. British Journal of Management, Vol. 11, pp.1–15.

Brandenburger AM, Nalebuff BJ (2011) Co-opetition. Crown Business.

Cardoso J, Lopes R, Poels G (2014) Service systems: concepts, modeling, and programming. Springer, pp. 1-91.

Chen IJ, Paulraj A, Lado A (2004) Strategic purchasing, supply management and firm performance. Journal of Operations Management. 22 (5): 505–523.

Cox A (2001) Understanding Buyer and Supplier Power: A Framework for Procurement and Supply Competence. The Journal of Supply Chain Management. 37 (1): 8-15.

Cox A (2015) Sourcing portfolio analysis and power positioning: towards a "paradigm shift" in category management and strategic sourcing. Supply Chain Management: An International Journal. 20(6): 717-736.

Cox A, Ireland P (2015) Value Sourcing: From Spend Management to Supply Management, Kindle E-Book, Earlsgate Press, Stratford-upon-Avon.

Dyer JH, Singh H (1998) The relational view: Cooperative strategy and sources of interorganizational competitive advantage. Academy of management review. 23(4): 660-679.

Ellram LM (1990) The supplier selection decision in strategic partnerships. Journal of Purchasing and materials Management, 26(4), 8-14.

Eltantawy R, Giunipero L, Handfield R (2014) Strategic Sourcing Management's Mindset: Strategic Sourcing Orientation and its Implications. International Journal of Physical Distribution and Logistics Management. 44(10): 768-795.

Gregor S, Hevner AR (2013) Positioning and presenting design science research for maximum impact. MIS Quarterly. 37(2): 337-355.

Helfat C, Finkelstein S, Mitchell W, Peteraf M, Singh H, Teece D, Winter S (2009) Dynamic Capabilities: Understanding Strategic Change in Organizations. John Wiley & Sons.

Hevner R, March ST, Park J, Ram S (2004) Design science in information systems research. MIS quarterly. 28(1): 75-105.

Hill C, Jones G (2012) Strategic Management: an integrated approach. Tenth edition, Cengage Learning.

Jacobs J (1974) Dependency and vulnerability: An exchange approach to the control of organizations. Administrative Sciences Quarterly. 19(1): 45-59.

Kocabasoglu C, Suresh NC (2006) Strategic sourcing: an empirical investigation of the concept and its practices in US manufacturing firms. Journal of Supply Chain Management. 42(2): 4-16.

Kraljic P (1983) Purchasing must become supply management. Harvard Business Review. 61 (5): 109–117.

Lusch RF, Stephen L, Vargo SL, Matthew O (2007) Competing through service: Insights from service-dominant logic. Journal of Retailing. 83(1): 2-18.

Lusch RF, Vargo SL (2006) Service-dominant logic: reactions, reflections and refinements. Marketing theory. 6(3): 281-288.

Maglio PP, Spohrer J (2008) Fundamentals of service science. Journal of the Academy of Marketing Science. 36(1): 18-20.

Osterwalder A, Pigneur, Y (2012) Designing Business Models and Similar Strategic Objects: The Contribution of IS. Journal of the Association for Information Systems, 14(5), 3.

Peffers K, Tuunanen T, Rothenberger MA, Chatterjee S (2007) A design science research methodology for information systems research. Journal of Management Information Systems. 24(3): 45-77.

Poels G (2010) The resource-service-system model for service science. International conference on Advances in conceptual modeling: applications and challenges. Springer Berlin Heidelberg. 6413. pp.117-126.

Polese F, Di Nauta P (2013) A viable systems approach to relationship management in SD logic and service science. in Business Administration Review. Schäffer-Poeschel. 73(2): 113-129.

Rafati L, Poels G (2017) Service Oriented Enterprise Engineering: A modeling discipline based on the viable system approach (vSa) for strategic sourcing decision-making. special issue of the International Journal of Information Systems in the Service Sector (IJISSS). Conditionally accepted for publication.

Rafati L, Poels G (2016) Service-Dominant Strategic Sourcing: Value Creation Versus Cost Saving. Exploring Services Science. Volume 247 of the series Lecture Notes in Business Information Processing. pp 30-44.

Rafati, L., & Poels, G. (2015) Towards Model-Based Strategic Sourcing. In Achieving Success and Innovation in Global Sourcing: Perspectives and Practices. Springer International Publishing. pp. 29-51.

Schuh C, Kromoser R, Strohmer MF, Pérez RR, Triplat A (2009) The Purchasing Chessboard™, pp. 55-207, Springer Berlin Heidelberg.

Spohrer J, Barile S, Polese F (2010) System Thinking for Service Research Advances. Service Science. 1(2): 130-135.

Teixeira JG, Patricio L, Huang K-H, Fisk RP, Nóbrega L, Constantine L (2016) The MINDS method: Integrating Management and Interaction Design Perspectives for Service Design. Journal of Service Research. DOI: 10.1177/1094670516680033.

Thalheim B (2012) The science and art of conceptual modelling. In Transactions on Large-Scale Data-and Knowledge-Centered Systems VI (pp. 76-105). Springer Berlin Heidelberg.

Van Weele AJ (2009) Purchasing and supply chain management: Analysis, strategy, planning and practice. Cengage Learning EMEA.

Vargo SL, Akaka MA (2009) Service-dominant logic as a foundation for service science: clarifications. Service Science. 1(1): 32-41.

Vargo SL, Akaka MA (2012) Value Co-creation and Service Systems (Re)formation: A Service Ecosystems View. Service Science. 4(3): 207-217.

Venable J, Pries-Heje J, Baskerville S (2016) FEDS: A framework for evaluation in design science research. European Journal of Information Systems. 25: 77-89.

Von Bertalanffy L (1972) The history and status of general systems theory. Academy of Management Journal, 15(4): 407-426.

# 5

# Designing a domain-specific modeling technique for value-driven strategic sourcing

**Summary:** This chapter focuses in particular on the third research objective to develop an analytically rigorous value-driven management approach for strategic sourcing. the research of this chapter aims to develop a domain-specific modeling technique founded on the S-D Logic, which focuses on the systemic exploration of sourcing alternatives and emphasizes the delivery of value to achieve desired outcomes.

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# Designing a domain-specific modeling technique for value-driven strategic sourcing

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**Abstract.** Strategic sourcing recognizes that procurement should support a firm's effort to achieve its long-term objectives. In particular, procurement needs to be a cross-functional end-to-end process inside the organization that is oriented towards value-creation within the company and between the company and its partners in the value chain. The main challenge to the implementation of value-driven strategic sourcing is the lack of instruments that are characterized by analytical rigor and robustness in the identification of strategic sourcing options to achieve strategic goals. Therefore, this research aims to develop a domain-specific modeling technique founded on the S-D Logic, which focuses on the systemic exploration of sourcing alternatives and emphasizes the delivery of value to achieve desired outcomes. This paper reports on a first cycle of Design Science Research, which includes the demonstration and the evaluation of the value and utility of the modeling artefacts by means of a case study about IT outsourcing in the healthcare industry.

**Keywords:** value-driven strategic sourcing, domain-specific modeling, capability-oriented modeling.

## 5.1 Introduction

Strategic sourcing recognizes that procurement is not a mere cost function, but that it should support the long-term objectives of a company. In this respect, organizations expect from their Chief Procurement Officer (CPO) to develop both long-term and short-term procurement plans. Therefore, strategic sourcing should employ value-driven management approaches, which are able to represent and analyze strategic options and alternatives that enable an organization to achieve its strategic objectives (David, 2011). More specifically, the organization has to understand that a cross-functional end-to-end process should be implemented, which goes beyond tactical cost savings and focuses on the 'value for money' of those assets that are critical for the value chain of the organization to manage the flow of value within the company and between the company and its suppliers and customers (Cox, 2015; Cox and Ireland, 2015). A value chain connects the supply and demand bases of an organization. In this context, the supply base includes all processes that are necessary to fulfill the organizational demand by focusing

on an efficient supply (i.e., determining what the suppliers propose as value). In contrast, the demand base comprises all the processes that are needed to create demand by identifying what the customer perceives as value (Jüttner et. al., 2007). A thorough understanding of the entire value chain is needed to sustain the strategic goals of an organization.

Although value-driven strategic sourcing is fairly well recognized, managers are still challenged by many barriers to its implementation (Kocabasoglu and Suresh, 2006). The main challenge is the lack of practical instruments to implement value-driven strategic sourcing. In particular, currently available instruments lack analytical rigor and robustness in the identification of strategic sourcing options to achieve strategic goals (Cox, 2015).

This problem can be tackled by the design of a new conceptual modeling technique that allows a systematic analysis of strategic sourcing alternatives and an evaluation of these alternatives by using value-driven metrics. Such a modeling technique contributes to the implementation of value-driven strategic sourcing in different ways. First, conceptual models support the identification, formalization, and visualization of the relevant value-driven management concepts. Furthermore, the development of conceptual models can support the design of techniques for generating and assessing strategic sourcing alternatives. Finally, conceptual models provide the basis for developing computer-aided design tools, which assist in automating the process of designing strategic sourcing alternatives (Osterwalder and Pigneur, 2013). A conceptual modeling technique consists of two components: (i) a modeling language and (ii) a modeling procedure. While the modeling language provides the constructs that can be part of a model, the modeling procedure describes the steps that are needed to construct a model (Karagiannis and Kühn, 2002).

More specifically, we have opted to design a new domain-specific modeling technique. In comparison with the use of general-purpose modeling techniques, a domain-specific modeling technique is particular useful for offering a rigorous and robust approach for value-driven strategic sourcing because domain-specific modeling improves the productivity of modeling as technical terms not have to be reconstructed by the end-user (Frank, 2013). Furthermore, a domain-specific modeling technique also preserves the quality of models as their integrity is ensured by preventing the construction of non-sensical models (Frank, 2013). The specific choice of developing a new modeling technique implies that end-users are required to work with a new modeling technique, which could be potentially harmful for the adoption of the technique in practice. However, the main rationale for

designing a new technique instead of implementing value-driven strategic sourcing by means of an existing Enterprise Modeling (EM) language (e.g., ArchiMate (The Open Group, 2016), MEMO (Frank, 2014)) is separation of concerns. As the prospective users of the modeling technique are managerial decision makers (e.g., chief procurement officers, chief strategic officers and strategic sourcing managers), our modeling technique should provide an abstraction and representation of the aspects that are relevant for value-driven strategic sourcing (Frank, 2013). To allow model-based exploration and analysis of strategic sourcing options, the intended modeling technique should operationalize a theoretically-founded conceptualization of the enterprise that is in line with the value-driven modeling paradigm. To avoid possible inconsistencies between the underlying conceptualization and the abstract syntax and semantics of existing EM languages, we have opted to create a new domain-specific modeling language. Furthermore, this also allowed us to easily create a visualization (i.e., concrete syntax) that is specifically tailored to the intended end-users. Therefore, this paper aims at realizing the following research objective:

- **Research objective:** To design a new domain-specific modeling technique, which (i) provides an analytically rigorous modeling approach for strategic sourcing and (ii) allows the model user to focus on the systemic exploration of strategic sourcing alternatives to achieve strategic goals

In previous research (Rafati and Poels, 2016), we found that the Service-Dominant (S-D) Logic (Lusch and Vargo, 2006) allows for a theoretical description of enterprises that is in line with value-driven management thinking and we subsequently designed a conceptualization of the enterprise by mapping the S-D Logic concepts onto concepts relevant to strategic sourcing that we derived from three related Strategic Management theories: The Resource-Based View Theory (Barney 1991), the Relational View Theory (Dyer and Singh 1998), and the Dynamic Capability Theory (Helfat et al. 2009). This mapping led to the identification of the conceptual principles that underlie value-driven strategic sourcing:

(i) An orientation towards modeling the organization's capabilities to (re)configure resources (e.g., assets and competencies) to deliver value and achieve strategic goals (Rafati and Poels, 2014a; 2014b 2015; 2016);

(ii) Providing a stable and overarching view on strategic sourcing for fostering dialogue amongst managerial decision makers (e.g., chief procurement officer, chief strategic officer and strategic sourcing manager) about strategic sourcing (Peeters, 2016);

(iii) Considering capability sourcing as a strategic process for organizing and fine-tuning the firm's value chain to ensure competitive advantage or survivability (Bain & Company 2005; Loftin et al., 2011).

The contribution of this paper is the introduction of the C.A.R.S. (i.e., Capability – Actor – Resource – Service) modeling technique as an analytically rigorous modeling technique to implement value-driven strategic sourcing. More specifically, we focus on the design of the C.A.R.S. modeling technique by the development of a modeling language (i.e., a meta-model in section 4.1.1, semantic definitions in section 4.1.2, and a notation in section 4.1.3) and a modeling procedure (section 4.2), based on the conceptualization provided by the S-D logic. As we aim to contribute new knowledge on how to explore in an analytical rigorous and systemic way strategic sourcing alternatives according to the value-driven management paradigm, our research methodology was Design Science Research (DSR) (Hevner et al. 2004). This knowledge was acquired through the building and evaluation of the C.A.R.S. artefacts (i.e., modeling language and modeling procedure). For the demonstration of C.A.R.S. modeling and the evaluation of the value and utility of the artefacts, a case study was employed, which involved IT outsourcing in the healthcare industry.

The remainder of this paper is structured as follows. Section 2 describes our previous work, which provides a theory-based conceptual foundation for the design of the envisioned modeling technique. The DSR methodology we employed for building and evaluating our research artifact is explained in section 3. The C.A.R.S. modeling technique resulting from the design research is presented in section 4, while section 5 presents the case study of IT outsourcing in the healthcare industry as a proof-of-concept demonstration and evaluation of how our approach helped exploring strategic sourcing alternatives. Section 6 positions the C.A.R.S. modeling technique in different disciplines by comparing it with related conceptual modeling techniques. Finally, section 7 summarizes the conclusions of this paper and outlines opportunities for future research.

## 5.2 Previous Work

The C.A.R.S. modeling approach is characterized by four different perspectives: (i) a way of thinking (i.e., a conceptual basis), (ii) a way of modeling (i.e., a modeling language and procedure), (iii) a way of working (i.e., a model based analysis approach) and (iv) a way of supporting (i.e., a computer-aided design tool) (Seligmann et al. 1989). The focal point of this paper is supporting the way of modeling by the development of a modeling language and a modeling procedure for value-driven strategic sourcing. Previous research mainly focused on the way of thinking by the introduction

of a systemic view on strategic sourcing based on the S-D Logic (Rafati and Poels, 2014b; 2015; 2016). Furthermore, this research also included the proposal of a preliminary modeling procedure for applying the C.A.R.S. approach in strategic sourcing (Rafati and Poels, 2015; 2016).

### 5.2.1 C.A.R.S. Conceptual Basis

To help implementing the new paradigm of value-driven management in sourcing, we previously designed the C.A.R.S. conceptualization (Rafati and Poels, 2016) (see figure 1) using the S-D Logic (Lusch and Vargo, 2006) as its theoretical foundation. The S-D Logic is especially suited as a foundation for conceptualizing value-driven strategic sourcing as it views a company as a service system, which is a dynamic value co-creating configuration of resources that is connected internally and externally to other service systems by value propositions through service exchanges (Vargo and Akaka 2009). Moreover, the S-D Logic provides a framework for thinking more clearly about the service system and how it competes (Lusch, et al. 2007) and survives (Vargo, et al. 2008) in its environment. The S-D Logic defines a service, which is the fundamental basis of value creation, as the application of operant resources for the benefit of another party (Vargo and Akaka 2009). While the traditional tactical view on sourcing is a more 'goods-dominant' worldview of suppliers and buyers as senders and receivers of goods (hence the procurement's focus is on realizing cost savings), the value-driven management view on (strategic) sourcing better matches the value co-creation interpretation of provider-customer relationships as in S-D Logic (Eltantawy et al. 2014).

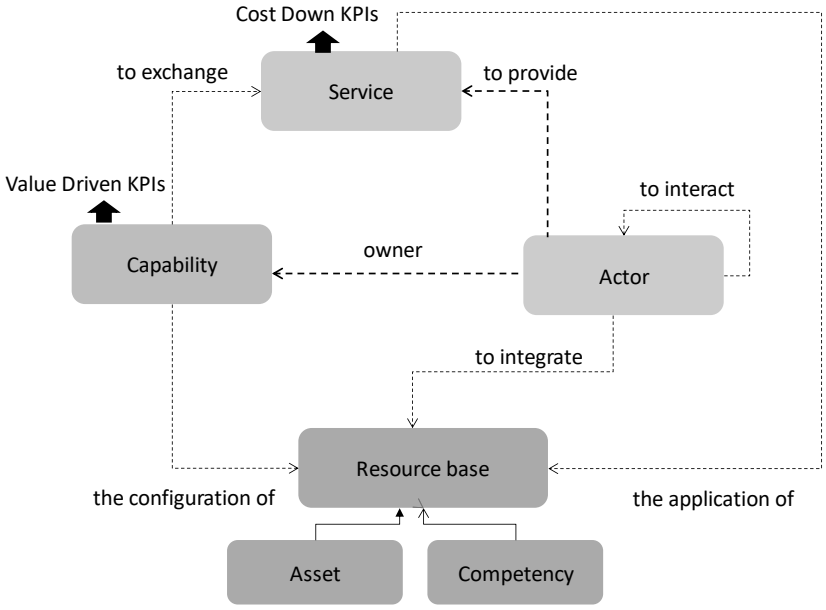


Figure 5.1. C.A.R.S. conceptualization

The C.A.R.S. conceptualization interprets the S-D Logic by applying it to the context of strategic sourcing (Rafati and Poels, 2016). The core C.A.R.S. concepts of capability, actor, resource (asset and competency) and service are a direct mapping from their corresponding S-D Logic concepts, i.e., service system, actor, resource (operand resource and operant resource) and service. In constructing C.A.R.S., we chose to retain some of the more specific strategic sourcing terminology instead of employing general S-D Logic terminology. The different C.A.R.S. concepts were defined as follows (Rafati and Poels, 2016):

**Capability.** A capability describes what an actor can do to ensure organizational competitiveness and survivability. More specifically, a capability is the capacity and ability of an actor to create value through service exchanges. In this context, a capability can be considered as the result of a specific configuration of resources, which need to be sourced. As the capability of an actor represents a potential long-term effect on the achievement of strategic objectives, value-driven Key Performance Indicators (KPIs) can be defined based on the capabilities of actors in the demand and supply side of the value chain. These KPIs are related to functional abilities like the organizational, managerial, and technical ability to measure long-term effects in achieving strategic goals such as establishing long-term partnerships or developing a sustainable competitive advantage

(Ellram 1990). For example, documentation and self-audit capability, quality management capability and design and development capability of the supplier can be used as soft or difficult-to-quantify criteria (value-driven KPIs), particularly in the context of strategic buyer-supplier partnerships (Narasimhan et al. 2001); (Sarkis and Talluri, 2002).

**Actor.** An actor is seen a resource integrator that provides services, proposes value, creates value and captures value (Vargo and Lusch, 2011a; Wieland et al. 2012). This actor notion is used to describe the role of the focal firm, its suppliers and its customers in a value network. Within this network, the following sourcing relationships are common: suppliers offer value propositions to the focal firm, the focal firm (as a buyer) is served by suppliers, the focal firm (as a provider) serves the customers, customers perceive and use value, and the focal firm captures value from both the demand and supply sides. These relationships imply that all actors are co-creators of value.

**Resource.** The resource base describes what an actor has, which can be configured to provide capabilities and to support the creation of value (Vargo and Akaka 2009). As such, the resource base includes tangible and static resources (e.g., goods), as well as intangible and dynamic resources (e.g., competencies and skills). In figure 1, we distinguish between assets (i.e., operand resources in S-D Logic) and competencies (i.e., operant resources in S-D Logic).

**Service.** A service is the application of resources by an actor (Vargo and Akaka 2009). Services can be exchanged with other actors to create value and to ensure organizational competitiveness (Lusch, et al. 2007) and survivability (Vargo, et al. 2008). We use this notion in C.A.R.S. to capture the performance of actors in achieving sourcing objectives (i.e., bottom-line results). Therefore, we define cost-saving KPIs for strategic sourcing, which are based on the performance of an actor in service exchanges. Cost-saving KPIs are quantifiable performance metrics to measure short-term effects in achieving strategic goals. Examples of these metrics are the cost of a service, the quality of a service, the delivery time of a service, etc. (Ellram 1990).

The C.A.R.S. conceptual basis is summarized by four viewpoints that are associated with its main constructs (i.e., capability, actor, resource, and service). These viewpoints specify conventions for the construction and the use of different sourcing views, which represent a system from the perspective of one or more decision-makers to address specific concerns (IEEE, 2000). An overview of the C.A.R.S. viewpoints, their focus and supported sourcing decisions is given in table 1.

Table 5.1. Summary of C.A.R.S. viewpoints

| *C.A.R.S. viewpoints* | *Focus* | *Sourcing decision* |
|---|---|---|
| Capability based Viewpoint | focuses on the abilities and capacities of the focal firm, its suppliers, and its customers to internally and externally configure the firm's resources and competencies with the aim of achieving a competitive advantage and surviving in a rapidly changing environment | choosing the right sourcing alternatives (e.g., outsourcing, insourcing, and co-sourcing) |
| Resource based Viewpoint | focuses on the firm-specific strengths (i.e., superior resources and core competencies) that are capable of creating value and allow a firm to gain competitive advantage | integrating superior resources and turning them into a specific benefit |
| Actor based Viewpoint | focuses on the firm's interactions with suppliers and internal and external customers to achieve short-term or long-term partnerships | (a) selecting the right suppliers and evaluating their strategic and performance dimensions for short-term and long-term partnerships; (b) finding new customers to increase the value creating potential |
| Service based Viewpoint | focuses on the firm's competitiveness and survivability that is determined by the participation of its network members (e.g., buyers, suppliers, customers) to co-create value | (a) determining how much money is spent at different suppliers, (b) determining how much value is perceived or captured by customers |

## 5.2.2 Modeling Procedure

The current techniques for strategic sourcing (e.g., the Purchasing Category Portfolio (Kraljic, 1983), the Power Portfolio Model (Cox, 2001), the

Purchasing Chessboard Approach (Schuh, et al. 2009), etc.) strongly focus on cost savings through performing spend analyses, supply market analyses and positioning techniques. These techniques have been criticized as sourcing is considered as a tactical spend management process rather than having a strategic importance to the organization (Cox, 2014; 2015). Furthermore, the techniques do not consider the variables that are required to assess and evaluate the complexity of the supply market, the value of purchasing categories, the power of suppliers against buyers, and the suitability of strategic sourcing alternatives (Cox, 2014; 2015).

To solve this issue, we proposed a preliminary modeling procedure based on the C.A.R.S. conceptualization for the systemic exploration of strategic sourcing alternatives (Rafati and Poels, 2016). This procedure consists of three steps:

(i) Determine the organization's capability positioning to find opportunities for cost savings and value creation;
(ii) Determine its buyer-supplier dependency positioning for setting relationship strategies in the supply market;
(iii) Identify sourcing strategies towards classifying capability sourcing and setting sourcing strategies.

In this paper, this preliminary modeling procedure is further extended and refined by connecting it to the developed meta-model of the C.A.R.S. modeling language.

## 5.3 Research Methodology

This research employs the DSR methodology, which is an overarching research methodology for designing new artifacts such as constructs, models, methods and instantiations of these (Hevner, et al. 2004). In this respect, the C.A.R.S. conceptualization (section 2.1) and its semantic definition (section 4.2) can be considered as a collection of constructs, the C.A.R.S. meta-model (section 4.1) as a model, the C.A.R.S. modeling method (section 4.3) as a supporting method, and the C.A.R.S. models (see section 5) as instantiations obtained through application of the modeling technique in a case study. The DSR process model consists of six research steps (Peffers et al. 2007): (i) problem identification and motivation, (ii) definition of solution objectives, (iii) design and development, (iv) demonstration, (v) evaluation, and (vi) scholarly communication (see figure 2).

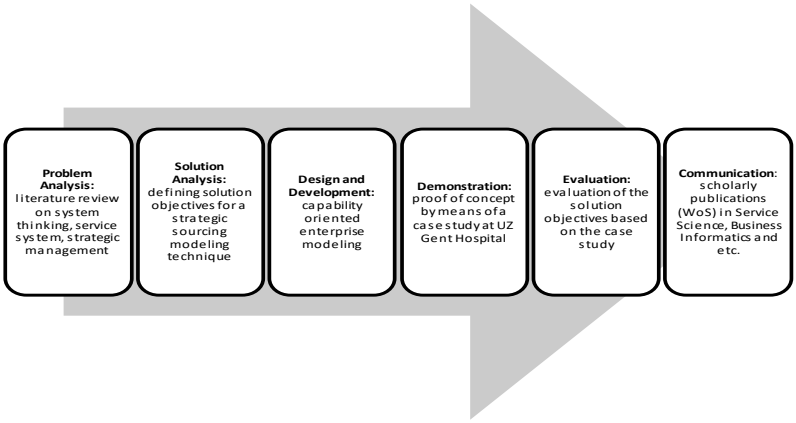


Figure 5.2. DSR Methodology process

**Problem Identification and Motivation.** The research problem about the lack of analytically rigorous instruments to help implementing value-driven strategic sourcing is discussed in the introduction (see section 1). Such instruments should help strategic sourcing managers to systematically explore and evaluate strategic sourcing alternatives.

**Definition of Solution Objectives.** As a solution to the identified problem, we propose the design of a new conceptual modeling technique for strategic sourcing. Based on the three earlier identified principles (see section 1), we define four requirements for such a modeling technique.

**Req.1.** The approach must focus on strategic sourcing and the procurement process.

An explicit focus on procurement and strategic sourcing is needed to support the creation of sourcing models, diagrams and views such as the strategic canvas (Kim and Mauborgne, 2002), the 5-forces model (Porter, 1979), the spend cube (Bartels et al. 2008), the core competencies model (Campbell and Luchs, 1997; Drejer, 2002), the sourcing canvas (Loftin et al., 2011), value chain models (Porter, 2011), cost models (e.g., total cost ownership), purchasing models (Kraljic, 1983; Cox, 2001), etc. These models can help the decision-making of stakeholders at the strategic level such as the chief procurement officer, the chief strategic officer, the strategic sourcing manager, the procurement manager, the purchasing manager, the category manager, and the supply chain manager.

**Req.2.** The approach must enable companies to support ***procurement data management and analytics competencies*** for fact-based decision-making.

Strategic sourcing has become a critical area of strategic management that is focused on decision-making regarding an organization's procurement activities such as spend analysis, capability sourcing, supplier selection and evaluation. However, many companies face challenges in obtaining the benefits associated with effective strategic sourcing. In this respect, managing the right procurement data for fact-based strategic sourcing decision-making is a core organizational challenge (Finch et al. 2014; LaValle et al. 2010; IBM Smarter Commerce, 2013; Aberdeen Group, 2014; Dhawan et al. 2011; Dhawan 2010; Butner, 2009). Therefore, we need an approach that enables the centralization of procurement data and the systemic exploration of sourcing alternatives to support procurement data management and analytics competencies (Rafati and Poels, 2015).

**Req.3.** The approach must provide a rigorous analysis considering both ***cost-saving KPIs and value-driven KPIs*** in strategic sourcing.

Cox (2014; 2015) introduces the need for a paradigm shift from a tactical to a strategic way of thinking about sourcing by focusing on value-driven targets. According to this strategic sourcing paradigm, there is need for a modeling approach to systemically explore sourcing alternatives by considering both cost-saving KPIs (e.g., total cost of ownership, switching cost, searching cost, etc.) and value-driven KPIs (e.g., organizational ability, technical ability, managerial ability, etc.) (Rafati and Poels, 2016).

**Req.4.** The approach must model ***both performance-related and (strategic) functional dimensions of value chain actors (e.g. buyer, supplier and focal firm)*** to achieve long-term and short-term sourcing objectives.

According to Talluri and Narasimhan (2004), sourcing decisions are not just operational decisions about the supplier and buyer's performance in a short-term relationship, but also strategic decisions about the supplier and buyer's capabilities for developing long-term relationships. Therefore, an approach is needed for modeling (i) the performance and (strategic) functional ability of actors (e.g. buyer, supplier, and focal firm) with respect to achieving sourcing objectives. The performance-related dimension of an actor (e.g., with respect to cost, quality, or delivery) represents short-term effects on the achievement of sourcing objectives. In contrast to this, the (strategic) functional ability (e.g., technical capability, managerial capability, organizational capability) of an actor represents potential long-term effects on these objectives.

**Design and Development.** Section 2 presented the C.A.R.S. conceptualization for strategic sourcing, which was founded on the S-D Logic as main theoretical basis. The design of the C.A.R.S. modeling technique starts from this conceptualization. This design includes the specification of a meta-model that defines the language constructs and their relationships (see section 4.1.1). For formulating the intended semantics of these meta-model elements, we use SBVR (i.e., Semantics of Business Vocabulary and Business Rules) (see section 4.1.2). Using SBVR, the C.A.R.S. constructs are characterized as Object Types and Roles. In this respect, an Object Type is *a noun concept that classifies things on the basis of their common properties*, while a Role is defined as *a noun concept that corresponds to things based on playing a part, assuming a function or being used in some situation* (SBVR 1.3, 2015). The C.A.R.S. relationships between constructs are considered as Fact Types, which are *concepts that have the meaning of a verb phrase that involve one or more noun concepts* (SBVR 1.3, 2015). Besides the meta-model and its semantics, section 4.1.3 proposes a concrete syntax for the core concepts. In section 4.2, the C.A.R.S. modeling technique is further completed by the specification of a supporting modeling procedure, which also includes guidance on the use of specific modeling viewpoints that can be constructed as instantiations of the C.A.R.S. modeling language.

**Demonstration.** We used a case study in the healthcare domain to demonstrate the use of our modeling approach for conceptualizing, designing, exploring, and analyzing strategic sourcing alternatives regarding IT outsourcing (see section 5.1).

**Evaluation.** The goal of this phase is to observe and measure how well the proposed modeling technique supports implementing value-driven strategic sourcing. We reflect upon the case study demonstration to evaluate the four solution requirements that were defined in the current section (see section 5.2).

**Communication.** The results of the first two steps of the DSR process (i.e., problem and solution analysis) were disseminated in peer-reviewed conference publications within domains such as System Thinking (Rafati and Poels, 2013), Service Science (Rafati and Poels, 2016) and Strategic Management (Rafati and Poels, 2015). The current paper presents the design & development, demonstration, and evaluation of the C.A.R.S. modeling technique.

## 5.4 C.A.R.S. Modeling Technique

Developing the C.A.R.S. modeling technique includes developing a modeling language (i.e., a meta-model in section 4.1.1, semantic definitions in section 4.1.2, and a notation in section 4.1.3) and a modeling procedure (section 4.2).

## 5.4.1 Modeling Language

### Meta-model

This section introduces the meta-model of the C.A.R.S. modeling technique (see figure 3), which is compliant with the MOF (i.e., Meta Object Facility) specification (OMG, 2016). This meta-model identifies the key concepts (i.e., Capability, Actor, Resource, and Service) and their interrelationships of the C.A.R.S. conceptualization. Value-driven and cost-driven KPIs are included as respectively strategic metrics and performance metrics. The meta-model also includes a number of classifications of the key C.A.R.S. concepts.

The meta-model further shows how services aim at delivering value and that this value is intended to result in desired outcomes. According to the meta-model, competitiveness and survivability are defined as two distinct desired outcomes of value creation through two functions, surviving and competition. While surviving is a function of how the firm exchanges its services to survive and thrive in its surrounding environment (Vargo, et al. 2008), competition is a function of how one firm exchanges its services to meet the needs of the customer relative to how another firm exchanges its services (Lusch, et al. 2007). Possible competitiveness outcomes are obtaining a sustainable competitive advantage, a temporary competitive advantage, competitive parity, etc. (Hill and Jones, 1991). To achieve these desired outcomes, a company requires a set of capabilities, which refer to the capacity and ability of an actor to internally and externally (re)configure resources (i.e., assets and competencies), which can be classified in either a core or a non-core category. Core capabilities are required to achieve competitiveness or survivability. Besides this, non-core capabilities support the firm's core capabilities to achieve desired outcomes. Moreover, capabilities are able to deliver value through service exchanges in both the supply and the demand market, which can be measured by strategic indicators (i.e., using value-driven KPIs). Service provisioning is the fundamental basis of value delivery by the application of resources for the benefit of another party (i.e., who requested the service) (Vargo and Akaka 2009). Resources can be classified as valuable, rare, inimitable, and non-substitutable as in the Resource-Based View of the firm (Barney 1991; 2002). The actual result of a service exchange can be measured through performance metrics (i.e., using cost-driven KPIs). Actors are engaged in these service exchanges as value co-creator and can play different roles as supplier, buyer, provider, customer or competitor. An actor can propose, perceive and capture the value to and from the market. Therefore, after value proposition, value creation and value capture functions, the value can

be interpreted as the proposed value, the perceived value or the captured value in the market.

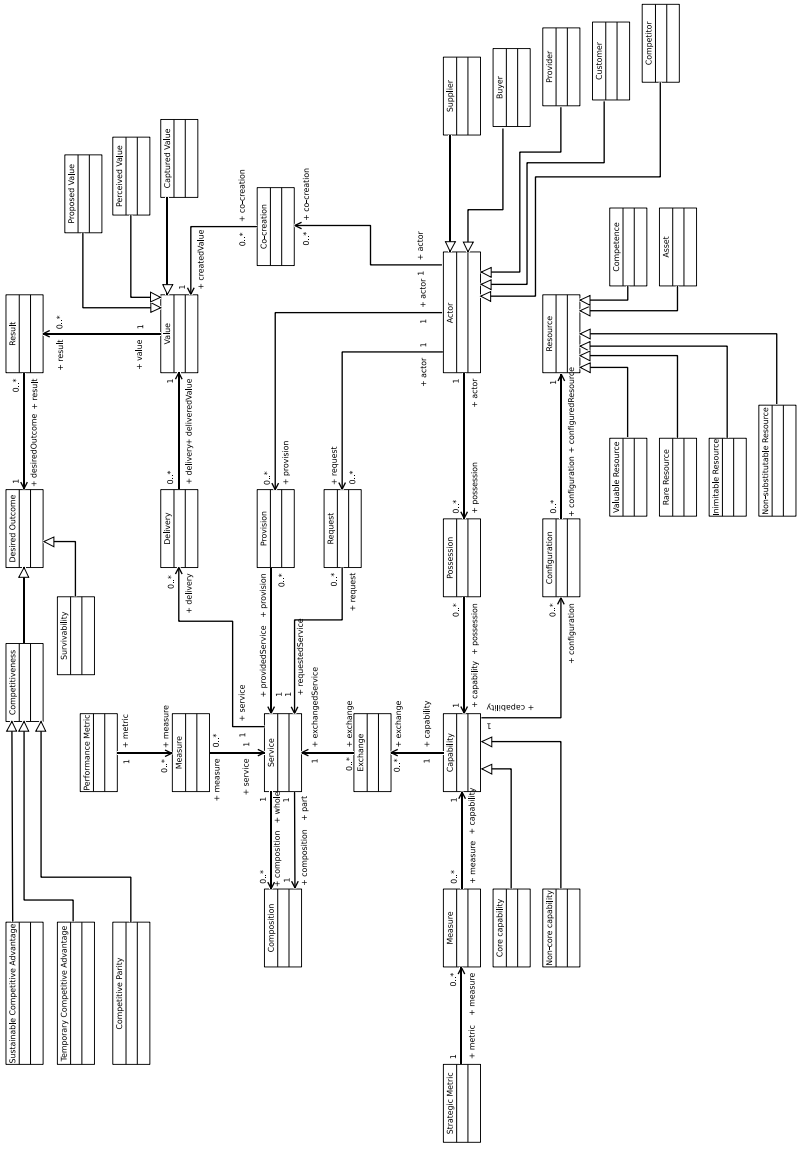


Figure 5.3. C.A.R.S. meta-model

## Semantics

The semantics of the meta-model is formalized by means of SBVR in table 2. To increase the understanding for the reader, clarifying examples are provided, which are inspired by our case study in the healthcare domain (section 5).

Table 5.2. C.A.R.S. concepts

| *Concept*<br><br>*(noun concept)* | *Definition* |
|---|---|
| Resource<br><br>(object type) | An asset or competency that an actor has or can call upon (Barney 1991; 2002)<br><br>*Examples:* skills, software and devices |
| Competency<br><br>(object type) | An active resource that acts upon other resource(s) to create value (Vargo and Akaka 2009; Poels, 2010; Lusch et al. 2007)<br><br>*Examples: skills, systems* |
| Asset (object type) | A passive resource that must be acted on to become a valuable resource (Vargo and Akaka 2009; Poels, 2010; Lusch et al. 2007)<br><br>*Examples: standards, technologies* |
| Valuable resource<br><br>(role) | A resource that is capable of creating value (Barney 1991; 2002)<br><br>*Example: healthcare information systems* |
| Rare resource (role) | A valuable resource that is possessed uniquely by one actor or by only a few others (Barney 1991; 2002)<br><br>*Example: business intelligence tools* |
| Inimitable resource<br><br>(role) | A valuable resource that competitors find difficult to imitate or obtain (Barney 1991; 2002)<br><br>*Example: specialized health standard* |

| | |
|---|---|
| Non-substitutable resource (role) | A valuable resource that does not have a strategic equivalent (Barney 1991; 2002)<br><br>*Example: integrated health system* |
| Capability<br><br>(object type) | The capacity and ability of an actor to internally and externally (re)configure resources, which is able to deliver value through service exchanges and which is needed to achieve a desired outcome (Helfat et al. 2009)<br><br>*Examples: healthcare core management, healthcare information management, hospital infrastructure management, hospital business management* |
| Core capability (role) | A capability that is required to achieve competitiveness or survivability and cannot be imitated or obtained by competitor(s) (Helfat et al. 2009)<br><br>*Examples: healthcare core management, healthcare information management* |
| Non-core capability<br><br>(role) | A capability that supports the firm's core capabilities but is not essential to the firm to achieve competitiveness or survivability or can easily be imitated by competitor(s) (Helfat et al. 2009)<br><br>*Examples: hospital infrastructure management, business information management* |
| Desired outcome<br><br>(object type) | A desired state of the firm in its environment (DoD, 2009; Azevedo, et al., 2015)<br><br>*Example: gaining profit or a sustainable position in the healthcare sector* |
| Survivability (role) | A desired outcome that results in the survival and prosperity of the firm (Vargo et al, 2008)<br><br>*Example: a sustainable position in the healthcare sector* |
| Competitiveness (role) | A desired outcome that results in more economic value in competition market (Hill and Jones, 1991)<br><br>*Example: gaining profit in the healthcare sector* |

| | |
|---|---|
| Sustainable competitive advantage<br><br>(role) | A desired outcome that results in maintaining a profit that is above average during a prolonged period (Hill and Jones, 1991)<br><br>*Example: achieving high profitability for a number of years in the healthcare market* |
| Temporary competitive advantage<br><br>(role) | A desired outcome that results in maintaining a profit that is on average to above average during a limited time (Hill and Jones, 1991)<br><br>*Example: achieving a profitability in the healthcare market, which is slightly above average* |
| Competitive parity<br><br>(role) | A desired outcome that results in maintaining an average profit (Hill and Jones, 1991)<br><br>*Example: achieving average profit in the healthcare market* |
| Service<br><br>(object type) | An application of resources for the benefit of another party, which is the fundamental basis of value creation through economic exchange (Vargo and Akaka 2009);<br><br>*Example: healthcare core service and healthcare supporting services* |
| Value<br><br>(object type) | An increase in the viability of an actor that only can be created by the participation of other actors (Vargo and Lusch, 2011b; Cardoso, et al, 2014)<br><br>*Examples: differentiation of healthcare core services, low costs of healthcare supporting services* |
| Captured value<br><br>(role) | What the actor captures after perceiving value by the beneficiary actor (Vargo and Lusch, 2011b; Bowman and Ambrosini 2000; Golnam et al, 2013)<br><br>*Example: profit* |
| Perceived value<br><br>(role) | The value as defined by the beneficiary actor, based on its perceptions of the usefulness of the product on offer (Vargo and Lusch, 2011b)<br><br>*Example: a care service with a high-level quality that results in a high perceived value* |

| | |
|---|---|
| Proposed value<br><br>(role) | The value that is promised by an actor to be delivered in a service exchange (Vargo and Lusch, 2011b)<br><br>*Example: enabling the hospital to deliver quality of care while capturing efficiency gains* |
| Performance metric<br><br>(object type) | A quantifiable or "hard" criterion to measure the performance of an actor to exchange services and to deliver value (Talluri and Narasimhan, 2004); (Ellram 1990)<br><br>*Example: quality, cost, delivery time of service* |
| Strategic metric<br><br>(object type) | A soft or difficult-to-quantify criterion to measure the capability of an actor to integrate resources, which is needed to achieve a desired outcome (Ellram 1990; Talluri and Narasimhan, 2004)<br><br>*Example: documentation and self-audit capability, quality management capability, design and development capability* |
| Actor (object type) | A party, which is engaged in a service exchange as a value co-creator (Vargo and Lusch, 2011a)<br><br>*Examples: hospital, patients, clinical staff, hospital staff, other users of the hospital systems, and other hospitals, vendors* |
| Supplier (role) | An actor who proposes value to be delivered to a beneficiary actor in a service exchange (Eltantawy et al. 2014)<br>*Examples: healthcare IT solution providers, healthcare technology vendors* |
| Buyer (role) | An actor who purchases services from supply market (Eltantawy et al. 2014; Golnam et al, 2013)<br>*Examples: general hospitals, university hospitals* |
| Provider (role) | An actor who provides services to beneficiary actor and who captures value (Eltantawy et al. 2014; Golnam et al, 2013)<br>*Example: a specific hospital (as a service provider)* |
| Customer (role) | An actor who requests services from demand market and who perceives and uses value (Eltantawy et al. 2014; Golnam et al, 2013)<br>*Examples: patients, healthcare laboratories* |
| Competitor (role) | An actor who provides the same services to the same group of beneficiary actors (Eltantawy et al. 2014; Golnam et al, 2013) |

| | |
|---|---|
| | *Example: other university hospitals than UZ Gent* |

The meta-model relationships (i.e., verb concepts) are formalized by SBVR in the Fact Table of table 3.

Table 5.3. C.A.R.S. facts

| ***Relationship (fact type)*** | ***Definition*** |
|---|---|
| configures | A capability configures resources (Helfat et al. 2009) |
| exchanges | A capability exchanges services (Vargo and Akaka 2009; Lusch et al. 2007) |
| is measured by | A capability is measured by strategic metrics (Talluri and Narasimhan, 2004) |
| possesses | An actor possesses capabilities (Eltantawy et al. 2014) |
| provides | an actor provides services to deliver value (Eltantawy et al. 2014) |
| requests | an actor requests services to deliver value (Eltantawy et al. 2014) |
| co-creates | An actor co-creates value (Vargo and Lusch, 2011b) |
| delivers | A service delivers value (Vargo and Akaka 2009; Lusch et al. 2007) |
| is measured by | A service is measured by performance metrics (Talluri and Narasimhan, 2004) |
| is part of | A subservice is part of a service |
| results in | Value creation results in a desired outcome (Lusch et al. 2007) |

## Notation

For instantiating the meta-model, a concrete syntax is needed. In table 4, we present the notation that we used when instantiating the meta-model for the case study (see section 5).

Table 5.4. C.A.R.S. concrete syntax

| *Modeling element* | *Concrete syntax* |
|---|---|
| Capability |  |
| Actor |  |
| Resource |  |
| Service |  |
| Value |  |
| Desired Outcome |  |
| Metric |  |
| Relationship |  |

## 5.4.2 Modeling Procedure

The focus of the C.A.R.S. modeling procedure is on value-driven strategic sourcing of capabilities. The sourcing of these capabilities, which are used in service exchange, is important to achieve competitiveness or survivability for an organization across the value chain and within a changing environment (Rafati and Poels, 2014a; 2014b; Bain & Company 2005; Loftin et al., 2011). The C.A.R.S. modeling procedure includes modeling steps and modeling results. The C.A.R.S. modeling procedure is constituted of five steps (see figure 4):

(i) Conduct a demand analysis;
(ii) Conduct a supply analysis;
(iii) Determine the capability positioning;
(iv) Determine the dependency positioning;
(v) Identify capability sourcing options.

Furthermore, an accompanying meta-model instantiation is proposed for each of these modeling steps. The C.A.R.S. viewpoints provide an overall image of the models that result from meta-model instantiation when applying the C.A.R.S. modeling procedure. A viewpoint is a representation of a whole system from the perspective of one or more decision-makers to address specific concerns (IEEE, 2000). In accordance with the viewpoints defined for the C.A.R.S. conceptualization (see table 1 in section 2.1), we define several viewpoints to address specific needs of strategic sourcing decision-makers:

1. An overall viewpoint on the demand market and supply market to find opportunities for sourcing, which is solved by the introduction of *demand-side and supply-side profile models*;
2. A positioning viewpoint on different classifications of capabilities, resources, services and actors (e.g., suppliers, customers and buyers) for setting strategies, which is realized by the *capability positioning portfolio model*;
3. A relational viewpoint on the relationship among suppliers, buyers, customers for assessing dependencies, which is given by the *dependency model* and the *actor positioning portfolio model*;
4. A sourcing viewpoint on various strategic sourcing alternatives and options of capabilities toward cost-saving and value-driven targets, which is shown by the *capability sourcing portfolio analysis model*.

These meta-model instantiations are demonstrated in section 5 where the procedure is applied to a case study. However, we first explain the five steps of the modelling procedure.

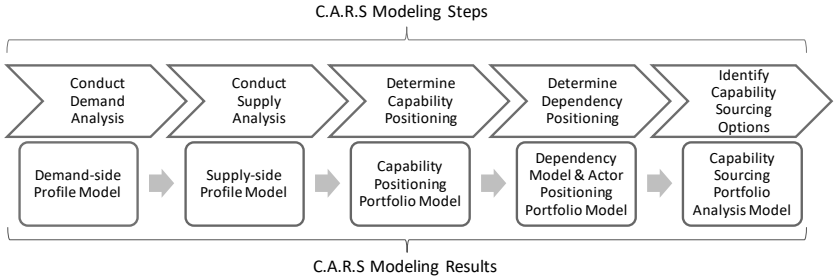


Figure 5.4. C.A.R.S. modeling procedure

**Step 1: Conduct Demand Analysis.** This step aims to increase the understanding of the demand side of the customer market to better assess opportunities for strategic sourcing. Our approach analyzes demand based on two dimensions of the focal firm: a functional dimension that is measured by strategic metrics and a performance dimension that is measured by operational metrics. These dimensions can be analyzed within C.A.R.S. by the development of a *demand-side profile model* (see figure 5 for an example). This

type of model is constructed by instantiating the desired outcome, value, service, capability, and resource meta-classes. The instances are related through configure, exchange, deliver, and results in relationships.

**Step 2: Conduct Supply Analysis.** This step is oriented towards improving the understanding of the supplier market. Comparable to the demand side, the supply market can be analyzed based on a functional dimension and a performance-related dimension, which are analyzed in a *supply-side profile model* (see figure 6 for an example). This type of model is constructed by instantiating the value, service, actor, and capability meta-classes. The instances are related through possess, create, and provide relationships.

**Step 3: Determine Capability Positioning.** This step aims to position the capabilities of the focal firm by considering both the demand and supply side of the value chain to find opportunities for cost savings and value creation. Inspired by Cox's criticality analysis (Cox, 2014), we introduce the *capability positioning portfolio model* (see figure 7 for an example) as a C.A.R.S. meta-model instantiation, which is based on two capability dimensions: (i) the potential to create more economic value (i.e., competitiveness) or the potential to survive (i.e., sustainability) and (ii) the available resource base to achieve the desired outcome. This results in a 2 x 2 matrix with four capability categories: (i) critical-strategic, (ii) strategic, (iii) critical-tactical capability, and (iv) tactical capability. For this type of model, only the capability meta-class needs to be instantiated.

**Step 4: Determine Dependency Positioning.** The purpose of this step is to position the dependency between buyers and suppliers to shape relationship strategies in the supply market. The C.A.R.S. modeling approach classifies this dependency based on the power of both the supplier and the buyer, which is measured by (i) the essentiality and substitutability of the exchanged service (Jacobs, 1974) and (ii) the capability to exchange services. The essentiality of a service is determined by the relative financial magnitude of the service, which refers to the impact of a service on the organizational profit. In contrast to this, the criticality of a service refers to the degree in which the focal firm is able to continue its operations in case of absence of the service. The substitutability of a service is determined by the availability of alternative sources and the level of relation-specific investments (i.e., the costs that result from switching between suppliers or buyers). This results in four possible categories to position the relationship between a buyer and a supplier: (i) buyer dominance, (ii) supplier dominance, (iii) interdependence and (iv) independence. C.A.R.S. categorizes the dependencies between a supplier and a buyer by a *dependency model* (see figure 8 for an example) and illustrates the suppliers' dependency

positioning by a 2 x 2 portfolio matrix, called the *actor positioning portfolio model* (see figure 9 for an example). The dependency model is constructed by instantiating the resource, service, actor, and capability meta-classes. The instances are related through configure, possess, provide, request, and composition relationships. For the actor positioning portfolio model only the actor meta-class needs to be instantiated.

**Step 5: Identify capability sourcing strategies.** The goal of the last step in the modeling procedure is to develop a *capability sourcing portfolio analysis model* (see figure 10 for an example) for classifying and setting capability sourcing strategies. The proposed model makes use of a 4 x 4 matrix to classify 16 capability sourcing categories based on the outcomes of the previous steps: the capability positioning and the buyer-supplier dependency positioning. The capability sourcing portfolio analysis is inspired by the sourcing portfolio analysis of Cox (2014), which is an existing approach to set supply strategies based on two leverage principles for exploring sourcing options: (i) moving into supply markets with low complexity, and (ii) understanding the current position and search for ways to exploit or balance the existing relationships. This type of model does not require instantiating any of the meta-classes of the meta-model, and is thus strictly spoken not a meta-model instantiation.

## 5.5 Case study

This section presents a proof-of-concept demonstration and evaluation of the C.A.R.S. modeling technique for exploring value-driven strategic sourcing by using an IT sourcing case study in UZ Gent, which is one of the largest hospitals in Belgium. More specifically, we illustrate how a strategic sourcing decision maker can apply the C.A.R.S. modeling technique to explore strategies and recommendations about sourcing IT capabilities in the hospital (see section 5.1). Furthermore, the C.A.R.S. modeling technique is evaluated based on the insights that we gained from the case study (see section 5.2).

### 5.5.1 Demonstration

We describe the IT sourcing scenario based on existing information about the healthcare IT contracts and agreements of UZ Gent. Furthermore, we did a reality check about the obtained results with the Chief Information Officer (CIO) of UZ Gent for a proof-of-concept evaluation of the proposed modeling approach. In the remainder of this paragraph, we illustrate how a strategic sourcing decision maker can apply the C.A.R.S. modeling technique to explore strategies and recommendations about sourcing IT capabilities in

the hospital. As explained in section 4.2, this application is guided by the 5-step C.A.R.S. modeling procedure (see figure 7).

**Step 1: Conduct Demand Analysis.** Figure 5 shows the *demand-side profile model* of UZ Gent, which shows the exchange of two services with internal and external customers like patients, clinical staff, hospital staff, and other hospitals. These services are healthcare core services (i.e., including clinical services and care services) and healthcare supporting services (i.e., including business administration services and ICT communication services). For these services, the associated value that is offered to the customers is differentiation (i.e., healthcare core services) and low costs (i.e., healthcare supporting services). The exchange of these services is supported by four IT capabilities: (i) healthcare core management, (ii) healthcare information management, (iii) hospital infrastructure management, and (iv) hospital business management. The definitions of these capabilities can be found in table 5.

Table 5.5. IT capability definitions

| *Capability* | *Definition* |
|---|---|
| Healthcare core management | the ability and capacity to deliver integrated healthcare core services supported by information and communication technologies |
| Healthcare information management | the ability and capacity to acquire, analyze and act on digital and traditional healthcare information (e.g., hospital information, clinical information, radiology information, and laboratory information) to provide high-quality patient care |
| Hospital infrastructure management | the ability and capacity to simplify communication and to speed up access to information with the aim of enhancing the clinical efficiency, increasing the productivity and improving the patient well-being |
| Hospital business management | the ability and capacity to acquire, analyze and act on administrative data (e.g., accounting, billing, purchasing, logistics, and catering data) to increase the hospital management performance and to decrease the overall costs |

The IT capabilities are based on various healthcare IT resources, such as skills (e.g., clinical skills, business skills, ICT skills, technical skills, and

organizational skills), technologies (e.g., displays, monitors, workstations, projectors, and video walls), software (e.g., image processing software and ERP software), systems (e.g., healthcare information system, reporting system, decision support system, and hospital-wide management information systems such as accounting, billing, and procurement management systems) and standards (e.g., Health Level-7 and DICOM). According to the hospital spend analysis, 40% of the total IT budget is spent on core services and 25% on supporting services.

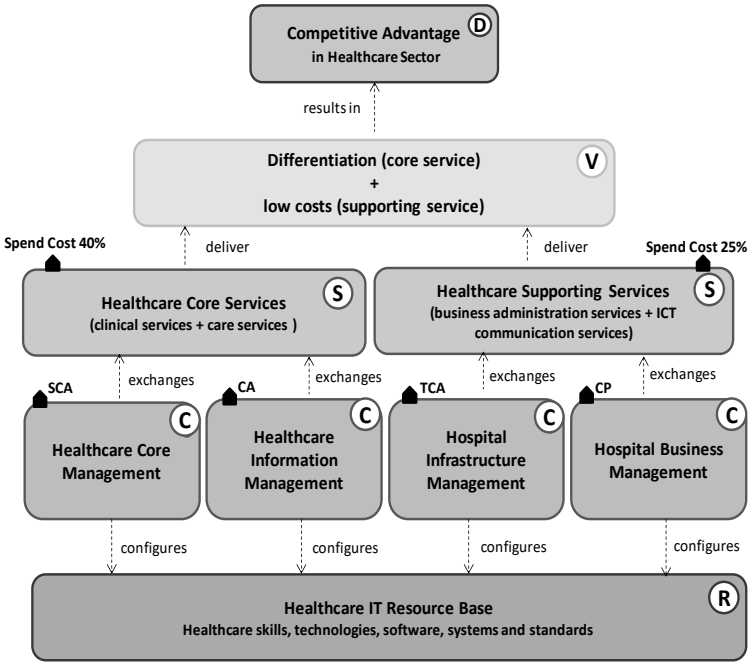


Figure 5.5. Demand side profile model of UZ Gent

**Step 2: Conduct Supply Analysis.** The supply side profile model (see figure 6) shows that two technical capabilities (i.e., the integrated healthcare solution development capability and the integrated business-ICT solution development capability) are needed to exchange both the healthcare core services and the supporting services. For the healthcare core services, potential suppliers are companies such as Cerner, Xperthis, Agfa Healthcare, Barco, Infohos, Carestream Healthcare, GE Healthcare, and Nexuz Healthcare. These services are offered through value propositions, which include the delivery of quality of care while capturing efficiency gains, providing timely access to the right information and intelligence, and offering integrated care. On the other hand, companies as SAP, Oracle, Microsoft, EMC, Dimension Data, Realdolmen, HP, PHILIPS, Fujifilm, Dell and Siemens are potential

suppliers of healthcare supporting services. These services are offered through the following value propositions: (i) supporting UZ Gent towards interdisciplinary collaboration, (ii) increasing business management performance, (iii) supporting UZ Gent towards integrated business operations, (iv) simplifying the hospital IT infrastructure to help save money, and (v) reducing the complexity of the hospital IT infrastructure through consolidation and virtualization.

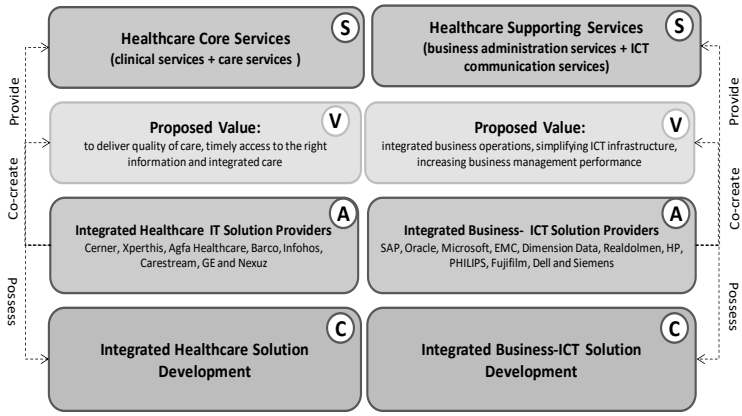


Figure 5.6. Supply side profile model of UZ Gent

**Step 3: Determine Capability Positioning.** The *capability positioning portfolio model* of UZ Gent, (see figure 7) shows that the healthcare core management capability is considered as a configuration of VRIN (i.e., valuable, rare, inimitable, and non-substitutable) resources and competencies (e.g., specialized healthcare skills, technologies, systems and standards), which is a critical-strategic capability that is able to achieve a sustainable competitive advantage in the demand market. The healthcare information management capability (i.e., a configuration of valuable resources and competencies such as healthcare skills, technologies, systems and standards), is a strategic capability that is able to achieve competitive advantage in the demand market. The hospital infrastructure management capability as a configuration of VRIN resources and competencies (e.g., hospital technologies, networks, and websites and data centers) is a critical-tactical capability that is able to achieve temporary competitive advantage in the demand market. Finally, the hospital business management capability is a tactical capability that is based on valuable resources and competencies (e.g. management information systems, business managerial skills and competencies), which results in parity competition in the demand market.

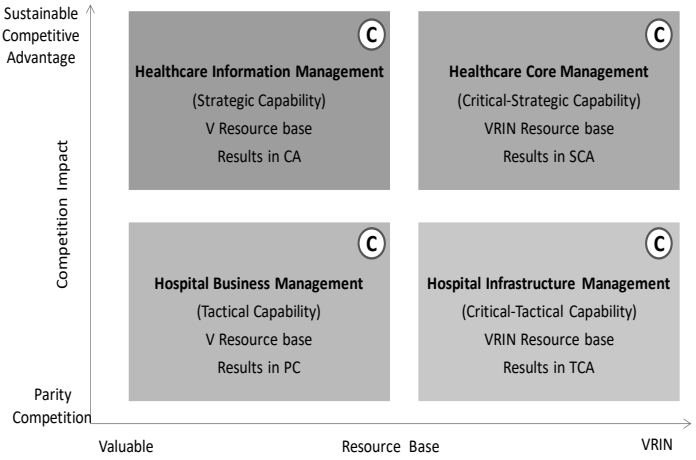


Figure 5.7. Capability positioning portfolio model of UZ Gent

**Step 4: Determine Dependency Positioning.** The *dependency model* in figure 8 focuses on the picture archiving service that is provided to UZ Gent's by Agfa Healthcare, which is a specialized healthcare IT solution provider. This service supports a seamless linkage of digital images with information from clinical information systems and other databases in the hospital. This service is part of the healthcare core services that are exchanged by the healthcare information management capability of UZ Gent. The buyer-supplier dependency analysis shows that the studied service is a common healthcare information system for UZ Gent with low-level criticality and low-level financial impact. On the other hand, this service is a core service of Agfa Healthcare with high-level criticality and high-level financial impact. There are seven alternative suppliers (i.e., Xperthis, Barco, Infohos, Carestream Healthcare, GE Healthcare, Nexuz Healthcare, and IBM Healthcare) to provide this service with low-level switching costs. Moreover, there are only three alternative buyers (i.e., one university hospital and two general hospitals) to request this service with high-level searching costs. Therefore, the relationship between UZ Gent and Agfa Healthcare is positioned as a "buyer dominance" relationship. Similarly, we can create dependency models for other suppliers in the market, which are required to develop a complete *actor positioning portfolio model* (see figure 9).

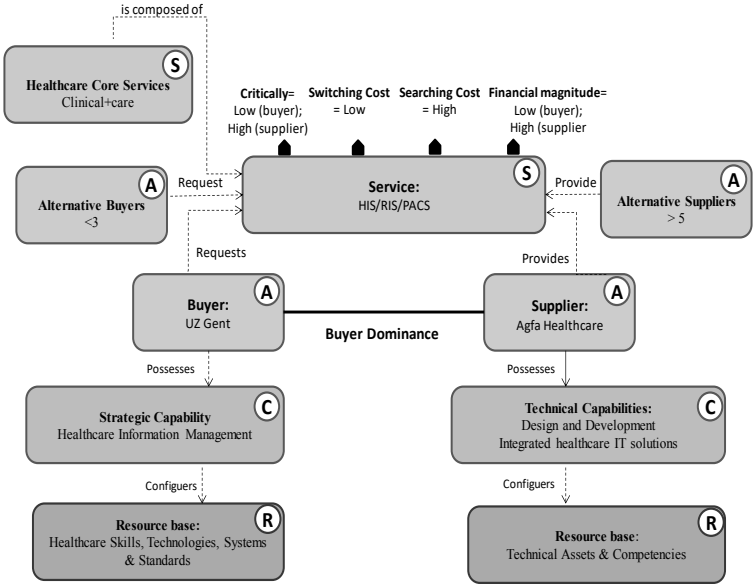


Figure 5.8. Buyer-supplier dependency model of UZ Gent and Agfa Healthcare

Figure 9 shows the results of the actor positioning portfolio analysis of all UZ Gent suppliers. The findings of this analysis can be summarized as follows:

1. Buyer dominance: Agfa, Barco, Infohos, Nexuz and Carestream are alternative suppliers to provide healthcare information systems through a buyer-dominant relationship with UZ Gent
2. Interdependence:
    a. Xperthis is classified in the interdependence cell as a supplier for hospital information management services.
    b. Cerner is the only supplier in the market to provide an integrated healthcare solution to UZ Gent, hence it can be positioned in the interdependence cell.
    c. Realdolmen is classified in the interdependence cell for providing hospital infrastructure management services.
3. Supplier dominance: Dimension Data and EMC are two dominant suppliers for hospital infrastructure management.
4. Independence:
    a. Two suppliers are classified in the independence cell for infrastructure management: HP and Dell.
    b. To support the business administration in UZ Gent, SAP, Oracle and Microsoft are all classified as having independence buyer-supplier relationships with UZ Gent.

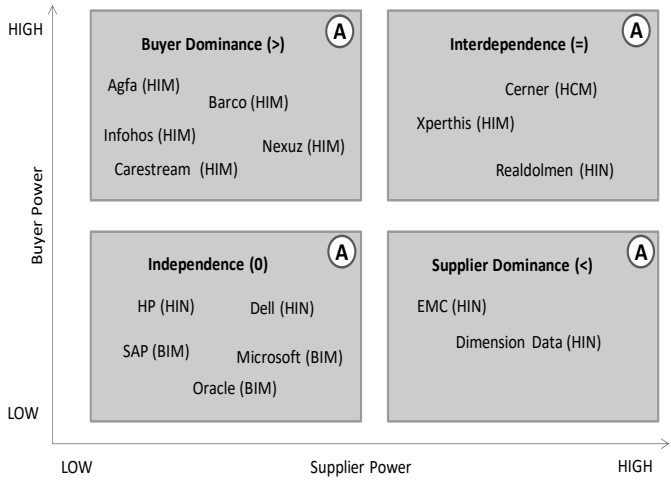


Figure 5.9. Dependency positioning portfolio model of UZ Gent

**Step 5: Identify capability sourcing strategies**. Figure 10 shows the modeling result of the last step of the C.A.R.S. modelling procedure, which aims to develop appropriate sourcing strategies based on the capability positioning portfolio model (figure 7) and the actor positioning portfolio model (figure 9). More specifically, the capability sourcing portfolio model classifies capability sourcing options into 16 categories based on the outcomes of the capability positioning (i.e., tactical capability, tactical-critical capability, strategic capability, and strategic-critical capability in figure 7) and the actor positioning (i.e., interdependence, dependence, buyer dominance and supplier dominance in figure 9). Figure à10 shows the results of applying the capability sourcing portfolio analysis in UZ Gent. In the following, we explain the possible and available options and strategies for sourcing UZ Gent's capabilities according to the capability sourcing portfolio analysis and its leverage principles.

Possible strategies for the *healthcare core management capability* (i.e., a critical-strategic capability) are:

1. Develop an integrated IT system in-house (i.e., insourcing), which can be sold to other hospitals in the market. The main advantage of this strategy is the development of an innovative platform that generates extra revenues by improving the internal IT capabilities and internal IT resource base. However, this will also result in high development costs.
2. Choose for outsourcing to realize cost reductions. However, this option comes at the expense of value creation and is only viable if there exist potential suppliers in the market.

3. Maintain the strategic partnership with Cerner through long-term agreements for value creation (e.g., by the development of a tailored healthcare system to realize differentiation) and reduce risk through master data management.

The *healthcare information management capability* is sourced within a supply market, which is characterized by many suppliers and relatively low switching costs. Therefore, UZ Gent has the following options:

1. Exploit the buying power through market competition and short-term agreements with suppliers to realize cost reductions.
2. Develop a strategic partnership with Xperthis through long-term collaborations to foster innovation. A possible disadvantage of this option is the emergence of a lock-in partnership.

Sourcing the *healthcare infrastructure management capability* is difficult for UZ Gent as their suppliers determine both the price and the quality, while the hospital has limited buyer power. Hence, possible sourcing strategies include:

1. Exploit market competition through short-term agreements with HP and Dell. However, this can have a negative impact on the creation of value.
2. Develop a strategic partnership with Realdolmen through moving into an alliance position. Although this can increase the creation of value, a risk of choosing this option is entering in a lock-in partnership.
3. Accept the hospital's dependency on Dimension Data and EMC and the existence of a locked-in partnership.

Finally, many options exist for sourcing the *business information management capability* as the supply market has many buyers and searching costs are relatively low. Therefore, the best sourcing option is realizing market competition through short-term agreements.

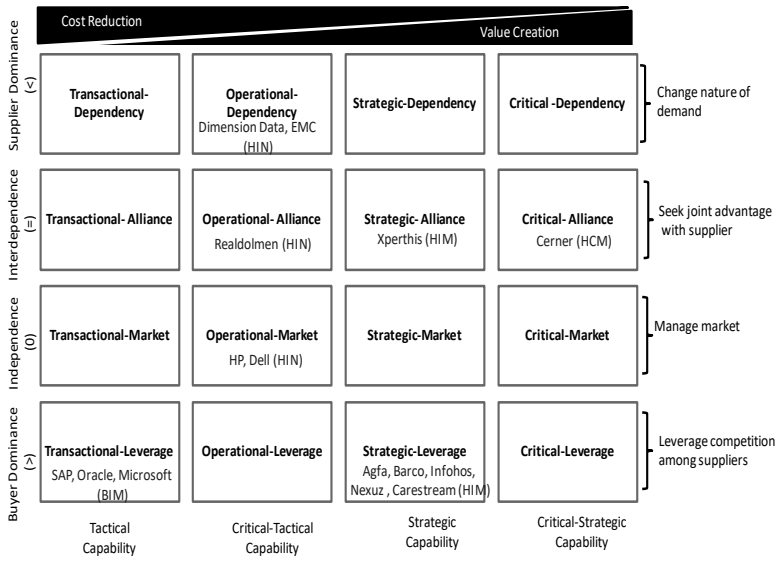


Figure 5.10. Capability sourcing portfolio model of UZ Gent

## 5.5.2 Evaluation

The CIO of UZ Gent realized that its sourcing strategy was mainly focused on cost-saving metrics (e.g., total cost of ownership, quality, and delivery time) rather than value-creating factors (e.g., capabilities, competencies and resources). In this respect, he believes that the C.A.R.S. modeling approach can support strategic sourcing decision makers to achieve value-related targets (e.g., innovation and long-term partnerships) through providing an IT capability portfolio, an analysis of both the demand and supply side of the hospital's capabilities, and a buyer-supplier dependency portfolio. In the remainder of this section, we evaluate the C.A.R.S. modeling approach against the solution requirements (see section 3) based on the insights gained from the case study at UZ Gent.

The C.A.R.S. modeling approach provides a set of viewpoints that are useful for decision makers at the strategic management level (i.e., requirement 1). More specifically, capability-oriented viewpoints are proposed to represent architectural descriptions that address specific concerns such as demand profiling, supply profiling, category positioning, dependency-power positioning, and sourcing portfolio management. For example, profile models (see figures 5 and 6) represent the demand and the supply profile of the IT market of UZ Gent. Furthermore, a capability-based

dependency model (see figure 8) illustrates the relationship between the hospital and its suppliers. Finally, positioning models (see figures 7 and 9) are able to model the capability and actor positioning portfolios. According to the CIO's feedback, these models are able to provide a stable view and a common language to support the discussion about IT sourcing options between the different decision makers at UZ Gent.

The proposed modeling technique enables companies to achieve procurement data management and analytics competencies for fact-based decision-making (i.e., requirement 2). The meta-model and the semantics of C.A.R.S. have the potential to be used as a conceptual data model, which could be further extended into a logical data model. In order to do so, more technical information and attributes need to be added to the current meta-model. Afterwards, this logical data model could be converted into a physical data model by applying implementation attributes, constraints, security roles, and by generating XML schema descriptions.

In this respect, the capability notion of the C.A.R.S. meta-model can be used to model strategic sourcing data about the capabilities of actors (e.g., supplier, buyer, competitor, customer, etc.) in both the supply and demand markets. In the case study, this resulted in an overview of the capabilities in the healthcare demand market and the required capabilities from the IT supply market of UZ Gent. Furthermore, the service notion can be used to model operational sourcing data about the cost of a service (e.g., spending, total cost of ownership, transaction costs, switching costs, and searching costs), the quality of a service, and the delivery time of a service. In the case study, this provided us more insights about services in the demand market, services that are exchanged between UZ Gent and its IT suppliers, searching costs, switching costs, and the financial impact of exchanged services (e.g., the picture archiving service). The actor notion can be used to model relational sourcing data about supplier-buyer relationships as illustrated by the dependency models between UZ Gent and its IT suppliers. Finally, the resource notion is useful to model sourcing data about the available resource base. For UZ Gent, this resource base includes skills, systems, technologies and standards.

C.A.R.S. provides a rigorous analysis of sourcing options by considering both cost-saving and value-driven KPIs (i.e., requirement 3). In the case study, value-driven KPIs were used to evaluate the technical capabilities of IT solution providers with the aim of identifying options for long-term partnerships, and to determine the operational capabilities of UZ Gent and their competitors to achieve a sustainable competitive advantage. Furthermore, cost-saving KPIs were considered to evaluate the current

performance of IT solution vendors in the provision of their services. This was realized through metrics such as the cost and quality for a short-term relationship.

The C.A.R.S. modeling approach is able to demonstrate both operational (i.e., performance-related) and functional (i.e., strategy-related) dimensions of the actors in the value chain (i.e., buyers, suppliers, and the focal firm) to achieve both long-term and short-term sourcing objectives (i.e., requirement 4). C.A.R.S. proposes a ***service-dominant logic*** for modeling the performance dimension of actors (e.g. buyer, supplier and focal firm) to achieve sourcing operational objectives (bottom-line results). On the other hand, C.A.R.S. proposes a ***capability-dominant logic*** for modeling the functional dimension (abilities) of actors to achieve long-term objectives. In the case study, we used the C.A.R.S. service concepts and related operational metrics to model the performance dimensions of UZ Gent and Agfa Healthcare in exchanging the picture archiving service. These dimensions include the criticality and financial magnitude of the service, the searching costs, and the switching costs. Furthermore, we applied the C.A.R.S. capability concepts and related strategic metrics to illustrate the functional dimension of UZ Gent and Agfa Healthcare in exchanging the picture archiving service by the technical capabilities of Agfa Healthcare and the strategic capabilities of UZ Gent.

## 5.6 Related Work.

Capability modeling has been used in both academia and practice to connect strategic objectives and high-level organizational information to the requirements of individual technological artifacts (Loucopoulos, 2015). The use of a capability as the representative of 'what' the business does and needs without describing the technical implementation (i.e., 'how') serves as a powerful abstraction tool to ensure the communication between technology and business specialists (Loucopoulos, 2015). The notion has been used for representing investment profiles for IT (Iacob et al., 2012; Keller, 2009), realizing business/IT alignment (Ulrich and Rosen, 2014), reasoning about alternatives of capability development (Danesh and Yu, 2004), mapping to operational components and services (DoD, 2009) and realizing a nearly automated transition to software development (Stirna et al., 2012; Zdravkovic et al., 2013).

Different conceptual modeling techniques use capabilities as a construct in their modeling language. These capability-oriented modeling techniques include the Component Business Model (CBM), the Value Delivery Modeling Language (VDML), Enterprise Capability Modeling (ECM), Business Strategy

and Valuation Concepts (BSVC), the DoDAF meta-model (DM2), Capability-based planning, Business Capabilities Centric Enterprise Architecture (BCCE) and Capability Driven Development (CDD). An overview of the scope of these modeling techniques is given in table 7.

Table 5.6. Capability-oriented modeling approaches

| *Approach* | *Discipline* | *Def.* | *App. Domain* |
|---|---|---|---|
| Component Business Model (IBM) | Business Architecture | a modeling approach to support the componentization and service- orientation of a business | business development at the strategic level (Ernest and Nisavic, 2007); (Cherbakov et al., 2005) |
| VDML | Value Modeling | a modeling approach for value-driven enterprise design and the management of business transformation | analysis and design of the operation of an enterprise, support for strategic transformation of enterprises (Berre, De Man and Lindgren, 2013) |
| Enterprise Capability Modeling | Requirement Engineering | a capability-centric modeling approach to achieve business/IT alignment | Business/IT alignment (Loucopoulos et al., 2015) |
| BSVC (ArchiMate) | Enterprise Architecture | an approach to model the organization's core capabilities and key resources to focus on capturing the business value of IT artifacts and projects in order to achieve a better alignment with business strategy | strategic alignment of project portfolios (Azevedo, et al., 2015) |

| | | | |
|---|---|---|---|
| DM2<br><br>(DoDAF) | | a modeling approach, which facilitates architectural alignment by mapping capabilities to a service-oriented implementation. | service-oriented architecture and development, Business/IT alignment (DoD, 2009) |
| Capability based Planning (TOGAF & ArchiMate) | | a modeling approach for capability analysis, development and delivery | enterprise planning and engineering, Business/IT alignment (Papazoglou, 2014) |
| BCCE (TOGAF) | | a modeling approach based on the component business model for the modularization IT architectures | business<br><br>development, IT architecture, EA integration (Barroero, Motta, and Pignatelli, 2010) |
| Capability Driven Development | Model Driven Development (MDD) | a holistic approach to model-oriented IS development and to allow the run-time adaptation of alternatives | Information System development (Zdravkovic, et al., 2013) |

CBM focuses on the realization of business change and the transformation of enterprises. The technique makes use of a componentization approach that is based on a process of deconstruction/reconstruction through business components (i.e., a part of an enterprise that has the potential to operate independently). In other words, business components represent a logical grouping of the work that is done within the enterprise, which contains people, activities, and supporting technology (Ernest and Nisavic, 2007; Cherbakov et al., 2005).

VDML links capability offerings to the organizational value network as the concept is considered as being fundamental for the delivery of a product or service and the realization of a company's business model. In this context, VDML defines a capability as *the ability of an organization to perform a particular type of work and may involve people with particular skills and knowledge, intellectual*

*property, defined practices, operating facilities, tools and equipment* (Berre, De Man and Lindgren, 2013).

ECM is a modeling approach to meet organizational challenges such as alignment, agility and sustainability in the context of dynamic enterprise requirements. ECM makes use of five interrelated viewpoints, in which capability modeling acts as a conduit to integrate the different views. This will offer enterprises the opportunity to analyze the effects of a changing environment on the strategic alignment among digital services and organizational objectives (Loucopoulos et al., 2015).

BSVC is an extension to the ArchiMate modeling language that aims to capture the business value of IT artifacts and projects in order to achieve a better alignment with the business strategy. BSVC defines a capability *as the ability of a static structure element, (e.g., actor, application component, etc.) to employ resources to achieve some goal*. BSVC uses this capability construct to facilitate the strategic alignment between business and IT (Azevedo, et al., 2015).

DM2 supports a modeling technique, which emphasizes the importance of describing capabilities by a viewpoint that facilitates capability deployment planning, implementation, monitoring and preservation. DM2 defines a capability as *the ability to achieve a desired effect under specified performance standards and conditions through combinations of ways and means (i.e., activities and resources) to perform a set of activities*. DM2 explicitly facilitates the mapping of capabilities to both operational components, which illustrates the functional scope and organizational span of a capability, and services to illustrate how various capabilities can support a service-oriented implementation (DoD, 2009).

CBP is a versatile business planning approach that focuses on the planning, engineering, and delivery of strategic business capabilities to the enterprise. As such, CBP assists in aligning IT with the business by focusing on the continuous creation of business value. Within this approach, which is used as an extension of the TOGAF framework and the ArchiMate modeling language, a capability is defined as *an ability, capacity or potential that an organization, person or system possesses* (Papazoglou, 2014).

BCCE integrates the IBM business component approach into the TOGAF framework. BCCE defines a capability as the *power or the ability to describe what a business component can do to create value for customers (Barroero, Motta, and Pignatelli, 2010)*. BCCE uses capability and business component maps to

support the modularization of the architecture of a business component, which are considered as IT clusters that provide and consume services.

CDD aims to facilitate a nearly automated transition to software development by modeling capabilities and the contexts in which they operate. CDD defines a capability as the *ability and capacity that enable an enterprise to achieve a business goal in a certain context.* As such, a capability formulates the requirements for accomplishing a business goal, which can be realized by applying a capability delivery pattern. Consequently, CDD facilitates run-time adjustments to changing requirements by the implementation of contextualized patterns of capability execution (Zdravkovic, et al., 2013).

In summary, existing capability-oriented modeling approaches are used in a wide variety of application contexts like strategic alignment, business development and transformation, enterprise architecture integration, requirement and change management, service oriented architecture, information system developments, and project and portfolio management. Hence, we introduce C.A.R.S. as a modeling technique to realize a more rigorous exploration and analysis of strategic sourcing alternatives. Therefore, C.A.R.S. explicitly focuses on procurement and strategic sourcing as a specific application domain.

## 5.7 Conclusion

In this paper, we propose the C.A.R.S. modeling technique as an instrument to implement value-driven strategic sourcing. This modeling technique is as a capability-oriented modeling approach founded on the S-D Logic, which focuses on the systemic exploration of strategic sourcing alternatives to achieve strategic goals. Furthermore, C.A.R.S. enables a rigorous analysis of strategic sourcing options. In this context, the modeling technique is designed by defining both a modeling language and a supporting modeling procedure. Furthermore, we used a case study to demonstrate the application of the C.A.R.S. modeling technique in a real-world scenario (i.e., IT outsourcing in UZ Ghent). This case study supports the evaluation of the C.A.R.S. modeling approach with respect to the identified solution requirements.

Although the evaluation enables us to demonstrate the potential applicability of the C.A.R.S. technique, we acknowledge that this needs to be repeated by future case studies. Therefore, we will investigate the application scope of the modeling approach by targeting different domains (e.g., commercial and non-commercial domains), different levels (i.e., micro

(e.g., local), meso (e.g., international), and macro (e.g., global)), and different sourcing trends (e.g., shared service centers, business process outsourcing, IT outsourcing, offshoring and global sourcing, etc.). This could potentially result in small adaptations to the modeling technique.

Besides a practical evaluation of the usefulness of the modelling technique, a formal evaluation of its syntax and semantics is needed in the future to detect and resolve possible language deficiencies. This could be realized by applying the C.A.R.S. modelling technique in case studies with diverse contexts, which enables to compare different instantiations of the modelling constructs to identify language flaws.

As C.A.R.S. is designed as a new domain-specific modeling technique, which does not originate from existing EM languages, it is important that future research is oriented towards the integration of our modeling technique with languages as MEMO and ArchiMate (e.g., as a new viewpoint specifically tailored to the CPO). This will ensure that value-driven strategic sourcing becomes a new EM perspective that is clearly integrated with the existing perspectives.

Finally, future research includes the development of a way-of-working to implement value-driven strategic sourcing. This research will be focused on model-driven analytical techniques to support data management (e.g., master data and reference data), data analysis (e.g., statistical, contextual, quantitative, descriptive, predictive and cognitive analyses), and visual data tools (e.g., SAS and SPSS) with the aim of realizing fact-based decision-making. Besides this, we will develop a computer-aided design tool to support the way-of-supporting. This can be realized by an assessment of the ability of existing EA modeling tools (e.g., Archi, Sparx Enterprise Architect, IBM Rational Enterprise Architect, and ADOIT for strategic management) to support the C.A.R.S. technique.

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## References

Aberdeen Group (2014). The CPO's Agenda for 2014... and Beyond. Technical report.

Azevedo, C. L., Iacob, M. E., Almeida, J. P. A., van Sinderen, M., Pires, L. F., & Guizzardi, G. (2015). Modeling resources and capabilities in enterprise architecture: A well-founded ontology-based proposal for ArchiMate.Information Systems, 54, 235-262.

Bain & Company (2005). Capability Sourcing / Outsourcing/ Offshoring, http://www.bain.com/consulting-services/performance-improvement/capability-sourcing.aspx

Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of management, 17(1), 99-120.

Barney, J. B. (2002). Gaining and sustaining competitive advantage.

Barroero, T., Motta, G., & Pignatelli, G. (2010). Business capabilities centric enterprise architecture. In Enterprise architecture, integration and interoperability (pp. 32-43). Springer Berlin Heidelberg.

Bartels, A., Pohlmann, T., Lo, H. & Lee, C. (2008). Market Overview 2008: Automated Spend Analysis, Forrester Research.

Berre, A. J., De Man, H., & Lindgren, P. (2013). Business Model Innovation with the NEFFICS platform and VDML. In NGEBIS'2013 workshop at CAISE (pp. 24-30).

Bowman, C., & Ambrosini, V. (2000). Value creation versus value capture: towards a coherent definition of value in strategy. British Journal of Management, 11(1), 1-15.

Butner, B. (2009). Sourcing in a Demanding Economic Environment. IBM Global Business Services.

Campbell, A., & Luchs, K. S. (Eds.). (1997). Core competency-based strategy. Cengage Learning Business Press.

Cardoso, J., Lopes, R., & Poels, G. (2014). Service Systems-Concepts, Modeling, and Programming (pp. 1-91). Springer.

Cherbakov, L., Galambos, G., Harishankar, R., Kalyana, S., & Rackham, G. (2005). Impact of service orientation at the business level. IBM Systems Journal, 44(4), 653-668.

Cox, A. (2001). Understanding buyer and supplier power: a framework for procurement and supply competence. Journal of Supply Chain Management, 37(1), 8-15.

Cox, A. (2014). Sourcing Portfolio Analysis: Power Positioning Tools for Category Management & Strategic Sourcing. Earlsgate Press.

Cox, A. (2015). From Spend Management to Supply Management - Improving Category Management & Strategic Sourcing. Technical report, IIAPS.

Cox, A., & Ireland, P. (2015). Value Sourcing: From Spend Management to Supply Management, Kindle E-Book, Earlsgate Press, Stratford-upon-Avon.

Danesh, M. H., & Yu, E. (2014, June). Modeling enterprise capabilities with i*: reasoning on alternatives. In Advanced Information Systems Engineering Workshops (pp. 112-123). Springer International Publishing.

David, F. R. (2011). Strategic management: Concepts and cases.

Dhawan, R. (2010) Procurement analytics. In: The CIPS Conference, Australia.

Dhawan, R., Walters, D. & Bhattacharjya, J. (2011). Procurement models for the future. In: The SMART Supply Chain Conference, Australia.

DoD, U. S. (2009). Department of Defense Architecture Framework.

Drejer, A. (2002). Strategic management and core competencies: Theory and application. Greenwood Publishing Group.

Dyer JH, Singh H (1998) The relational view: Cooperative strategy and sources of interorganizational competitive advantage. Academy of management review. 23(4): 660-679.

Ellram, L. M. (1990). The supplier selection decision in strategic partnerships. Journal of Purchasing and materials Management, 26(4), 8-14.

Eltantawy, R., Giunipero, L., & Handfield, R. (2014). Strategic sourcing management's mindset: strategic sourcing orientation and its implications. International Journal of Physical Distribution & Logistics Management,44(10), 768-795.

Ernest, M., & Nisavic, J. M. (2007). Adding value to the IT organization with the component business model. IBM Systems Journal, 46(3), 387-403.

Finch, G., Davidson, S., Kirschniak, C., Weikersheimer, M., Reese, C. & Shockley, R. (2014). Analytics: The Speed Advantage; Why Data-Driven Organizations are Winning the Race in Today's Marketplace. IBM Global Business Services.

Frank, U. (2013). Domain-Specific Modeling Languages: Requirements Analysis and Design Guidelines. Domain Engineering: Product Lines, Languages, and Conceptual Models. In. Domain Engineering (pp. 133-157). Springer Berlin Heidelberg.

Frank, U. (2014) Multi-perspective enterprise modeling: foundational concepts, prospects, and future research challenges. Software & Systems Modeling, 13(3), 941–962.

Golnam, A., Viswanathan, V., Moser, C. I., Ritala, P., & Wegmann, A. (2013). Designing value-oriented service systems by value map. In Business Modeling and Software Design (pp. 150-173). Springer International Publishing.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., & Winter, S. G. (2009). Dynamic capabilities: Understanding strategic change in organizations. John Wiley & Sons.

Hevner, A.R., March, S.T., & Park, J. (2004) Design Research in Information Systems Research. MIS Quarterly, 28(1), 75-105.

Hill, C., & Jones, G. (1991). Strategic Management. An Integrated Approach.

Iacob, M. E., Quartel, D., & Jonkers, H. (2012, September). Capturing business strategy and value in enterprise architecture to support portfolio valuation. In Enterprise Distributed Object Computing Conference (EDOC), 2012 IEEE 16th International (pp. 11-20). IEEE.

IBM Smarter Commerce (2013). Procurement: optimizing savings and mitigating risk in a complex world. Technical report.

IEEE. (2000). Software Engineering Standards Committee. IEEE recommended practice for architectural description of software-intensive systems. Technical Report IEEE Std 1471-2000, IEEE Computer Society. .

Jacobs, D. (1974). Dependency and vulnerability: An exchange approach to the control of organizations. Administrative science quarterly, 45-59.

Jüttner, U., Christopher, M., & Baker, S. (2007). Demand chain management-integrating marketing and supply chain management. Industrial marketing management, 36(3), 377-392.

Karagiannis, D., & Kühn, H. (2002). Metamodelling platforms. In EC-Web (Vol. 2455, p. 182).

Keller, W. (2009). Using capabilities in enterprise architecture management. White Paper, Object Architects.

Kim, W. C., & Mauborgne, R. (2002). Charting your company's future.Harvard business review, 80(6), 76-83.

Kocabasoglu, C., & Suresh, N. C. (2006). Strategic sourcing: an empirical investigation of the concept and its practices in US manufacturing firms. Journal of Supply Chain Management, 42(2), 4-16.

Kraljic, P. (1983). Purchasing must become supply management. Harvard business review, 61(5), 109-117.

LaValle, S., Hopkins, M., Lesser, E., Shockley, R. & Kruschwitz, N. (2010). Analytics: The New Path to Value; How the Smartest Organizations are Embedding Analytics to Transform Insights into Action. IBM Global Business Services.

Loftin, R., Lynch, R., & Calhoun, J. (2011). The Sourcing Canvas: A Strategic Approach to Sourcing Decisions, p. 13. Accelare Inc., USA.

Loucopoulos, P., Stratigaki, C., Danesh, M. H., Bravos, G., Anagnostopoulos, D., & Dimitrakopoulos, G. (2015, October). Enterprise Capability Modeling: Concepts, Method, and Application. In 2015 International Conference on Enterprise Systems (ES) (pp. 66-77). IEEE.

Lusch, R. F., & Vargo, S. L. (2006). Service-dominant logic: reactions, reflections and refinements. Marketing theory, 6(3), 281-288.

Lusch, R. F., Vargo, S. L., & O'Brien, M. (2007). Competing through service: Insights from service-dominant logic. Journal of retailing, 83(1), 5-18.

Narasimhan, R., Talluri, S., & Mendez, D. (2001). Supplier evaluation and rationalization via data envelopment analysis: an empirical examination.Journal of supply chain management, 37(2), 28-37.

OMG (2016). OMG Meta Object Facility (MOF) Core Specification. Version 2.5.1.

Osterwalder, A., & Pigneur, Y. (2013). Designing Business Models and Similar Strategic Objects: The Contribution of IS. Journal of the Association for Information Systems, 14(5), 237-244.

Papazoglou, A. (2014). Capability-based planning with TOGAF® and ArchiMate®.

Peeters, F. (2016). A Conceptual Framework for Visual Representations and Schematic Descriptions at the level of Strategic Management, Master of Science in de Toegepaste Economische Wetenschappen, Handelsingenieur, Ghent University.

Poels, G. (2010). The resource-service-system model for service science. In Advances in Conceptual Modeling–Applications and Challenges (pp. 117-126). Springer Berlin Heidelberg.

Porter, M. E. (1979). How competitive forces shape strategy.

Porter, M. E. (2011). Competitive advantage of nations: creating and sustaining superior performance. Simon and Schuster.

Rafati, L., & Poels, G. (2013, September). Service Oriented Enterprise Engineering: Applying Viable System Approach (vSa) in Enterprise Engineering for Sourcing Decision Making. In Enterprise Distributed Object Computing Conference Workshops (EDOCW), 2013 17th IEEE International (pp. 124-129). IEEE.

Rafati, L., & Poels, G. (2014a). Capability sourcing modeling. In Advanced Information Systems Engineering Workshops (pp. 77-87). Springer International Publishing.

Rafati, L., & Poels, G. (2014b). Introducing service-oriented organizational structure for capability sourcing. In Exploring Services Science (pp. 82-91). Springer International Publishing.

Rafati, L., & Poels, G. (2015). Towards Model-Based Strategic Sourcing. In Achieving Success and Innovation in Global Sourcing: Perspectives and Practices (pp. 29-51). Springer International Publishing.

Rafati, L., & Poels, G. (2016). Service-Dominant Strategic Sourcing: Value Creation Versus Cost Saving. IESS 2016: 30-44. Springer International Publishing.

Sarkis, J., & Talluri, S. (2002). A model for strategic supplier selection. Journal of supply chain management, 38(4), 18-28.

SBVR 1.3 (2015). Semantics of Business Vocabulary and Business Rules. Object Management Group, http://www.omg.org/spec/SBVR/1.3/PDF

Schuh, C., Kromoser, R., Strohmer, M. F., Pérez, R. R., & Triplat, A. (2009). The Purchasing Chessboard™ (pp. 55-207). Springer Berlin Heidelberg.

Seligmann, P. S., Wijers, G. M., & Sol, H. G. (1989, November). Analyzing the structure of IS methodologies, an alternative approach. In Proceedings of the First Dutch Conference on Information Systems (pp. 1-2). Amersfoort, The Netherlands, EU.

Stirna, J., Grabis, J., Henkel, M., & Zdravkovic, J. (2012). Capability driven development–an approach to support evolving organizations. In The Practice of Enterprise Modeling (pp. 117-131). Springer Berlin Heidelberg.

Talluri, S., & Narasimhan, R. (2004). A methodology for strategic sourcing. European journal of operational research, 154(1), 236-250.

The Open Group (2016). ArchiMate® 3.0 Specification.

Ulrich, W., & Rosen, M. (2012). The business capability map: Building a foundation for business/it alignment. Cutter Consortium for Business and Enterprise Architecture.

Vargo, S. L., & Akaka, M. A. (2009). Service-dominant logic as a foundation for service science: clarifications. Service Science, 1(1), 32-41.

Vargo, S. L., & Lusch, R. F. (2011a). Service-dominant logic: Looking ahead. In Presentation at the Naples Forum on Service, June (pp. 14-17).

Vargo, S. L., & Lusch, R. F. (2011b). It's all B2B... and beyond: Toward a systems perspective of the market. Industrial Marketing Management, 40(2), 181-187.

Vargo, S. L., Maglio, P. P., & Akaka, M. A. (2008). On value and value co-creation: A service systems and service logic perspective. European management journal, 26(3), 145-152.

Wieland, H., Polese, F., Vargo, S., & Lusch, R. (2012). Toward a service (eco) systems perspective on value creation. Wieland, H., Polese, F., Vargo, S., Lusch, 12-24.

Zdravkovic, J., Stirna, J., Henkel, M., & Grabis, J. (2013, June). Modeling business capabilities and context dependent delivery by cloud services. InAdvanced Information Systems Engineering (pp. 369-383). Springer Berlin Heidelberg.

# 6

# Conclusion

**Summary:** The conclusion gives an overview of PhD research results (section 6.1), research implication (section 6.2) and provides an outlook on current and future works based on the limitations of the research (section 6.3). Furthermore, this chapter includes a summary of the contributions and publications (section 6.4).

## 6.1 Research Results

The problem addressed by our PhD research is the lack of practical instruments (i.e., tools and techniques) to implement the value-driven management approach to strategic sourcing and to deliver the data management and data analytics capabilities required to prepare companies for fact-based decision-making in procurement. We defined our research goal as *to develop a modeling approach that enables companies 1) to drive fact-based decision-making with respect to procurement data management and procurement analytics"; and 2) to implement strategic sourcing toward achieving value-driven targets*.

This goal was further refined by formulating the research objectives of four studies in three iterations:

**Iteration 1:** This iteration focused on systemic view, conceptual basis and foundation theories which are used to develop the proposed modeling approach. Iteration 1 includes two studies as:

- **Study 1:** The first study has been defined to design a conceptual basis to develop the proposed approach. The objective of this study is "to develop a conceptual solution for (i) enabling centralization of procurement data; and (ii) enabling the systemic exploration and evaluation of strategic sourcing alternatives".

- **Study2:** The second study has been defined to specify a modeling discipline to develop the proposed approach. The objective of this study is "to define a modeling discipline which can provide (1) the systemic viewpoints to interpret complex sourcing phenomena; and (2) the outside-box models to specify the value-driven interactions of an enterprise (as a system) with other actors in its ecosystem".

**Iteration 2:** This iteration focused on developing the first draft of the proposed modeling approach. Iteration 2 includes one study as:

- **Study 3:** The third study has been defined to develop the first draft of the proposed modeling approach including a modeling language and a method. The objective of this study is "to design (i) a systemic view on strategic sourcing with emphasis on value creation to realize strategic sourcing as value-driven management.; and (ii) a conceptual modeling language for the exploration of strategic sourcing alternatives to achieve value-driven targets".

**Iteration 3:** This iteration focused on developing the final and formal version of the proposed modeling approach. Iteration 3 includes one study as:

- **Study 4:** The last study has been defined to develop a formal domain-specific modeling technique including modeling language and modeling procedure. The objective of this study is "to design a new domain-specific modeling technique, which (i) provides an analytically rigorous modeling approach for strategic sourcing, and (ii) allows the model user to focus on the systemic exploration of strategic sourcing alternatives to achieve strategic goals".

To address these objectives, our aim was to elaborate the envisioned approach in four different perspectives: (i) a way of thinking (i.e., a systemic view of strategic sourcing offering a conceptual solution for the identified problems in the form of a conceptualization of a strategic sourcing modeling language), (ii) a way of modeling (i.e., the strategic sourcing modeling language and a method for how to use it), (iii) a way of working (i.e., a model-based analysis approach) and (iv) a way of supporting (i.e., a computer-aided design tool). We limited the scope of the PhD research proper to the first three perspectives, while for the fourth perspective a solution architecture is proposed as a starting point for future research (included in an appendix to this dissertation, see section 6.2). In the following, we explain the research results regarding the first three perspectives.

i) ***A systemic view of strategic sourcing and a conceptualization for a strategic sourcing modeling language (a way of thinking).*** This result relates to research objectives of study 1 and study 2, and was obtained through the research reported in chapters 2 and 3. A systemic view is a systems view, meaning that strategic sourcing is performed for an organization being part of a system of organizations that are interrelated through value co-creation relationships. This system is what we called the value net. A systemic view allows understanding an organization's position in a value net from both reductionist and holistic perspectives. Creating such understanding is key to value-driven management of strategic sourcing. Such systemic view has been designed by taking a service ecosystem perspective of an organization. It means that understanding an organization's position in the value net (as required for value-driven management of strategic sourcing) can be achieved by seeing an organization as being part of a service ecosystem, i.e., a system where elements exchange services through sharing resources and capabilities. We used this systemic view to develop the conceptual basis (which we called C.A.R.S, which stands for Capability – Actor – Resource -

Service) of a new modeling language based on constructs that we derived from Service Science that are used to describe such service ecosystems. We believe that Service Science offers conceptual frameworks and theories to describe service ecosystems, and that is the solution we proposed for designing a systemic view on strategic sourcing that helps creating a better understanding of the position of an organization in a value net. The modeling of the value net and the focal firm within it, using constructs like resource, service system, service, actor, value, and the relationships between these, allows for a view of strategic sourcing in line with value-driven management. We observed that such constructs, taken from Service Science (and in particular the Viable Systems Approach and the Service-Dominant Logic) can be mapped onto strategic sourcing concepts from Strategic Management Theories. The descriptive power of Service Science theories is thus used to design a conceptualization that expresses a service ecosystem view on the organization and its value net, which allows for a way of thinking on strategic sourcing according to the value-driven management paradigm.

ii) ***A strategic sourcing modeling language and method (a way of modeling).*** This result relates to research objectives of study 3 (first version of way of modeling) and study 4 (formal version of way of modeling) and was obtained by the research reported in chapters 4 and 5, building upon the conceptual and theoretical foundation laid out in chapters 2 and 3. The main challenges of the value-driven management approach are the lack of analytical rigor and robustness in the identification of strategic sourcing options to achieve strategic goals. To implement value-driven strategic sourcing, our solution approach was conceptual modeling. Conceptual modeling contributes to strategic sourcing decision-making in different ways. Based on ideas of Osterwalder and Pigneur (2013) regarding the use of conceptual models for management, we posited that conceptual models can support the identification, formalization, and visualization of the concepts that are relevant for value-driven strategic sourcing. Furthermore, conceptual modeling can support the design of model-based techniques for generating and assessing strategic sourcing alternatives. Finally, a conceptual model can be the basis for developing computer-aided design tools, which assist in automating the process of designing strategic sourcing alternatives. To create conceptual models that describe sourcing alternatives for strategic sourcing, a domain-specific conceptual modeling technique, which

consists of both a modeling language and a supporting method, is needed. In this PhD research, we designed the C.A.R.S. modeling technique for value-driven management in strategic sourcing. This technique enables a rigorous analysis of strategic sourcing options, which we identified as a main challenge in this field. More specifically, C.A.R.S. was proposed as a capability-oriented modeling approach founded on the Service-Dominant Logic, which focuses on the systemic exploration of strategic sourcing alternatives to achieve strategic goals. In this context, we designed the modeling technique by defining both a modeling language and a supporting modeling method.

iii) ***A model-based analysis approach (a way of working).*** This result relates to the research objectives of study 3 (first demonstration of way of working) and study 4 (second demonstration of way of working) and was obtained by the research reported in chapters 4 and 5. A model-based analysis approach can be integrated into our approach to support fact-based decision-making. We demonstrated this in the two case-studies we performed. For the case of IT service outsourcing in the UZGent hospital (see chapters 3 and 5), we used C.A.R.S-based models to apply techniques and indicators like a capability positioning technique to evaluate the competition degree of capabilities and the criticality degree of the resource base measured by VRIN metrics and a dependency positioning technique to evaluate the essentiality and substitutability of the exchanged service measured by financial impact, switching and search costs to decide on IT service outsourcing strategies. For the case of sustainable procurement at Umicore (see chapter 4) we applied other techniques like a capability positioning technique to evaluate the strategic impact of capability measured by a VRIN assessment of the available resources and the sustainability impact of capabilities measured by economic factors (e.g., cost, quality and delivery time), social factors (e.g., customer privacy, health and safety of staff and customer, satisfactory working environments and discrimination in employment), and environmental factors (e.g., resource consumption, recycling income, environmental taxes). Clearly, the choice of model-based analysis techniques and metrics depends upon the value that drives strategic sourcing (e.g., profitability, sustainability, welfare, etc.).

The above research results have been developed through considering different theories like viable system approach (VSA), service-dominant logic (S-DL), resource- based view (RBV), dynamic capability view (DCV), rational

view theory (RVT), capability oriented modeling (CoM). The main results and artifacts of this research are (1) a systemic view; (2) a conceptual basis; and (3) a way of modeling (modeling language and method). First, viable system approach (VSA) has been used to develop a systemic view on the ecosystem of the enterprise (value net). Second, a conceptualization based on service-dominant logic (S-DL) is defined that is aligned with the new way of thinking in Strategic Sourcing (value driven) which is focused on establishing valuable relationships and interactions among actors in an eco-system. Furthermore, this conceptual basis (conceptualization) has been enriched and improved by core concepts of strategic management (e.g. resource, capability, competitive advantage, etc.) based on foundation theories of strategic management like resource- based view (RBV), dynamic capability view (DCV) and rational view theory (RVT). Finally, among different modeling orientations (e.g. process oriented, goal oriented, service oriented, etc.), capability oriented modeling has been chosen as way of modeling which is able to provide a stable and overarching view for fostering dialogue amongst managerial decision makers (e.g., chief procurement officer, chief strategic officer and strategic sourcing manager) about strategic sourcing.

## 6.2 Research Implication

Briefly, the implication of the obtained results for research is the knowledge incorporated in the design of C.A.R.S, which provides a basis for further research into how conceptual modeling and service ecosystems thinking helps implementing value-driven strategic sourcing. The implication for practice is the development of a practical approach to implement value-driven strategic sourcing, which requires some further research as is described in section 6.3.

Furthermore, there are possibilities of integration between the proposed conceptual modeling approach (C.A.R.S) and other management theories (total quality management) or management fields (such as enterprise resource planning, R&D, knowledge management, etc.). In this research, we applied C.A.R.S for systemic exploration of sourcing alternatives (strategic decisions) to achieve value driven targets. Sourcing decisions are strategic decisions which are concerned with the whole environment in which the firm operates (we called this the value net). S-D Logic defines a right viewpoint/level of abstraction (a macro/holistic view focused on value co-creation) and right conceptual basis/language for strategic sourcing decision making (e.g., finding a new supplier in the market for a long-term partnership). On the other hand, we can apply conceptual modeling for operational/tactical decision making, but we need to investigate if S-D Logic can provide (i) a right viewpoint/ level of abstraction (a micro/reductionist

view on short-term targets) and (ii) a right conceptual basis/language (for example concepts like contract, process, culture, behavior) for operational/tactical decision making (e.g., ordering materials from suppliers, control and track formal and legal agreements). Totally, this research work proposes innovative topics moving beyond the only tactics level by concretely showing how to implement and manage business processes systemically by creating a coherent connection between strategies (holistic and macro-level) and tactics (reductionist and micro-level). In this dissertation, appendix 2 refers to a managerial implication which is a brief tutorial on how managers can apply C.A.R.S.

## 6.3 Limitations and Future Research

While chapter 2 presented an overview of our solution approach (and hence introduced C.A.R.S), chapters 3, 4 and 5 present the further development of our solution with respect to theoretical foundations and actual design. In particular, the research results presented in chapters 4 and 5 can be seen as the final iterations of the way of thinking and way of modeling, respectively, in our current Design Science project, whereas the way of working is demonstrated through the case-studies elaborated in these chapters. We repeat here the limitations of our research in these final two chapters and discuss how we (can) deal with them. We also outline how we plan to extend the current approach in our future research.

In the research of chapter 4, first, as C.A.R.S was only applied to one sourcing scenario and was not division-wide or company-wide implemented within Umicore, we have not provided evidence of its efficacy but only showed its potential in solving specific procurement problems related to sustainable procurement at Umicore. Second, although the case-study enabled us to demonstrate the potential utility of the C.A.R.S approach, we realize that it is difficult to generalize the results based on a single case study in a specific setting (i.e., sustainable procurement as value-driven strategic sourcing). Third, as our approach is work-in-progress and currently lacks software tools to support the modeling and analysis tasks, the case-study involved the active participation of the researchers and required extensive documentation on behalf of the case study organization.

Regarding these limitations, we acknowledge that a complete Design Science research requires an extensive evaluation of the artefact. We did not meet this requirement in the current research for two reasons. First, at this moment it has not been decided whether C.A.R.S will be adopted by Umicore. We applied C.A.R.S in Umicore to a real sourcing scenario (joint development and production of phosphate-based cathode materials for use in

rechargeable batteries by Umicore and Prayon). This application was extensively discussed with the procurement director. The C.A.R.S analysis confirmed the current sourcing strategy for the Prayon partner, but also identified an alternative strategy (which at this moment is less optimal). More important, with respect to evaluation, is that based on this application there was agreement that C.A.R.S has the potential to solve current problems with procurement at Umicore that are related to procurement not being a systemic and integrated process. In that sense C.A.R.S has the potential to improve upon current practice at Umicore. We acknowledge that showing this potential is not the same as providing evidence of efficacy. Referring to the FEDS framework for evaluation in DSR (Venable et al. 2016), the application of our DSR artifact in a case-study is a naturalistic (i.e., application to a real scenario and not a fictitious one) and formative (i.e., meant to explore the potential utility of C.A.R.S, while the approach itself needs further development like formalization and method and tool support, as being described in the last section of chapter 4) evaluation that fits into a 'human risk & effectiveness' evaluation strategy. Second, even if C.A.R.S would have been adopted by Umicore (or any other company of that scale), evidence of efficacy cannot be provided in the short-term. As we argued, strategic sourcing as value-driven management is a process rather than a project. We believe it will therefore take time to observe the impact of C.A.R.S on achievement of Umicore's sustainable procurement goals like long-lasting partnerships with suppliers, the co-development of sustainable products and services, and the tracking and reporting of supplier performance based on sustainability metrics. But even without having been able to perform such long-term effectiveness study, it is our opinion that the scenario-based evaluation of C.A.R.S provides arguments for its potential in contributing as a solution to the problem of lack of practical instruments to implement value-driven management in strategic sourcing.

In the research of chapter 5, we have applied the proposed approach to an IT outsourcing case-study in a large hospital (Rafati and Poels 2017c). Further case-studies are needed to explore the support for value-driven strategic sourcing in different domains (e.g., contracting services from public authorities), for different sourcing scenarios (e.g., actors being simultaneously buyer and supplier in a value co-creation process), for different sourcing trends (e.g., business process outsourcing, offshoring and global sourcing), and in different sourcing contexts (e.g., emerging economies, instable regulatory environments). This research can potentially result in adaptations to the modeling approach. It will also inform us on the boundaries of the application scope of C.A.R.S. We acknowledge that defining this application scope explicitly, e.g., through an axiomatization that emphasizes specific properties of C.A.R.S concepts depending on the

application context, is a major research challenge and might require other research that extends the current case-study research.

Our future research plans also include the development of techniques to enable a more rigorous analysis of strategic sourcing options (e.g., statistical, contextual, quantitative, descriptive, predictive and cognitive analyses), which we identified as a main challenge in this field. Future research may, for instance, look into how to incorporate in the analysis sourcing strategies that allow recovering from disturbing or disruptive events which affect the sourcing of capabilities and the performance of value co-creation processes. A further research recommendation we received from an anonymous reviewer is to discuss the procurement managerial decision in a general context of decision theory and problem-solving theory. Jonassen (1997) defines two types of problems: 1) Well-structured problems; and 2) Ill-structured problems. Well-structured problems typically present all elements of the problem; engage a limited number of rules and principles that are organized in a predictive and prescriptive arrangement; possess correct, convergent answers; and have a preferred, prescribed solution process. On the other hand, ill-structured problems have many alternative solutions to problems; vaguely defined or unclear goals and constraints; multiple solution paths; and multiple criteria for evaluating solutions; so, they are more difficult to solve. Jonassen (2000) describes differences among problems in terms of their structuredness (dynamicity), domain specificity (abstractness), and complexity. Accordingly, ill-structured problems tend to be more complex, dynamic and domain-specific than well-structured problems. Referring to the theory of problem solving of Jonassen, there are different kinds of problems including story problems, rule using/rule induction problems, decision making, troubleshooting, diagnosis-solution, strategic performance, policy problems, design problems, and dilemmas. In future work, we will more precisely characterize "procurement and strategic sourcing related problems" as ill-structured problems which are usually constrained to decisions with a limited number of solutions (decision-making problems).

Jonassen (2006) further introduces modelling as a problem-solving solution. He promotes the use of mind tools for facilitating conceptual change. Constructing models facilitates intense cognitive and social activities that result in conceptual change. He has emphasized the construction of mental models of the problem space. A mental model is a mental abstraction of a construct (its components and their interrelationships) which can help to hypothesize and confirm solutions to the problem. Mental models are enhanced and confirmed by the construction of external models. Those models may be quantitative

(equations) or qualitative. Both are essential to understanding and solving problems. Several types of modelling tools, including databases, concept maps, expert systems, systems modelling tools, and simulations, visualization tools may be used to construct external models (Jonassen, 2006). In future research, we can define conceptual modelling as a problem-solving approach to create a mental model of the solution space (i.e., exploring alternative value creation options in strategic sourcing). We believe this will further help positioning our research that is based on conceptual modelling as a problem-solving solution.

Another perspective is provided by the use of heuristic methods, which have already a tradition in production planning, in situations like uncertainties in formulation of the objective among others. A heuristic method refers to any approach to problem solving that employs a practical method not guaranteed to be optimal or perfect, but sufficient for the immediate goals. As opposed to exact methods, which guarantee to give an optimum solution of the problem, heuristic methods only attempt to yield a good, but not necessarily optimum solution. There are different heuristic methods for problem-solving including decomposition methods, inductive methods, reduction methods, constructive methods and local search methods. Conceptual modelling as a problem-solving approach provides for a better understanding of the different options in the solution space and allows for evaluating these options, but does by itself not guarantee the choice of optimal solution. In this regard, conceptual modelling is not an exact method, but shares similarities with heuristic methods. Our future research plans include the development of techniques to enable a more rigorous analysis of strategic sourcing options. We can use the heuristic methods as an example of such techniques to integrate into C.A.R.S.

Finally, another research suggestion is taking into account the perspective opened in viable systems approach (vSa) and decision making in service management (Badinelli et al., 2012) to investigate whether the decision processes requested by procurement are simple (based on procedures driving to the “best” result), complicated (facing increasing number of components, relations, interconnections, as well as uncertainty and variety) or complex (facing emergent systems’ properties that arise from interactions not captured by the specification of variables and parameters). In chapter 3, we explored strategic sourcing decision-making from the perspective of the viable systems approach (vSa) and proposed a modelling discipline founded on vSa. The proposed modelling discipline effectively assumes strategic sourcing to require complex decision-making. Future research applying vSa theory may analyze and classify each (other) step of

the procurement process as requiring simple, complicated or complex decision-making.

Besides these ideas related to the way of working, another research idea is to develop a computer-aided design tool to implement the way of supporting. This can be realized by an assessment of the ability of existing Enterprise Architecture modeling tools (e.g., Archi, Sparx Enterprise Architect, IBM Rational Enterprise Architect, and ADOIT for strategic management) to support the C.A.R.S. technique. An outline of a solution architecture for the way of supporting of C.A.R.S has already been developed (Besheli et al., 2016). The proposed solution architecture includes i) a business function model to illustrate the functional and operational aspects of procurement based on C.A.R.S.; ii) a conceptual data model to describe the data and information aspects of strategic sourcing and procurement process requirements, in an abstract way; and iii) a logical data model to build the procurement data mart as a way of implementation of C.A.R.S modelling approach. We prefer to present this outline in an appendix to this dissertation as it is only a preliminary version which needs further development.

## 6.4 Research Contributions and Publications

Three chapters (chapter 3, 4, 5) of this dissertation have been submitted to international peer-reviewed journals (chapters 3 and 4 are accepted and chapter 5 is under the second round of review) and one chapter (chapter 2) has been published in the post-conference proceedings of an international workshop. Below is a list of all publications and conferences contributions related to the PhD research.

### Publications in Peer-Reviewed International Journals

Rafati, L., & Poels, G. (Accepted, July 2017). Service Oriented Enterprise Engineering: a modeling discipline based on the viable systems approach (vSa) for strategic sourcing decision-making. The International Journal of Information Systems in the Service Sector (IJISSS).

Rafati, L., & Poels, G. (Accepted, August 2017). Value-Driven Strategic Sourcing Based on Service-Dominant Logic. INFORMS Service Science journal.

Rafati, L., Roelens, B., & Poels, G. (Under second round of review, July 2017). Designing a domain-specific modeling technique for value-driven strategic

sourcing. Submitted to The International Journal of Enterprise Modelling and Information Systems Architectures (EMISA).

### Publications in Peer-Reviewed International Conference Proceedings (Listed in Web of Science)

Rafati, L., & Poels, G. (2016, May). Service-dominant strategic sourcing: value creation versus cost saving. In International Conference on Exploring Services Science (pp. 30-44). Springer International Publishing.

Rafati, L., & Poels, G. (2015, February). Towards Model-Based Strategic Sourcing. In International Workshop on Global Sourcing of Information Technology and Business Processes (pp. 29-51). Springer International Publishing.

Rafati, L., & Poels, G. (2014). A conceptual framework for capability sourcing modeling. In 8th European Conference on IS Management and Evaluation (ECIME) (pp. 341-346). Academic Conferences and Publishing International Limited.

Rafati, L., & Poels, G. (2014, June). Capability sourcing modeling. In International Conference on Advanced Information Systems Engineering (pp. 77-87). Springer International Publishing.

Rafati, L., & Poels, G. (2014, January). Introducing Service-oriented Organizational Structure for Capability Sourcing. In IESS (pp. 82-91).

Rafati, L., & Poels, G. (2013, September). Service Oriented Enterprise Engineering: Applying Viable System Approach (vSa) in Enterprise Engineering for Sourcing Decision Making. In Enterprise Distributed Object Computing Conference Workshops (EDOCW), 2013 17th IEEE International (pp. 124-129). IEEE.

### Publications in Peer-Reviewed International Conference Proceedings (Not Listed in Web of Science)

Rafati, L. (2014). Capability sourcing: a service-dominant logic view. In 8th Mediterranean Conference on Information Systems.

### Other Conferences and Workshops

Besheli, P. R., Rafati, L., & Poels, G. (2016). A Solution Architecture to Support the CARS Conceptual Model for Strategic Sourcing.

Rafati, L., (2013, May). Service Oriented Enterprise Engineering: applying viable system approach (vSa) in Enterprise Engineering. The 13th CIAO! Doctoral Consortium Workshop, in conjunction with the Enterprise Engineering Working Conference (EEWC 2013), Luxembourg, Luxembourg.

Rafati, L., & Poels, G. (2013). Service oriented enterprise engineering: viewing the enterprise as a service ecosystem. In 7th International Workshop on Value Modeling and Business Ontology (VMBO-2013).

### PhD Courses

BENAIS PhD Course in Information Systems, Information Systems Viewpoints, Theories, Research Methods and Impact of Recent IT developments on the field, 17&18 Oct 2013, University of Twente.

BENAIS PhD Course in Information Systems, Service Science, Business Process Modeling, 9 & 10 January 2014, Universiteit Gent. (presentation)

PhD Course, Engineering and Design Science Methodologies, Antwerp University, May 2014, (presentation/paper).

The CUSO Summer School on BUSINESS INFORMATICS @ IEEE CBI 2014, Switzerland, 14 July, 2014.

Service Research Positioning Workshop, (empowered by AMA SERVSIG.) December 11-12, 2014, Ghent, Belgium.

The NEMO Summer School Series, NEXT GENERATION ENTERPRISE MODELLING IN THE AGE OF INTERNET OF THINGS, July 18th - July 29th, 2016 - University of Vienna, Austria.

## References

Badinelli, R., Barile, S., Ng, I., Polese, F., Saviano, M., & Di Nauta, P. (2012). Viable service systems and decision making in service management. Journal of Service Management, 23(4), 498-526.

Besheli, P. R., Rafati, L., & Poels, G. (2016). A Solution Architecture to Support the CARS Conceptual Model for Strategic Sourcing.

Jonassen, D. H. (2000). Toward a design theory of problem solving. Educational Technology: Research and Development, 48 (4), 63–85

Jonassen, D. H. (2006). Modeling with technology: Mind tools for conceptual change. Columbus, Ohio: Merrill/Prentice-Hall.

Jonassen, D.H. (1997). Instructional design model for well-structured and ill-structured problem-solving learning outcomes. Educational Technology: Research and Development 45 (1), 65-95.

Osterwalder, A., & Pigneur, Y. (2013). Designing business models and similar strategic objects: the contribution of IS. Journal of the Association for information systems, 14(5), 237.

Rafati, L., Roelens, B., & Poels, G. (2017). Designing a domain-specific modeling technique for value-driven strategic sourcing. Submitted to The International Journal of Enterprise Modelling and Information Systems Architectures (EMISA).

Venable J, Pries-Heje J, Baskerville S (2016) FEDS: A framework for evaluation in design science research. European Journal of Information Systems. 25: 77-89.

# Appendix 1

## A Solution Architecture to Support the C.A.R.S Conceptual Model for Strategic Sourcing

**Summary:** The appendix is an outline of a solution architecture for the way of supporting of C.A.R.S. according to four views, Business View, Functional View, Data view and Implementation View.

**Reference:** Ramezani, P., Rafati, L., Poels, G. A Solution Architecture to Support the C.A.R.S Conceptual Model for Strategic Sourcing. Paper presented at the 10th International Workshop on Value Modelling and Business Ontologies (VMBO 2016), Trento, Italy, 2016.

# A Solution Architecture to Support the C.A.R.S Conceptual Model for Strategic Sourcing

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**Abstract:** Many companies face challenges in obtaining the benefits associated with effective strategic sourcing. From an organizational perspective, procurement data management is a core organizational challenge for chief procurement officers (CPOs) for fact-based strategic sourcing decision-making. This paper demonstrates how a model-based approach can support companies to achieve two key competencies, procurement data management and analytics, which allow moving the company toward fact-based strategic sourcing decision-making. We define a solution architecture for the proposed model based approach according to four views, Business View, Functional View, Data view and Implementation View. In this paper, C.A.R.S has been described as a reference model in the business view of the solution. Accordingly, in the functional view, a business function model (BFM) has been developed in order to build a complete and consistent set of required process blocks for strategic sourcing decision-making based on C.A.R.S. To support the data view of the solution, a conceptual Entity-Relationship data model to clarify functional and performance entities has been designed and finally, a logical data model has been proposed for procurement Data Mart with snowflake schema by abstract key structure as a way of implementation of the IT solution architecture with Top-Down approach.

**Keywords:** functional model, data model, data mart, procurement, strategic sourcing, procurement functional dimension, procurement performance dimension.

## 1. Introduction

Procurement has gained importance in supply chain management due to factors such as globalization, increased added value in the supply chain, and accelerated technological change. Vice versa, the growing importance of supply chain management has led to an increasing recognition of the strategic role of procurement [1]. Procurement has evolved from mere buying into strategic sourcing [2]; [3] and has recently been recognized as a critical driving force in the strategic management of supply chains [4]; [5]; [6]. Strategic sourcing recognizes that procurement is not just a cost function, but supports the firm's effort to achieve its long-term objectives [7]. Strategic sourcing has become a critical area of strategic management that

is centered on decision-making regarding an organization's procurement activities such as spend analysis, capability sourcing, supplier selection and evaluation, contract management and relationship management. Because of the increasing significance of procurement, strategic sourcing decisions become more important. Sourcing decisions are strategic decisions at the management level about finding opportunities for and delivering sustainable savings; choosing the right sourcing alternatives like outsourcing, insourcing and co-sourcing (i.e., the typical make-versus-buy decisions) to achieve (sustained) competitive advantage; selecting the right suppliers and evaluate their strategic and performance dimension for long-term and short-term partnerships; identifying solutions for mitigating supplier risk, improving supplier governance and enforcing supplier compliance. These decisions are critical for various procurement decision-makers such as chief procurement officers (CPOs), chief strategic officers (CSOs), strategic sourcing managers, category managers, product managers, purchasing managers, contract managers and supplier/customer relationship managers. This paper demonstrates how a model-based approach can support companies to achieve two key competencies, procurement data management and analytics, which allow moving the company toward fact-based strategic sourcing decision-making.

The paper is organized as follows: Section 2 describes the results of our literature review on fact-based decision-making in strategic sourcing and subsequently elaborates on our research objective; Section 3 introduces the proposed approach to achieve this research objective; Sections 4, 5 and 6 discuss the solution architecture of proposed approach in four views, business, functional, data and implementation. Finally, Section 7 concludes the paper.

## 2. Procurement Data Management and Analytics

To drive fact-based decision-making, organizations require two critical competencies, data management and data analytics. The data management competency is the ability to address issues of data architecture, extraction, transformation, movement, storage, integration, and governance. The data analytics competency is the ability to analyze data for answering key business questions through applying advanced techniques such as modeling (e.g. statistical, contextual, quantitative, predictive, cognitive, other emerging models), deep computing, simulation, data mining, and optimization. Procurement analytics uses procurement data systematically through techniques from applied analytical disciplines to drive strategic sourcing decision-making for planning, management, measurement and learning. Advanced procurement analytics provides the fuel for an

organization to make better sourcing decisions faster [8]; [9]. Many companies face challenges in obtaining the benefits associated with effective strategic sourcing. From an organizational perspective, procurement data management is a core organizational challenge for CPOs and CSOs [10]; [11]. A number of businesses have insufficient accurate and timely information about their spending patterns and suppliers. Most businesses are challenged with spend analysis and need to manage vast volumes of internal and external supplier data due to the disparate nature of systems and data sources [10]; [11]. With a large and increasingly global supply base and scattered data, most companies are overwhelmed with supplier information management and challenged to apply that information for procurement analytics to drive fact-based decision-making [12]; [13].

To address the above organizational challenge and enable companies to obtain competencies with respect to procurement data management and procurement analytics, our research objective is developing a model-based strategic sourcing approach (C.A.R.S) for enabling 1) the centralization of procurement data; and 2) the systemic exploration and evaluation of strategic sourcing alternatives that supports companies to achieve procurement data management and analytics competencies for fact-based decision-making. The next section introduces the proposed approach (C.A.R.S) to achieve this research objective.

## 3. C.A.R.S: a model based strategic sourcing approach

First, we propose the construction of a conceptualization of strategic sourcing that can be used as a language for modeling procurement data. Different kinds of procurement data (e.g. spend cost data, sourcing data, supplier data, contract data and relational data) can be identified based on the core procurement concepts and their attributes and relations. Second, we propose conceptual modeling as a technique for exploring strategic sourcing alternatives. We introduce conceptual models as schematic descriptions [14] of sourcing alternatives and apply the proposed conceptualization as a common language for describing these models. Therefore, we introduce the C.A.R.S (Capability – Actor – Resource – Service) conceptualization as a language for strategic sourcing modeling Figure 1. The C.A.R.S concepts are defined as follows:

***Capability*** is *'What the actor Can do'* for competitiveness and survivability. The capability notion can illustrate the abilities of firm, buyer and supplier to achieve long-term objectives. The capability of an actor represents its potential long-term effects on the achievement of sourcing objectives.

***Actor*** is *'Who is the Resource Integrator'* that provides service, proposes value, creates value and captures value.

***Resource base*** is *'What the actor Has'* that is capable to create value. The resource base notion includes tangible and static resources (e.g. goods), as well as intangible and dynamic resources (e.g. competencies and skills), hence both ***resources*** and ***competencies*** are included in the resource base.

***Service*** is *'What the actor Does'* that is exchanged with other actors for competitiveness and survivability. The service notion can illustrate the performance dimension of actors to achieve operational objectives (bottom-line results). Performance of an actor represents short-term effects on the achievement of sourcing objectives.

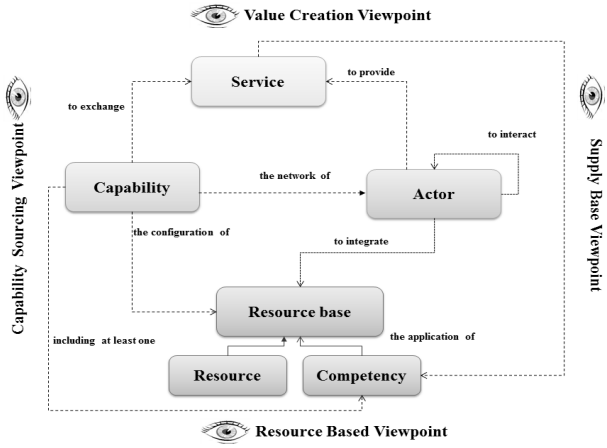


Figure 1. C.A.R.S conceptualization and viewpoints

The next section explains the solution architecture of C.A.R.S based on four views, Business View, Functional View, Data view and Implementation View.

## 4. Solution Architecture_ Business View

The purpose of the C.A.R.S conceptualization and its viewpoints is to support strategic-sourcing decision-makers by offering a common language to model procurement data such as spend data, sourcing data, supplier data, contract data and relational data that reside in disparate systems and data sources. The capability notion, its attributes and other supplementary concepts defined in the capability sourcing viewpoint can be used to model the (strategic) sourcing data about outsourced, insourced and co-sourced

capabilities, operational, organizational and technical capabilities and also data about capacities to leverage the existing resource base, to reconfigure the existing resource base, to integrate the resources, to develop new products and capabilities, to absorb the external resource base and to take advantage of market opportunities (adapting). The service notion, its attributes and other supplementary concepts defined in the value creation viewpoint can be used: a) to model the performance (operational) data about the spend cost, the total cost of ownership, the transaction cost, the captured value (profit) and the perceived value; b) to model the contract (operational) data about the quality of service, the service level agreements and the service delivery time, the contract's clauses, RFx (e.g. RFI, RFQ, RFP) and KPIs for evaluating supplier performance. The actor notion, its attributes and other supplementary concepts of the supply base viewpoint can be used to model the relational data about the suppliers and their classification such as registered, approved, active, partner, strategic partner, undesirable and blocked and also data about the (strategic and non-strategic) customers. The resource notion, its attributes and other supplementary concepts defined in the resource-based viewpoint can be used to model sourcing data about the internal and external resource base, interconnected resources, composite resources, threshold and distinctive competencies and VRIN resources.

We propose a model driven approach based C.A.R.S conceptualization to explore strategic sourcing alternatives for three distinct purposes: descriptive, predictive or prescriptive in three executive steps:

**Spend exploration:** to determine how much cost is being spent, with whom, and for what.

**Sourcing exploration:** to identify sourcing objectives and choose the right sourcing model alternatives (e.g. outsourcing, co-sourcing and insourcing) to achieve objectives through capability sourcing.

**Supply base exploration:** to identify, evaluate and qualify suppliers for long time or short time partnership.

## 5. Solution Architecture_ Functional View

In order to build a complete and consistent set of measurable requirements for strategic sourcing modeling based on C.A.R.S, we used Functional Modelling to generate new requirements and elucidate existing requirements of the conceptual model. The functional model graphically illustrates system functions and the sequence and interrelationships of the functions. The purpose of this part of our solution is to describe the functions

and processes represented in our reference model, and establish a basis for fact-base decision making for strategic (out)sourcing management. The result of our modeling is a Business Function Model (BFM) of the strategic sourcing decision making that emphasizes the functional and operational aspects of the (out)sourcing and procurement activities. Our Business Function Model (BFM) is a general description of operations that help the organization to carry out their strategic procurement and (out) sourcing mission and "provide a conceptual structure for the identification of general business functions" [15]. It can show the critical processes in the context of the strategic (out)sourcing. The processes in the represented function model are consistent with the processes for procurement and supply management based on C.A.R.S. Processes are a group of related activities performed to select the strategic supplier for the service in demand by considering both functional and operational aspects. The Main Stream diagram represents the main steps of analyzing demand and supplier for strategic fact-based decision making for procurement activities and (out)sourcing projects Figure 2.

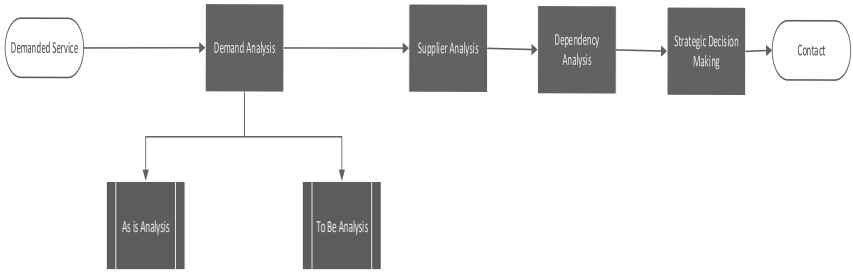


Figure 2. Main Stream of the CARS functional flow diagram

## Demand Analysis, which has two sub-processes as “As Is Analysis and To Be Analysis”

This step aims at developing a profile to understand the demand side of the market to assess opportunities for determining the best sourcing strategies. In order to have better understanding of the service in demand, we propose sub-processes to achieve this goal. At first, in the As Is Process both aspects of current situation of the demanded service should be analyzed which needs historical data of procurement activities of the organization. Out sourcing Validation is a sub-process for this process, which is filtering and feed backing stage to verifying demanded service as a capable out sourcing project. In this sub-process, we can analyze our services in demand to check them from strategical and operational view. In Capability stage we want to

know if the service is related to our core capabilities and strategic resources? If yes, it's better to revise the demand because of strategic risk. While operational analysis, we are able to find the Total Cost of Ownership (TCO), Production Cost (PC), Transactional Costs (TC) and related benefits such as Net Perceived Value (NPV) of the service to validate it for being an outsourcing project. The functional data of the demanded service, resource data and actor data and the operational data of the demanded service, spend data and market data are the required data for this block.

Furthermore, we need to establish and concrete our demand to recognize what capability and performance are in desire for the service. In order to answer this question, we should analysis the resources in demand to predict the possible capability of the demanded service. Besides, we can calculate and investigate our desired performance based on determined capabilities. The final result of the demand analysis function could be a "To Be Strategic Canvas" which represents our perspective of the capability and performance of our demanded service. The perceived output of this step is a generated dataset of demand analysis.

## Supplier Analysis

This step aims at developing a profile to understand the supply side of the market to assess opportunities for determining the best sourcing strategies. In this step we need to analyze suppliers to recognize and rate them based on how much their capabilities- resources and also performance profiles are fitted to our determined capability and performance for the service in demand. In this step, we need suppliers profile with functional and operational data and also generated demand dataset as input data for our process block. The perceived output of this step is a generated dataset of the rated suppliers and their profiles.

## Dependency Analysis

This step aims at developing a portfolio for positioning buyer -supplier dependency for setting relationship strategies in supply market. In this step, we need generated demand and supplier datasets and their profiles data as input of our process block. The relational capability-performance dependency matrix of demand-supplier is our perceived result for this functional stage.

## Strategic Decision Making

This step aims at developing a portfolio for classifying capability sourcing and setting sourcing strategies. At the end, CPO's or other related managers are able to make a fact-based and strategic decision by integrating and visualizing our generated results as an (out)sourcing portfolio for the demanded services.

# 6. Solution Architecture_ Data View

## Conceptual Data Model: Entity-Relationship Diagram

The conceptual data model may be used to form commonality relationships between Entity–Relationship (ER) models as a basis for data model integration. The conceptual means the high-level business solution to a business process or application effort frequently defining scope and important terminology [16]; [17].

In this study, we represented the ER model as a data model for describing the data and information aspects of strategic sourcing and procurement process requirements, in an abstract way. The main components of our ER model are entities, attributes and the relationships that can exist among them. An entity is an abstraction from the complex objects of a domain. "When we speak of an entity, we normally speak of some aspect of the real world that can be distinguished from other aspects of the real world" [18]. This model pays particular attention to relationships and the interactions among entities and their attributes. In the development of databases, relationships require special treatment, because they are the glue that holds information together and because their realization in relational databases is particularly important [19].

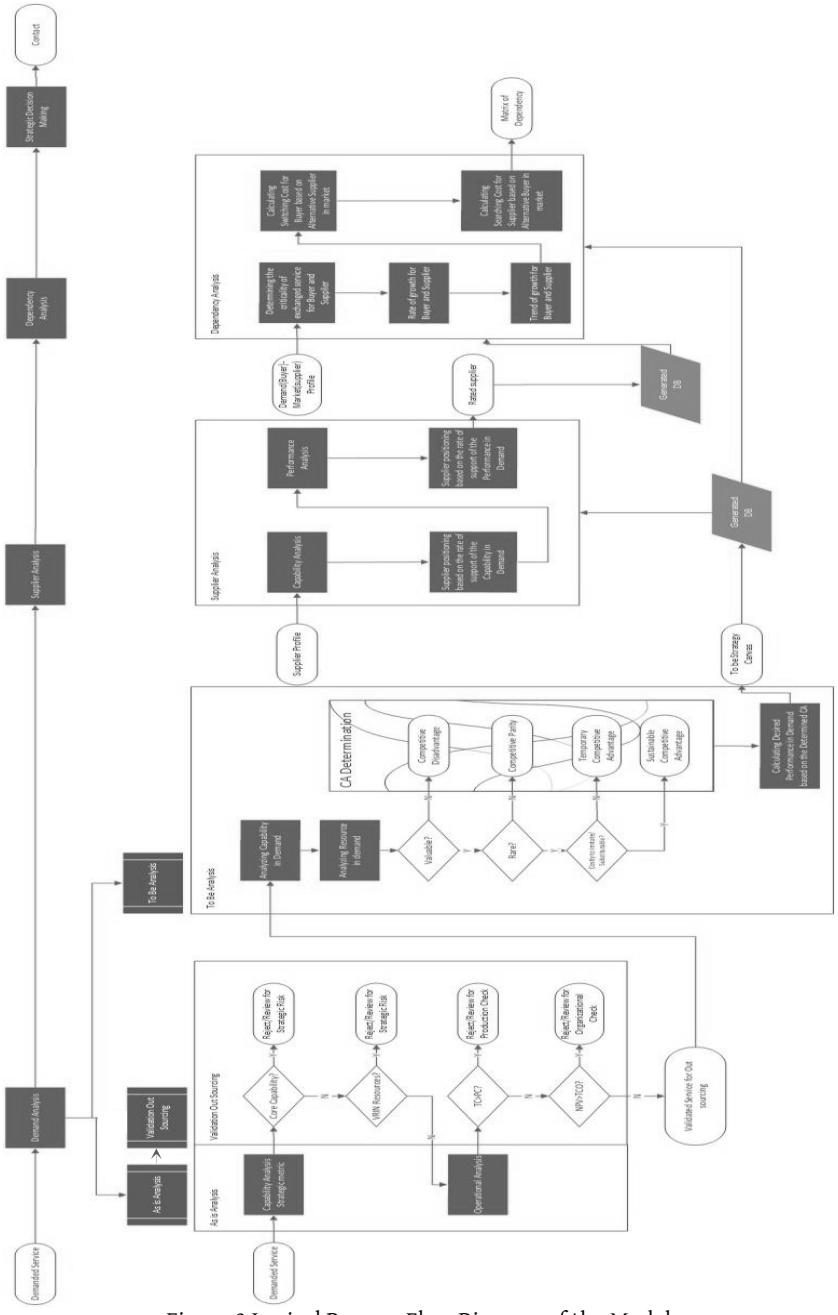


Figure 3 Logical Process Flow Diagram of the Model

### Conceptual Design

Conceptual design is the highest level of ER modeling in that it contains the least granularity of detail but founds the overall view of what is to be included within the model set [19]. This conceptual ER model will be used as the foundation to create our logical data models. In this study, an abstraction of Functionality and Performance objects is represented as two complex and critical entities and their possible attributes. We believe, by developing and clarifying these objects in the sourcing domain, the efficiency of the process of decision-making could be highly improved. Represented high-level data model shows attributes related to these high-level entities, which are involved to procurement and strategic sourcing decision-making relation. Regard to the complexity of these objects we just present their main attributes without considering the possibility of these requirements from demand (buyer) side, supply (supplier) side and their dependency Figure 4.

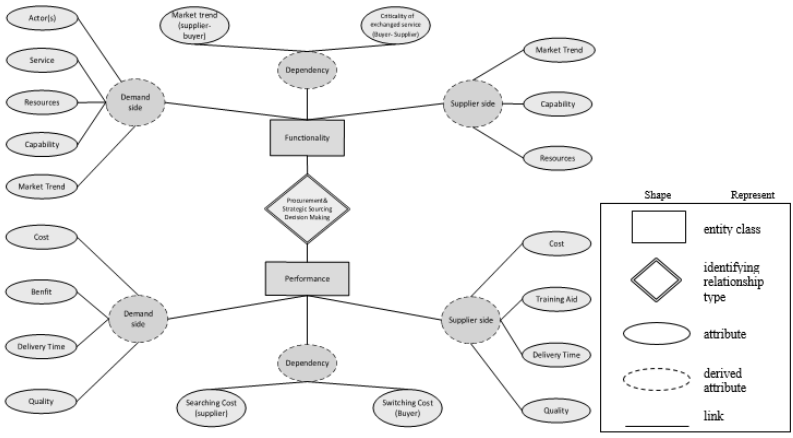


Figure 4. Conceptual data model

## 7. Solution Architecture_ Implementation View

In this part, we propose a procurement data mart as a way of implementation of the model. Regard to the complexity of the required entities for strategic sourcing decision making we need a fast and agile data repository with low time of response. Also in this process, we would need some summarized external data, which could be added to the procurement data mart. Whether a company has a data warehouse system (DW) or not this solution could be implemented. Our proposal is based on the assumption of a hypothetical firm

without DW system and in this case, this departmental data mart could be integrated with other departmental data marts to build a data warehouse system for the firm in future. Using procurement data mart as a platform to consolidate and integrate scattered procurement data from disparate operational procurement applications and also some other required data from other unites mostly regard to the functional dimension such as summarized data from marketing, accounting and technical departments, is important to accelerate the ability to ingest and analyze procurement data and translate them into insights that can inform decision-making. However, the data warehouse system provides a solution that is closer to the "single version of the truth", but they do take a huge amount of effort, and an ability to coordinate across the entire organization. Therefore, Kimball's top-down approach is more appropriate for small-to-medium firms [20]; [21]. The schematic design of the main steps of building the procurement data mart is presented in Figure 6. Staging area is a temporary storage zone used for data processing in the extract, transform and load (ETL) process [22].

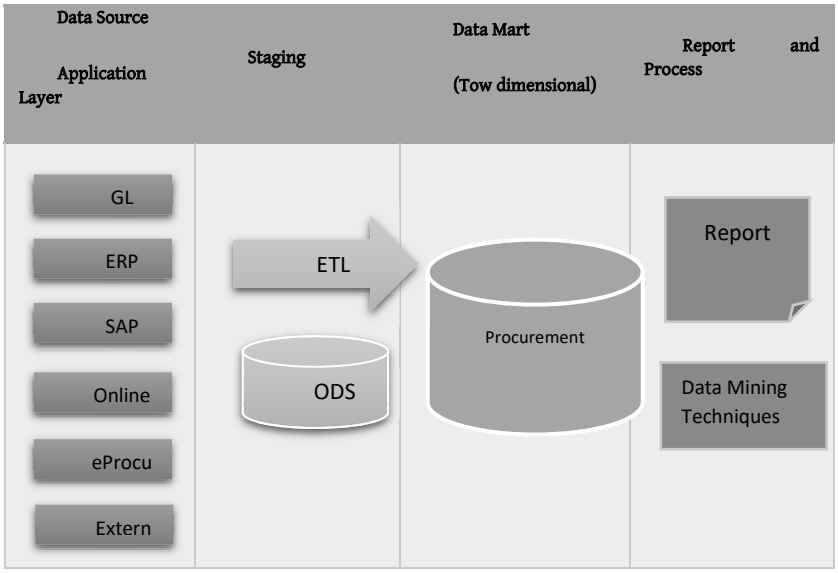


Figure 6. Main steps of building the procurement data mart

To build the procurement department data mart based on our entity-relationship data model, we present part of our logical data model with abstract key structure in snowflake schema to represent the operational possibility of support both functional and operational primary dimensions of our fact table Figure 7.

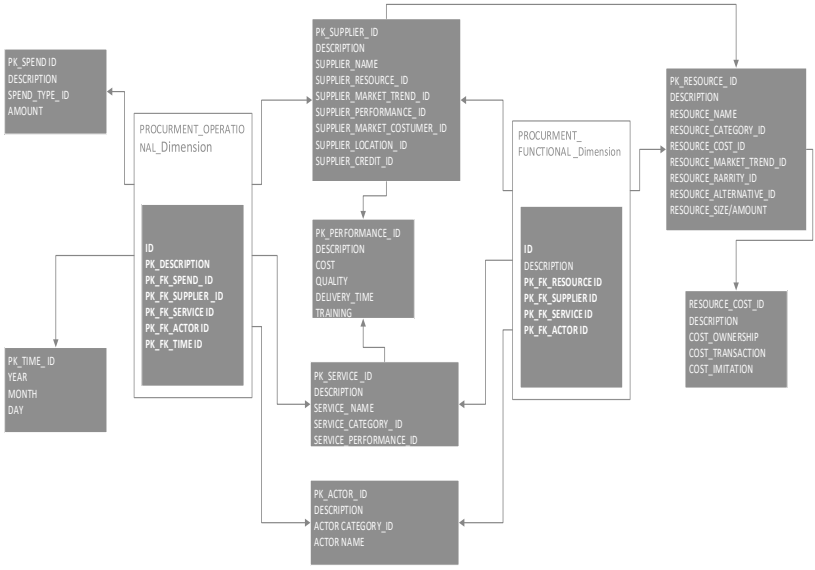


Figure 7. Logical data model with abstract key structure in snowflake schema

## 8. Conclusion

Strategic sourcing has become a critical area of strategic management that is centered on decision-making regarding an organization's procurement activities such as spend analysis, capability sourcing, supplier selection and evaluation, contract management and relationship management. Companies are acting in an increasingly volatile, uncertain, complex and ambiguous world. Hence, more and more they expect from the chief procurement officers (CPOs) to develop long-term and short-term plans in supply chain management. Leading companies need to transform their supply network from static, isolated and internally focused to externally collaborative to achieve the today's procurement objectives and priorities. To create a new business model of supply network, organizations should adopt a strategic sourcing approach that includes initiatives designed to drive above priorities. C.A.R.S as a model driven approach has been defined to explore sourcing alternatives based on a common language that enables fact-based decision-making through procurement data management and analytics competencies. We defined the solution architecture for the proposed model based approach according to four views, Business View, Functional View, Data view and Implementation View. As the future works, we develop the logical key

structure of functional and performance dimensions of procurement fact table to propose the physical data model for procurement data mart.

## References

1. Anderson, P.H., Rask, M.: Supply chain management: new organizational practices for changing procurement realities. Journal of Purchasing and Supply Management 9 (2), 83–95, (2003).

2. Ellram, L.M., Carr, A.S.: Strategic purchasing: a history and review of the literature. International Journal of Physical Distribution and Materials Management 30 (2), 10–18, (1994).

3. Cooper, M.C., Ellram, L.M.: Characteristics of supply chain management and the implications for purchasing and logistics strategy. International Journal of Logistics Management 4 (2), 13–24, (1993).

4. Chen, I.J., Paulraj, A., Lado, A.: Strategic purchasing, supply management and firm performance. Journal of Operations Management 22 (5), 505–523, (2004).

5. Ellram, L.M., Liu, B.: The financial impact of supply management. Supply Chain Management Review 6 (6), 30–37, (2002).

6. Paulraj, A., Chen, I.J., Flynn, J.: Levels of strategic purchasing: Impact on supply integration and performance, Journal of Purchasing and Supply Management, Vol.12, pp107-122, (2006).

7. Weele, A.: Purchasing and Supply Chain Management. Analysis, Startegy, Planning and Practise. 5th edition. Cengage Learning EMEA. Hampshire, (2010).

8. Finch, G., Davidson, S., Kirschniak, C., Weikersheimer, M., Reese, C., Shockley, R.: Analytics: The speed advantage; Why data-driven organizations are winning the race in today's marketplace, IBM Global Business Services, (2014).

9. LaValle, S., Hopkins, M., Lesser, E., Shockley, R., Kruschwitz, N.: Analytics: the new path to value; How the smartest organizations are embedding analytics to transform insights into action, IBM Global Business Services, (2010).

10. Procurement: Optimizing savings and mitigating risk in a complex world, Technical report, IBM Smarter Commerce, (2013).

11. The CPO's Agenda for 2014... and Beyond, Technical report, Aberdeen Group, (2014).

12. Dhawan R., Walters D., Bhattacharjya J.: Procurement Models for the Future, the SMART Supply Chain Conference, Australia, (2011).

13. Dhawan R.: Procurement analytics, the CIPS conference, Australia, (2010).

14. Thalheim, B.: The science and art of conceptual modeling. In A. Hameurlain et al., editor, TLDKS VI, number 7600 in LNCS, pages 76–105. Springer, Heidelberg, (2012).

15. Paul G.: Mastering E-business. Routledge, 2010.

16. "Data Model Scorecard -". technicspub.com. Retrieved January 5, 2016.

17. Chen PP. The entity-relationship model—toward a unified view of data. ACM Transactions on Database Systems (TODS). 1976 Mar 1;1(1):9-36.

18. Strickland J. Simulation Conceptual Modeling. Lulu. com; 2011.

19. Riccardi G. Database System Concepts with Website Development Applications. Addison-Wesley Longman Publishing Co., Inc.; 2002.

20. Kimball R, Caserta J. The data warehouse ETL toolkit. John Wiley & Sons; 2004.

21. Ponniah P. Data warehousing fundamentals for IT professionals. John Wiley & Sons; 2011.

22. Ponniah P. Data warehousing fundamentals: a comprehensive guide for IT professionals. John Wiley & Sons; 2004.

# Appendix 2

## A brief tutorial on how to apply C.A.R.S

**Summary:** The appendix is a tutorial which explains how the C.A.R.S. approach can be used by managers.

Figure 1 depicts the steps that a (strategic sourcing) manager needs to perform in coordination with the enterprise architect to apply C.A.R.S to support a strategic sourcing decision. In the following, we introduce each step:

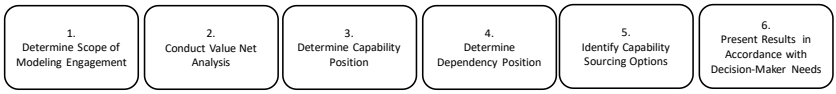


Figure 1. Executive steps to apply C.A.R.S

***Step 1: Determine the scope of modeling.*** In this step, the manager defines the scope of strategic sourcing decision-making considering the micro level (e.g. dyadic exchange encounter), the meso level (e.g. local), and the macro level (e.g. global), as well as geographical, operational and functional bounds, the level of detail required for the modeling, requirements for decision-making, decision points, purpose and target objectives. The result of this step is a document describing the scope of the modeling engagement.

***Step 2: Conduct value net analysis***. In this step, the manager applies the C.A.R.S overall viewpoint on the value net of the focal firm to find opportunities for sourcing. The result of this step is a value net profile model. (See chapter 4, Section 4.5.2, Page 100)

***Step 3. Determine Capability Positioning:*** This step aims to position the capabilities of the players in the value net to evaluate their strategic abilities to create value. Here, the manager uses the C.A.R.S positioning viewpoint for classifications of capabilities. The result of this step is a capability positioning portfolio model. (See chapter 4, Section 4.5.2, Page 101 and chapter 5, Section 5.5.1, Page 138)

***Step 4: Determine Dependency Positioning:*** The purpose of this step is to position the mutual dependency between players to shape relationship strategies in the value net. Hence, the manager uses the C.A.R.S relational viewpoint for assessing dependencies among players of value net, which is given by the dependency model and the actor positioning portfolio model. (See chapter 4, Section 4.5.2, Page 102 and chapter 5, Section 5.5.1, Page 139-140)

***Step 5: Identify capability sourcing strategies:*** For classifying and setting capability sourcing strategies, the manager applies the C.A.R.S sourcing viewpoint which is a view on various strategic sourcing alternatives and options of capabilities toward cost-saving and value-driven targets, that is shown by the capability sourcing portfolio analysis model. (See chapter 4, Section 4.5.2, Page 103 and chapter 5, Section 5.5.1, Page 142)

***Step 6: Document Results in Accordance with Decision-Maker Needs.*** In the last step, the manager, supported by the enterprise architect, transforms the modeling results into a meaningful presentation for decision-makers.