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Supply Chain Integration Model: Practices and Customer Values

Dissertation to obtain PhD in Industrial Engineering

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Resumo

Visando aumentar a eficiência e responder à procura do mercado, no ambiente atual de negócios, as empresas organizam-se e operam em cadeias de abastecimento. A integração da cadeia de abastecimento minimiza diferentes tipos de perdas e satisfaz as necessidades do consumidor final. O primeiro passo em direção à sua integração consiste em entender os valores do consumidor e reconfigurar a cadeia de abastecimento para apoiar estes valores. Esta tese aborda a integração da cadeia de abastecimento através da identificação da relação entre as suas práticas e os valores dos consumidores. Para o efeito utilizaram-se a rede Bayesiana e a rede de processo analítico como ferramentas para quantificar as relações comparativas entre as entidades. A abordagem proposta começa com a identificação dos *trade-off* relativos aos valores dos consumidores usando a rede Bayesiana. Em paralelo, as práticas da cadeia de abastecimento são analisadas comparativamente através de entrevistas com especialistas, as quais são tecnicamente quantificadas usando a rede de processo analítico. Da conjugação destas ferramentas resultou uma rede de valores dos consumidores e de práticas da cadeia de abastecimento. Esta rede permite identificar quantitativamente as relações entre os nós da rede, podendo ser utilizada para planear cenários e lidar com análises de sensibilidade. Espera-se que este modelo seja usado na tomada de decisão na cadeia de abastecimento por técnicos e profissionais, constituindo uma medida quantitativa para monitorar a influência das práticas nas preferências do consumidor final. Três estudos de caso são analisados: o primeiro identifica e analisa seis valores dos consumidores, nomeadamente, a qualidade, o custo, a customização, o tempo, o *know-how* e o respeito pelo ambiente. Os resultados obtidos forneceram os *inputs* para o desenvolvimento do modelo de integração da cadeia de abastecimento para as indústrias alimentar e do vestuário. As práticas da cadeia de abastecimento são categorizadas em dois grupos: produção e logística. Os dois outros estudos de caso incluem práticas de produção, nomeadamente ao nível das operações funcionais, da diminuição do trabalho em curso, da implementação de *standards*, do planeamento de produção e da utilização de materiais recicláveis, assim como, de práticas logísticas, nomeadamente, a visibilidade *upstream/downstream* do inventário, a partilha de informação com os consumidores, a implementação de padrões logísticos e a prática de *just-in-time.*

Palavras-chaves: Gestão da Cadeia de Abastecimento, Integração, Práticas, Valor para o Consumidor, rede Bayesiana, Rede de Processo Analítico.

Abstract

In order to increase partnership efficiency and truly meet the customers' demands, in today's business environment companies are operating in supply chains. Integration of supply chains facilitates minimizing diferent types of wastes and satisfying needs of the end customer. The first step toward supply chain integration is to understandand the customer values, and to reconfigure supply chain to support those values. The current research addresses supply chain integration through quantifying relations between supply chain practice and customer values. It employs Bayesian network and analytic network process as tools to quantify comparative relations among entities. The proposed approach starts with identifying trade-offs along customer values using Bayesian network. In parallel supply chain practices are comparatively analyzed through interviews with experts which is technically quantified using analytic network process. Thereafter, these two parallel phases join together to form a network of customer values and supply chain practices. The network is able to quantitatively identify relations among nodes; in addition, it can be used to plan scenarios and handle senstitivity analyses. This model is expected to be used by supply chain decision makers to have a quantitative measure for monitoring the influence of practices on preferences of the end customer. A survey and two case studies are discussed which go through aforementioned phases. The survey identifies and analyzes six customer values namely quality, cost, customization, time, know-how and respect for the environment. It makes input for the two cases which develop supply chain integration model for fashion and food industry. Supply chain practices are categorized into two groups of manufacturing and logistics practices. The two case studies include five manufacturing practices as cross functional operations, decrease work in process, implement standards, mixed production planning, and use recyclable materials as well as four logistics practices namely visibility to upstream / downstream inventories, information sharing with customer, implement logistics standards, and just in time.

Keywords: Supply chain management, Integration, practices, Customer value, Bayesian network, Analytic network process.

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List of Abbreviations and Symbols

AHP	Analytic Hierarchy Process
ANP	Analytic Network Process
BAN	Bayesian Network Augmented Naïve-Bayes
BN	Bayesian Network
CSCMP	Council of Supply Chain Management Professionals
CV_n	Customer Values
ERP	Enterprise Resource Planning
GBN	General Bayesian Network
ISO	International Organization for Standardization
JIT	Just-in-time
LP	Linear programming
P_{Lj}	Logistics Practices
P_{Mi}	Manufacturing Practices
SCI	Supply Chain Integration
SCM	Supply Chain Management
TAN	Tree Augmented Naïve-Bayes

1 Introduction

This chapter presents the introduction of this dissertation. It covers the aim of the research, objectives and research questions, methodology, delimitations and limitations, and content. It puts forward the outlines and structure of the research.

1.1 Aim

During the 1990s, many manufacturing and service firms collaborated with their strategic suppliers to upgrade traditional supply and materials management functions and integrate them as part of corporate strategy. Correspondingly, wholesalers and retailers also integrated their logistics activities with other functional areas to elaborate on their competitive advantage. Eventually, these two traditional supporting functions of corporate strategy evolved and merged into a holistic and strategic approach to materials and logistics management, nowadays known as Supply Chain Management (SCM) (Keah Choon Tan, 2002). The dominant belief is that the most successful companies are those that are operating closely within their supply chain and have carefully linked their internal processes to external suppliers and customers (Mitra and Singhal, 2008). Evolving from the economic theory of vertical integration and the operational theory of product life cycle, SCM has been a major source of competitive advantage in the global economy. According to the study by Harland (1996), SCM is the management of a network of interconnected businesses involved in the provision of product and service packages required by the end customers in a chain of firms. This definition requires SCM's to integrate internal activities with expectations of the end customers. Stonebraker and Liao (2006) argue that development of the integrated supply chain is the most significant contribution to the delivery of goods and services.

Supply chains are facing variety of challenges such as customer service, cost control, partner relation management, fragmented chain, lack of visibility, and coordination difficulties. An effective supply chain management should deliver the right product in the right quantity and in the right condition with the right documentation to the right place at the right time at the right price. Supply chain operating costs are under pressure from rising freight prices, more global customers, technology upgrades, rising labor rates, expanding healthcare costs, new regulatory demands and rising commodity prices. Moreover, different organizations, even different departments within the same organization, can have different methods to measure performance, expectations, and results. Most enterprises are connected to others as customers or suppliers, thus form a supply chain, and are dealing with aforementioned challenges. Following are some real examples of supply chain challenges:

- On December 2003, the wireless company Motorola Inc. failed to meet demand for camera phones due to parts shortages and inaccurate prediction of demands. Motorola announced that, due to component shortages, it would deliver fewer than expected camera phones during the holiday season of 2003 to European and U.S. service providers. Motorolla said it uses parts that are about one-third smaller than those of its competitors; therefore it couldn't rapidly change the supplier of those parts. But industry analysts say the root of this problem was primarily due to the poor planning and weak coordination between supply chain partners (Businessweek, 2003).
- On March 20123, Wal-Mart customers frequently faced empty shelves and failed to find their items such as cold medicine, mouthwash, lamps, and cosmetics. According to customers, it is not as though the merchandise is not there; it is piling up in aisles and in the stores. Lack of human resource is the main reason at the shop to restock the shelves. According to the company's website, in the past five years Wal-Mart store increased by 13 percent. In the same period, its total workforce dropped by 1.4 percent. Failing to satisfy end customers has led to sales lost and revenue reduction in Wal-Mart which is the world's third largest public corporation. (Dudley, 2013).
- On October 2010, Petite Palate, the baby food company which was based in New York, closed its business. It was very successful in 2007 to provide organic frozen baby food to about 100 stores. In the fall 2008, the company had problem with its suppliers and was struggling to get its products into the freezer section of grocery stores; yet managers stuck to their concept because they believed frozen food was healthier for children than food in jars or pouches. After the fail of the company, managers pointed out that lose coordination with suppliers and mismatch between their product and expectations of their customer led to shutting down Petite Palate.

Looking into such examples, stresses the existing problem of enterprises in effectively integrating their activities with their supply chain partners as well as aligning their products with the end customer expectations. Integration, as a key factor in achieving improvements, has been one of the main themes in the SCM literature, therefore it is frequently examined by researchers (Danese and Romano, 2011; Droge, Vickery, and Jacobs, 2012) and they have shed light of its different aspects. Integration is the quality of collaboration that exists among clusters to achieve an effective, efficient and united system. Flynn *et al*. (2010) define Supply Chain Integration (SCI) as the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organization processes. The eventual goal of SCI is to achieve effective and efficient flows of products and services, information, money and decisions, to provide maximum value to the end customer (Rosenzweig *et al*., 2003; Ellegaard and Koch, 2012). Looking into the year wise frequency distribution of SCI in the web, indicates the continuous global attention to this important subject (figure 1.1). This reveals the fact that this field of research has been extensively browsed and yet there are considerable research potentials left to be explored.

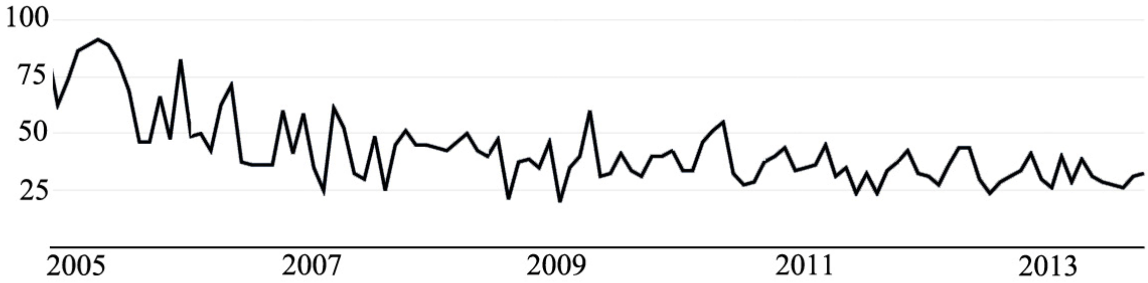


Figure 1.1 Year wise frequency distribution of the keyword "supply chain integration": 2005 till October 01, 2013 – Generated by Google Trends (the figure is on the scale of 100)

Review on the SCI literature (discussion is presented in the Section 2.6) reveals that in spite of the available extensive literature on this field, still supply chains are suffering from lack of integration. The study by Carter *et al*. (2009) argue that in the current state, development of a comprehensive SCI is not feasible due to barriers such as: lack of financial integration, cultural barriers, lack of customer-centric metrics, inconsistent relationships with customers and suppliers, inequality in risk sharing. However, it seems possible to contribute to the literature by throwing light on some aspects of it. Supply chains require integration approaches which address these barriers in quantitative and qualitative ways.

This research is planned as a part of a project called “lean, agile, resilient, and green supply chain management” (LARG SCM) funded by Fundação para a Ciência e Tecnologia da Faculdade de Ciências e Tecnologia (MIT Project: MIT-Pt/EDAM-IASC/0022/2008). The main objective of the LARG SCM project is to develop a deep understanding of the relationships and compatibilities of lean, agile, resilient, and green to contribute to have more efficient production systems and supply chains.

The outputs of this thesis and the above project have been published as conference and journal papers. Conference papers were meant to provide visibility and publicity to the proposed ideas whereas comprehensive details for the academic record are submitted to scientific journals (Maleki, Bashkite, and Cruz-Machado, 2012; Maleki and Cruz-Machado, 2013a, 2013b, 2013c; Maleki, Espadinha-cruz, Valente, and Cruz-Machado, 2011; Maleki, Grilo, and Cruz-Machado, 2011; Maleki, Liiv, Shevtshenko, and Cruz-Machado, 2012; Maleki, Shevtshenko, and Cruz-Machado, 2013). These publications support the scientific relevance of the proposed approach.

1.2 Objectives and research questions

The need for a comprehensive integration model is stressed through research works. Although there have been some works on this fields, there are gaps due to its diversity. The purpose of this dissertation is to fill in some gaps through developing an integration model which quantitatively addresses relations between SCM practices and customer values. In order to do so, a combination of Analytic Network Process (ANP) and Bayesian Network (BN) is proposed in the model development procedure (see chapter 4). The proposed model imports comparative data about preferences of end customers and priorities of SCM practices through interview with expert; then it generates quantitative output about their relations. Therefore, the following research questions are addressed:

a. What are the gaps and missing points in the SCI literature?
b. How can we integrate customer values and SCM practices?
c. How can we quantify relations between customer values and SCM practices?
d. Which tools can be employed to manage the mutual correlations between customer values and supply chain practices?

In order to answer the first three questions, state of the art of SCI is required to locate gaps and identify practices and customer values. The next two questions go more into details to establish relations between practices and customer values and quantify them through an integration model. It is expected from the integration model to enable the following possibilities:

a. Connect practices in supply chain with customer values: to ensure implemented practices are contributing to final expectations of customers.
b. Identify trade-offs between customer values: the ultimate goal is to satisfy all customer values but, in case implementation of one practice results in increasing one value and decreasing another, truly understanding trade-offs is crucial for the decision making procedure.
c. Quantitatively present relations: tacit knowledge of experts about practices as well as customer preferences should be converted into quantitative data.
d. Provide possibilities to plan scenario and perform sensitivity analysis.

The current research takes a critical step toward integration in supply chain. It quantitatively addresses relations among internal activities of supply chain and expectations of end customer. Both enterprises and customers (and in the large scale the community) benefit from this approach. Enterprises will get quantitative value on the relations between their activities and expectations of their end customers; end customers will have their preferences satisfied. Some of customer values such as requiring environmentally friendly product / service, directly contributes to the community demands.

1.3 Methodology

This dissertation benefits from an inductive research methodology in which theory is built based on observations and data analysis. It is a theory building work where one survey and two case studies are employed. The survey collects data and analyzes customer values and in doing so, provides input for the two case studies where SCI model is developed in the fashion and food industries.

The survey collects data from end customers regarding six identified values in six industries. Customer values are identified from literature. Case study one develops SCI model for the fashion industry. It benefits from interviews with supply chain specialist of a large scale company in the USA (it is presented in the section 5.2). Case study two develops SCI model for the food industry. It benefits from interview with director of a small scale company in New Zealand (it is presented in the section 5.3).

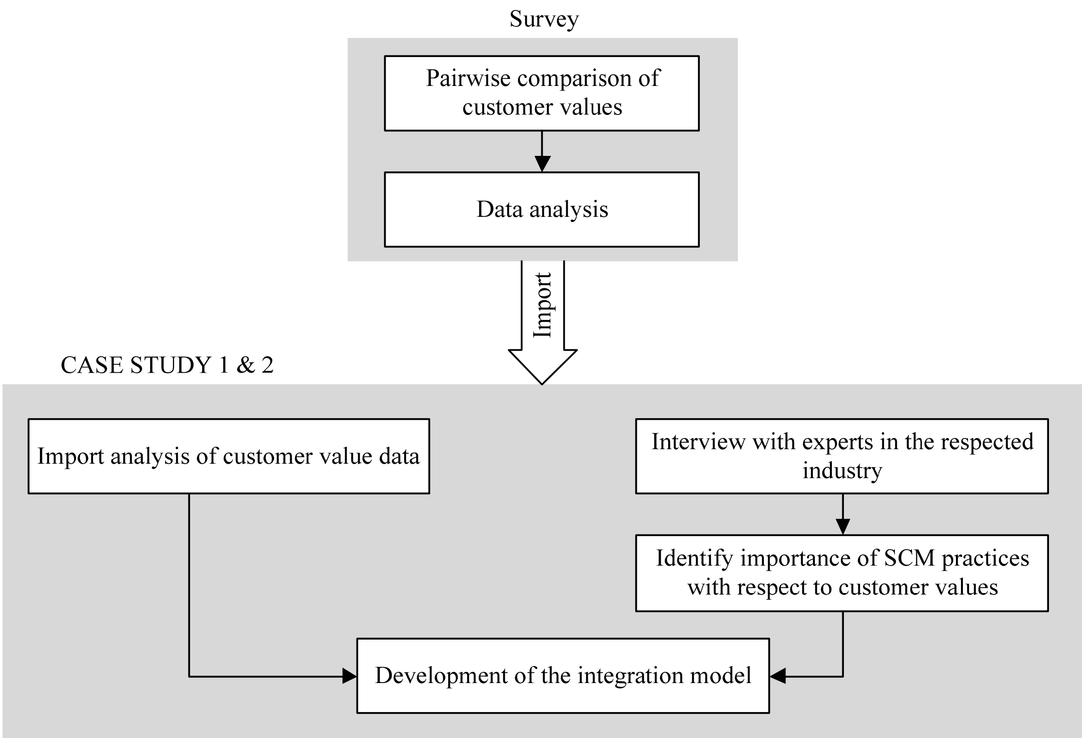


Figure 1.2 Research methodology overview

Two methods are used in the case studies to reach objectives. In the survey, Bayesian network is used to identify correlations between customer values. The output of this survey is a network of customer values where they are represented as nodes of the network and influence of each node on others is quantitatively presented. Thereafter, SCM expert is asked to comparatively identify importance of practices with respect to customer values. In this phase analytic network process is used to convert tacit knowledge of expert into quantitative figures so that they can be integrated with customer values. Finally, the SCI model is build through combining inputs from customer values (the initial BN) and expert interview (through ANP). The SCI model is managed by BN to quantitatively present relations and influences among SCM practices and customer values (figure 1.2).

1.4 Delimitations and limitation

Delimitations put boundaries on the study so that it objectively concentrates on research questions. SCI is a broad field of research therefore achieving expected results requires concentration on research questions. According to objectives, the focus has been on exploring relations between practices and customer values and other influential factors are outside scope of the research. In addition, selected industrial sectors, practices, and customer values are other delimitations of this research which are forming its scope.

There are some limitations to this research which should be noted. The main limitation is that it excludes environmental factors such as social events, media, and advertisements on the customer preferences. As Tse *et al*. (1988) shown, culture may provide detailed norms for specific classes of situations. Therefore, culture is an obstacle to generalizing the findings, and further replication studies would be needed in different cultures to observe similarities and differences. In addition, the collected data represents a snapshot at a point in time, and the subject studied may change over time. In addition, practices and customer values are given the same importance weight. However, in some industries the analysis makes more sense if values get weights. One final important point is that, in the body of this research, whenever we deal with customer value, we refer specifically to customer perceived value that is the overall feeling of the customer.

1.5 Content

The content of the current dissertation is organized into six chapters. After introduction, the second chapter reviews and reports SCI literature. It keeps focus on recent works; however a few of old references are also considered due to their influence on literature. Through providing state of the art of SCI, this chapter identifies current gaps in the published scholar works. In addition, this chapter explores ANP and BN as methods which will be used in the forthcoming chapters to develop integration model. The Mendeley 1.8.3 software developed by Mendeley Ltd., UK is used in the literature review chapter which made it possible to review large number of references in the research area. The third chapter is dedicated to research methodology which explains how research objectives are pursued. Till the end of chapter three the thesis identifies the existing gaps in the literature, provides scientific theoretical background of the research area, and proposes the research methodology. Thereafter, a conceptual model is proposed and discussed in the fourth chapter, which addresses identified gaps in the literature (presented in the chapter two). The proposed model answers research questions and accomplishes objectives. The fifth chapter presents the survey and the two case studies based on the proposed model. Finally, the dissertation concludes in the sixth chapter through providing main results as well as theoretical and managerial implications and recommendation for future works (figure 1.3).

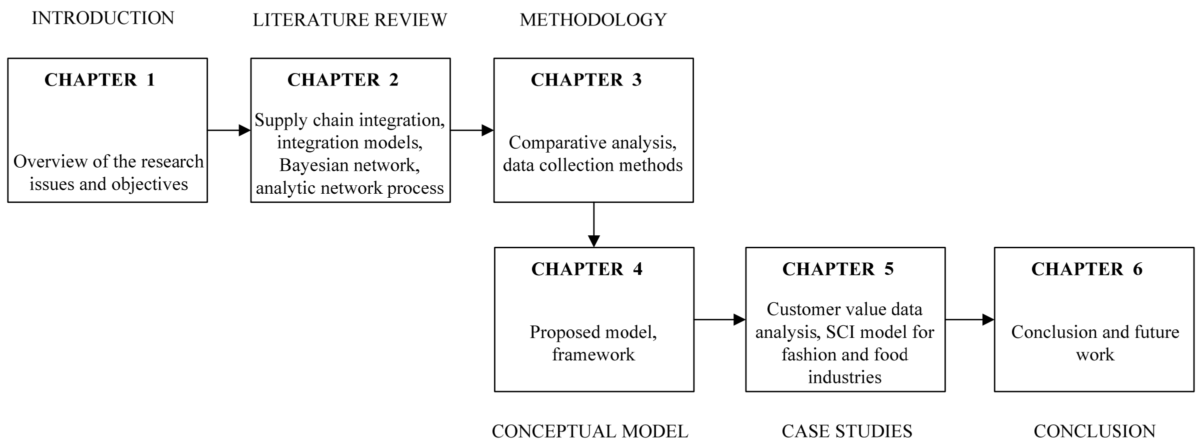


Figure 1.3 Thesis structure

1.6 Conclusion

This chapter served as the introduction to this dissertation. The justification of the research topic as well as objectives and expected results were discussed. The current dissertation fits its work in the context of integration approaches in supply chain. It explores how supply chains practices can be connected to values of the end customer to ensure those practices are contributing to customer expectations. The proposed approach is subject to some limitations which are discussed in this chapter. The following five chapters of this dissertation present a detail description of state of the art, methodology, proposed model, and conducted survey and case studies.

2 Literature Review

This chapter reviews and reports supply chain integration literature. It starts with general descriptions on supply chain management as the big context then moves into SCI and integration models. It also explores Bayesian network and analytic network process as the two methods which will be used in the development of the supply chain integration model. At the end of chapter, discussion on the gaps and missing point in the SCI literature is presented through review on key references of the field.

2.1 Supply Chain Management

There have been significant attempts in the literature to understand developments in SCM. The concept of SCM was first introduced by Forrester (1961), who suggested that success of industrial business is dependent on the "interactions between flows of information, materials, manpower and capital equipment". The term "supply chain" did not become popular until early 1980s (Oliver and Webber, 1982). Only handful of articles mentioned the phrase "supply chain" in the period 1985-1997. The acceleration in development of SCM paradigm took place in late 1990s, with the majority of theoretical and empirical investigation starting in 1997 (Giunipero *et al.*, 2008; Soni and Kodali, 2012).

According to the study by Harland (1996), SCM is the management of a network of interconnected businesses involved in the provision of product and service packages required by the end customers in a supply chain. This definition requires SCM's to integrate internal activities with expectations of the end customers. In addition the Council of Supply Chain Management Professionals (CSCMP) defines SCM as it "encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, SCM integrates supply and demand management within and across companies" (Council of Supply Chain Management Professionals, 2010).

Many companies have been concerned with development of supply chain measures through which they can measure and eventfully increase the profitability of participants of their supply chain. A key issue in supply chain management is to develop a measurement system to enable coordination mechanism for joint decision making (Kim and Oh, 2005) that can align objectives of independent members and coordinate their activities so as to optimize performance of the whole chain (Yan, Wang, and Zhou, 2010). In addition, a smooth and well controlled material flow lies at the heart of best supply chain design and practice (Towill, Childerhouse, and Disney, 2002). According to a research conducted by Hoole (2005) companies that are measuring the performance of their supply chain and employing more mature supply chain practices are faster in reducing costs comparing to their less mature peer companies. More precisely, supply chain costs may vary as much as five to six percent of annual revenue among companies of the same industry sector. Therefore, modeling of the performance in order to improve its mechanism is crucial for supply chain growth (Panchal and Jain, 2011; Panicker and Sridharan, 2011).

SCM is an interdisciplinary topic that addresses diverse fields: materials management, quality, industrial market, purchasing, logistics, inventory, procurement, production planning, intra- and inter-organizational relationships, policy making, etc. Collaboration between buyer and supplier or building of a relationship lies at the core of SCM (Cheng *et al*., 2010; Khalfan, 2012; Lyu, Ding, and Chen, 2010). In the literature, integration is also discussed as removing barriers (or boundaries) between organizations.

Integration as a key factor in achieving improvements has been one of the main themes in the SCM literature, therefore it is frequently examined by researchers and they have shed light of its different aspects (Childerhouse *et al*., 2011; Danese and Romano, 2011; Fisher, 1997; Prajogo and Olhager, 2012). A great deal of research has been done on the importance of integrating suppliers, manufacturers, distributors, and customers (e.g. Lam and Ip, 2011; Lockstrom *et al*., 2011; Spralls, Hunt, and Wilcox, 2011) that in other words covers integration chain partners from technical and strategic aspects. Stonebraker and Liao, (2006) explore environmental contingencies, Mondragon, Lalwani, and Mondragon, (2011) study auditing and performance measures, Danese and Romano (2011) focuses on customer side and supply side integration, and Mujuni Katunzi (2011) points out obstacles of process integration along the chain from manufacturing firms perspective. Researchers have employed different approaches to examine these issues. There seems to be no consensus on definition of SCI, although different authors have presented numerous definitions depending on their research concern (table 2.1). Some terms are repeated in SCM definitions which show common concerns, these terms are: supplier, customer, flow, integration, coordination, etc. Table 2.1 presents dominant definitions of SCM since 1982 till 2010 which is given by CSCMP, the key concerns of each definition are underlined in this table. The definition given by CSCMP has appeared more frequently than others in the literature. The common terms and key concerns of SCM definitions reveal the fact that integration and coordination between upstream (suppliers) and downstream (customers) is strongly stressed. In other words, integration is embedded in the definition of SCM.

Table 2.1 Dominant definitions of supply chain management

Reference	Definition
Oliver and Webber (1982)	Coined expression supply chain generally encompasses the set of organizations and processes involved in supplying a firm's products, from its suppliers' suppliers to its customers' customers.
Cooper, Lambert, and Pagh (1997)	SCM is "... an integrative philosophy to manage the total flow of a distribution channel from supplier to the ultimate user."
Handfield and Nichols (1999)	The SCM encompasses all activities associated with the flow and transformation of goods from raw materials stage (extraction), through to the end user, as well as the associated information flows. Material and information flow both up and down the chain. SCM is the integration of these activities through improved relationships to achieve a sustainable competitive advantage.
Sengupta, Heiser, and Cook (2006)	The supply network structure includes the upstream supply chain for a company, including a variety of decisions related to outsourcing, supplier certification and rationalization of the supply base.
Lambert (2008)	SCM is the integration of key business processes across the supply chain for the purpose of creating value for customers and stakeholders.
Radhakrishnan, Prasad, and Gopalan (2009)	SCM can be described as a beneficial coordination and incorporation of organizations with distinct objectives to achieve a common goal.
Council of Supply Chain Management Professionals (2010)	SCM encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, SCM integrates supply and demand management within and across companies. It is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model.

2.2 Supply Chain Integration

Integration is the quality of collaboration that exists among clusters to achieve an effective, efficient and united system (Sabherwal and Kirs, 1994). Flynn *et al*. (2010) define SCI as the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organization processes. The eventual goal of SCI is to achieve effective and efficient flows of products and services, information, money and decisions, to provide maximum value to the customer. While some researchers consider SCI as an undimensional construct (Rosenzweig *et al*., 2003), the majority of the literature looks at SCI as having different dimensions such as supplier integration (Cousins and Menguc, 2006), supplier and customer integration (Devaraj *et al*., 2007), strategic design integration (Droge *et al*., 2004), internal integration (Pagell, 2004), and logistics-production-marketing and external integration (Gimenez and Ventura, 2005). From another perspective, integration has two major categories (a) external strategic design integration that goes beyond the boundaries of the focal firm to involve suppliers and customers, and (b) internal design-process integration which is more tactically oriented (Droge *et al*., 2004).

Supply chain is commonly described in a composition of three levels: a focal firm which does the manufacturing, first downstream tier of firms (known as first tier customer), and first upstream tier of firms (known as first tier supplier) (figure 2.1). Manufacturing practices are implemented as internal activities whereas logistics practices connect firms in different tiers. In the ideal case, all technical practices should be aligned with preferences of the end customer sitting at the end of the downstream. This envisions a common, or at least consistent, set of goals across the firms (Baharanchi, 2011; Briscoe and Dainty, 2005; Pagell and Wu, 2009).

Saeed *et al*. (2005) point out that competitive intensity and the environment in which the company operates, influence the extent of external integration. External integration can also help improve internal performance. As Cachon and Fisher (2000) argue, open information sharing policy with upstream and downstream partners (external integration) allows organizations to reduce batch sizes and also lead times to improve internal integration.

The current research addresses SCI in terms of quantifying relations among manufacturing and logistics practices with customer values. As it is discussed by Carter *et al*. (2009) the literature agrees that comprehensive SCI is not feasible due barriers presented in the table 2.2. The current research doesn’t claim to solve mentioned problems. However, authors believe that one step toward SCI is to quantify relations among technical practices and customer values.

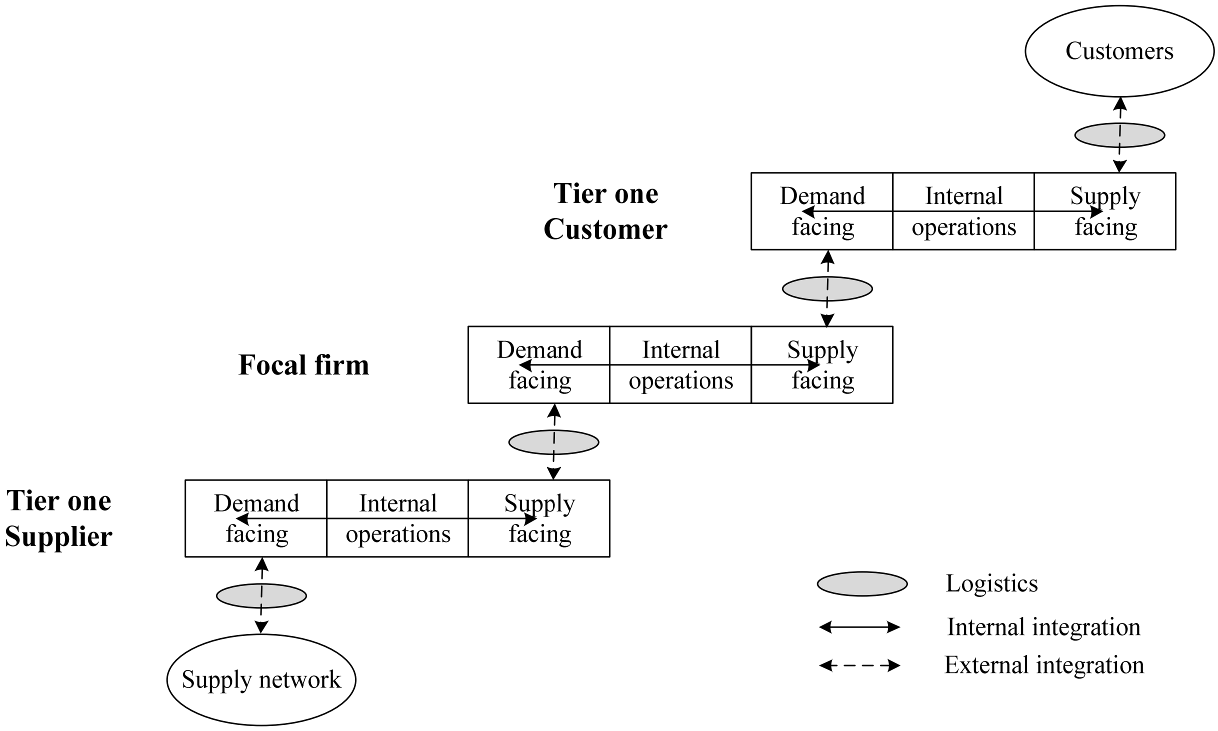


Figure 2.1 Integrated supply chain triad - Adapted from Carter *et al*. (2009)

Although there is an extensive body of literature on supply chain integration, this area requires further research examining collaborative relationships between an enterprise and its customers (Paulraj *et al*., 2008). The current research contributes to the downstream aspect of external integration, where customer integration is concerned. In the current research we argue that a true understanding of end customer is the key to customer integration, which is critical to achieve supply chain integration.

Table 2.2 Integration barriers amd obstacles - Adopted from Forslund and Jonsson (2009) and Mujuni Katunzi (2011)

SCI barriers and obstacles	Description
Lack of visibility	The inability to easily share or retrieve trading partner information in real time, as desired by supply chain participants.
Silo mentality / I win you lose	Failing to see the big picture and acting only in regard to a single department within the firm or a single firm within the supply chain.
Lack of trust	Unwillingness to work together or share information because of fear that the other party will take advantage of them or use the information unethically.
Lack of management skills and knowledge	Lack of process and information system skills and lack of knowledge regarding the benefits of SCM among management and other employees, within the firm and among partners.

Supply chains are generally complex and are characterized by numerous activities spread over multiple functions and organizations, which pose challenges to reach effective SCI (Kanda and Deshmukh, 2008). In the literature, integration is also discussed as removing barriers and boundaries between organizations. Researchers use different terms to address integration such as: enterprise modeling (Ponis *et al*., 2007), business process engineering (Hilmola, Hejazi, and Ojala, 2005), enterprise engineering (Ling *et al*., 2011), enterprise integration modeling (Ivanov, 2009; Lockstrom *et al*., 2010), supply chain integration model (Lin and Lin, 2011), and enterprise collaboration model (Savino and Neubert, 2007). Although there is slight difference in the wordings of these terms but the ultimate objective is to integrate inter-enterprise relations.

2.2.1 Vertical integration

Vertical integration takes place at different levels of the chain. The integration between producer and the distributor enables better physical and information flows, improvements in the trade-off between level of service and average stock, more economical inventory management control and better transportation systems (Soosay, Hyland, and Ferrer, 2008). Most referred driving forces of vertical integration are: demand fluctuations, environmental uncertainty, customer focus, advanced technology, information technology, and intensified competition are among most referred driving forces of vertical integration (Chen and Paulraj, 2004; Guan and Rehme, 2012; Olausson, Magnusson, and Lakemond, 2009).

The lack of integration may result in poor performance of supply chain (Kanda and Deshmukh, 2008). Ramdas and Spekman (2000) report consequences of lack of integration as: inaccurate forecasts, low capacity utilization, excessive inventory, inadequate customer service, inventory turns, inventory costs, time to market, order fulfillment response, quality, customer focus and customer satisfaction. Fisher, Raman, and McClelland (1994) has cited a study of the US food industry, which estimated that poor integration among supply chain partners was wasting $30 billion annually. The mismatch between supply and demand results in rise in the costs of stock out (Dabhilkar, 2011; Johnsen, 2009), markdown , expediting, shipment, advertising, and sale preparation, excess inventory (Horvath, 2001), obsolescence, and disposal . Wolf (2011) believes that the lack of SCI is partly due to a lack of knowledge and structural framework as to how internal and external integrations can be achieved.

2.2.1.1 Direction of integration

Direction of integration addresses upstream integration with suppliers and downstream integration with customers. Downstream integration is a key managerial area to improve performance in supply networks. Though most studies agree that downstream integration positively influences performances, the literature also reports cases of failures in achieving significant improvements (e.g. Dabhilkar, 2011; Danese and Romano, 2012; Lintukangas, Peltola, and Virolainen, 2009). Company position determines whether downstream or upstream integration has more effectiveness. Downstream integration helps firms to secure the distribution channels of their products, especially in markets with increased uncertainties. Second, it can offer a way to control efficiency gains and cost reductions in the supply chain (Frohlich and Westbrook, 2001). And third, downstream markets can offer important benefits in addition to large new sources of revenue (Guan and Rehme, 2012). Supplier integration refers to the degree to which a firm can partner with its key suppliers to structure their inter-organizational strategies, practices, procedures and behaviors into collaborative, synchronized and manageable processes in order to fulfill customer requirements (Yeung *et al*., 2009). Supplier or upstream integration increases the productivity of the chain and leads to reduction of wastes.

The textile company, Inditex, owns nearly the entire supply chain; it is a good example of upstream and downstream integration which eight different brands (Zara, Pull and Bear, Massimo Dutti, Bershka, Stradivarius, Oysho, Zara Home, and Kiddy's Class) and 3,914 stores in 70 countries (Cambra-Fierro and Ruiz-Benitez, 2009; Guan and Rehme, 2012). High vertical integration has provided Inditex competitive advantages of planning flexibility, short lead time, frequent replenishment of stores, and differentiated products.

2.2.1.2 Level of integration

Level of integration refers to the extent integrative activities within one dimension are developed. SCM literature agrees that the position of company in chain strategically influence its level of integration with other members (e.g. Cook, Heiser, and Sengupta, 2011a; Morton and Zettelmeyer, 2004; Olhager, 2003). Most of SCI studies hold the same view that level of SCI has a positive influence on performance outcomes (Doran and Giannakis, 2011a, 2011b; Ellegaard and Koch, 2012; Miocevic, 2011; Van Donk and Van Der Vaart, 2005). Kim (2009) argues that there exists a significant interrelationship between SCI practice level and competition capability. However, when it comes to decision making, strategic concentration is a key issue for manufacturing companies when designing a supply chain. As a corporate strategy and a SCM governance strategy, high integration level efficiency relates to organizational economics and strategic SCM (Guan and Rehme, 2012). Results of the research by Olausson *et al*. (2009) indicates that the level of vertical integration affects how and to what extent a new product development projects can access and take advantage of manufacturing competence (internal or external).

2.2.1.3 Customer value and customer integration

The development of information and communication technology provides many companies with a convenient environment to collect detailed data about their individual customers. Companies can take advantage of customer data to align their mission, vision, and activities with preferences of their end customers. Thus, the emphasis is now on the issue of how to effectively utilize the customer databases to manage the customer relationship. It is more important to capture information about customers than just to build up a database (Li, Xu, and Li, 2005). The customer perception about a product or service which is called customer value has been the research focus of many marketing scholars. Customer value is the benefit that a customer will get from a product or service. This benefit might be measured in monetary terms, such as when a product helps save the customer money that would have been spent on something else. This benefit can be difficult to quantify, such as the enjoyment that a customer receives from a product or service. The term "customer value" should not be confused with the value of customers to businesses. It refers to the value that the customers receive, not to how valuable customers are. Some businesspeople explain customer value as realization compared with sacrifice. "Realization" is a formal term for what customers get out of their purchases. Sacrifice is what they pay for the product or service (Leverkuhn, 2013). In addition, Business dictionary defines customer values as “The difference between what a customer gets from a product, and what he or she has to give in order to get it”. The study by Lapierre (2000) classifies customer values as product related, service related, and relationship related. This study goes into more details to explore the sacrifices which customer may make to gain more weight of their preferred value; the identified sacrifices according to the Li *et al*. (2005) study are price, time, and effort. Looking into definition of customer value and the research works in its area reveals the fact that there are inherent trade-offs among customer values. In other words, increasing one customer value may lead to decrease in another.

Customer integration, point out the need to give a final response to the expectations and requisites of customers. It is the competence of firms employed to create lasting distinctiveness with customers of choice. Those answers assume different and multiple forms:

a. The level of computerization for customer’s ordering
b. The level of sharing of market information
c. The level of communication
d. The establishment of quick ordering systems
e. The level of feed-back follow-up
f. The frequency of contact

Customer integration requires extended knowledge on what is considered as value for the end customer. Customer value is the perceived preference for evaluation of product attributes, attribute performance, and consequences arising from use of that facilitate (or block) achieving the customer’s goals and purposes in use situations. Without value, there is little likelihood of any sustainable market oriented development, yet research into consumer value is still underdeveloped (Sparks, Butcher, and Bradley, 2008). Research by Graf and Maas (2008) and Gallarza, Gil-Saura, and Holbrook (2011) trace the concept of value in the literature and provide a wide range of definitions and opinions about this concept. Since firms define themselves in the context of their supply chain, it is critical for them to link and align their practices with expectations of their end customer (Romano, 2003). There is no consensus on the definition of customer value, but generally there are two identifiable theoretical approaches which treat customer value from the company perspective and the customer perspective.

The company perspective is closely related to relationship marketing, which aims to develop and maintain profitable business relationships with selected customers. The customer perspective focuses on value generated by a company's product or service as perceived by the customer, and relates to the fulfillment of customer goals and desires by company products and/or services.

2.2.1.4 Supplier integration

Supplier integration is a tool to help organizations to gain competitive advantage. Strategic supply management skills and the supply management function's perceived status are hypothesized as antecedents to supplier integration leading to supply management performance (Eltantawy, Giunipero, and Fox, 2009). Supplier integration is the core competence derived from better coordination of all the critical suppliers in a company's supply chain to jointly achieve improved service capabilities at lower total supply chain cost. It assumes a strategic approach reflected in a strong partnership covering, not only, the information sharing in almost all areas, but also the intense collaboration in operational questions, like process of procurement and production, design, production schedule and production costs and performance. The research by Das, Narasimhan, and Talluri (2006) indicates that a balanced approach to supplier integration is the preferred route to performance. It is beneficial to invest in supplier integration. It may be unwise though, to continue with such investments in an indiscriminate fashion. Supplier integration connects different members of the chain which may not share the same characteristics, therefore it requires appropriate safeguards and coordinating mechanisms to succeed (Petersen, Handfield, and Ragatz, 2005).

2.2.1.5 Planning integration

All supply chain agents have to assure technology compatibility and real time simultaneous information to make possible a centralized and integrated planning and schedule. The planning synchronization can be a real integration tool, allowing the reduction of the bullwhip effect, the inventory management through all supply chain, the development of supply chain processes and the partnership and trust environment (Efendigil and Önüt, 2012). But those goals are greatly dependent on technology compatibility and well structured information system for the all supply chain (Panetto and Molina, 2008; Wang *et al*., 2008).

Planning integration assumes an essential role when trying to reduce supply chain costs and improve its productivity: the possibility to have a quality planning managed at the supply chain level. Although longer planning horizon have become a crucial characteristic of modern supply chain relationship, long-term relationships does not refer to any specific period of time, but rather, to the intention that the arrangement is not going to be temporary (Chen and Paulraj, 2004). Information sharing among members is the critical factor which may lead to a successful planning integration (Angeles, 2009; Ho, Tai, and Lee, 2007).

Relationships based on the final customer, i.e. Briscoe and Dainty (2005), assuming the customer's expectations as an integrating tool, should be an important issue for supply chain integration. All agents must focus on the same goals and that will be possible focusing in customer.

In order to facilitate the progressive involvement among partners an appropriate emphasis should be on maintaining ongoing customer-supplier relationships. Effective relationship management in the contemporary supply chain management and advocated the identification and the use of "relationship integration" is focused by Bowesox *et al*. (1999). Relationship integration includes inter-firm level as well as internal customers relationships.

2.2.1.6 Dyadic relations

From a holistic perspective, SCM practices are formed and managed in the one-to-one relationship between a supplier and a buyer. A long-term relationship, which is often seen as part of SCM, can only develop and prosper if both the supplier and buyer profit from the relationship (Bozarth *et al*., 2009; Chen, Paulraj, and Lado, 2004). Therefore, a supplier will compete more with other similar suppliers than compete with the competitors of his buyer (Terpend *et al*., 2008). Studies have shown that supply chains are moving from traditional perspective of dyadic relations with the level of the overall supply network through the concept of horizontal relations (Knoppen, Christiaanse, and Huysman, 2010; Wilhelm, 2011; Wu and Barnes, 2011; Wu, Choi, and Rungtusanatham, 2010) however such transition requires appropriate infrastructure to manage multi dimensional relations (Vijayasarathy, 2010).

2.2.1.7 Outsourcing

Outsourcing refers to allocation of business activities from a source internal to an organization to a source outside of the organization (Kroes and Ghosh, 2010). Some theorists argue that outsourcing increases the efficiency of supply chain (Lutz and Ritter, 2009; Tsay, 2010; Williamson, 2008). There are success stories of outsourcing activities in the SCM context. For instance companies such as The Gap (U.S.), Hennes and Mauritz (Sweden), and Benetton (Italy) tend to outsource activities to outside partners to be able to keep strong vertical integration along their chain. Although outsourcing is prevalent in certain industries and segments, it has been argued that different economic and technological circumstances require distinct SCM governance strategies (Dabhilkar *et al*., 2009; Rothaermel, Hitt, and Jobe, 2006; Tsay, 2010). The selection of outsourcing service providers should be more emphasis on its core competence and the integration degree of the chain, so that outsourcing service providers can better enhance the competitive advantages (Cao and Zhu, 2011).

2.2.1.8 Vulnerability to disturbances

Jüttner (2005) defines supply chain vulnerability as an exposure to serious disturbance arising from risks and affecting the supply chain's ability to effectively serve the end customer market. History of recent event reveals the fact that serious disturbance should be considered in SCM. Some examples of disturbing events in recent years are: volcano, strike at supplier, terrorist attack, terrorist attack, hurricane, ports congestion, global strike, product non-conformance, fire (Carvalho, Maleki, and Cruz-Machado, 2012). Global supply chains are more risky than domestic ones due to numerous links interconnecting a wide network of firms. These links are prone to disruptions, bankruptcies, breakdowns, macroeconomic and political changes, and disasters leading to higher risks and making risk management difficult (Manuj and Mentzer, 2008). A more vertically related firm exerts more control over its inputs or outputs, and more likely to recover quickly from a disruption (Hendricks, Singhal, and Zhang, 2009). Tomlin (2006) defines volume flexibility as the amount of extra capacity that becomes available, and the speed with which it becomes available when faced with supply disruptions. The ability to cope with disturbances will determine supply chain performance.

2.2.2 Functional integration

Functional perspective towards SCI emphasis stems from the fact that SCM is supposed to be a boundary-spanning activity. It is critical antecedent to effective SCI (Fawcett and Magnan, 2002a). Functional integration enables information transfer among different manufacturing/ logistics/ business functions more accurate, fast, and cost effective, which enhances the information processing capabilities. From historical point of view, SCI literature is mostly concentrated on vertical aspects (Fisher, 1997; Moreno-Luzón and Peris, 1998; Rothaermel *et al.*, 2006; Schoenherr and Swink, 2012; Suzuki, Jarvis, and Sexton, 2011); however in the new century functional aspects are also discussed in the literature (Baharanchi, 2009; Liu, Shah, and Schroeder, 2012; Wolf, 2011). Subsections of 2.2.2 review literature about functional perspective of integration in terms of performance measures, mass customization, organizational culture, and functional and innovative products.

2.2.2.1 Performance measures

Without output measures no assessment of the operational performance of a collaborative SCM is possible (Angerhofer and Angelides, 2006). Performance measurement is an essential element of effective planning and control as well as decision making. The measurement results reveal the effects of strategies and potential opportunities in SCM. Performance measurement describes the feedback or information on activities with respect to meeting customer expectations and strategic objectives. It reflects the need for improvement in areas with unsatisfactory performance (Bhagwat and Sharma, 2007). Performance measurement and auditing are of particular relevance at a time when networks have become more complex due to conditions affecting markets such as globalization, innovations in information and communication technology, advances in manufacturing processes, shortened product lifecycles and discerning customers demanding high quality products at low prices (Mondragon *et al.*, 2011). With respect to SCM performance, a large number of measures have been used in the literature, stressing that performance is a multi-dimensional concept itself (Hartmann, Kerkfeld, and Henke, 2012; Oke and Kach, 2012; Van Donk and Van Der Vaart, 2005). A performance measurement program should be complete—important aspects of performance in any link are not ignored—and they must be tailored to varying needs of participants. This requires collaboration of industry consortiums, consultants, and researchers (Gunasekaran, Patel, and McGauRoland, 2004).

Literature reveals the fact that improving supply chain performance has become one of the critical issues for gaining competitive advantages for enterprises. Abd El-Aal (2011) conducted a case study on simulated supply chain and concluded that performance evaluation plays an important role in setting objectives, evaluating performance and determining future courses of actions. They note that most valuations studies in supply chains are focused on financial aspects and there is a lack of performance evaluating methods which involves non-financial aspects. Performance measures and metrics are needed to test and reveal the viability of strategies without which a clear direction for improvement and realization of goals would be highly difficult (Gunasekaran, Patel, and Tirtiroglu, 2001). Furthermore, performance measures facilitate the understanding of mutual interactions in the diverse and complex context of supply chain. They are crucial for understanding the behavior of supply chain and integrate the behavior of its members (Azevedo, Carvalho, and Cruz-Machado, 2011; Carvalho and Cruz-Machado, 2009). Supply chain complexity in different levels such as industry, geographical region or business (Bozarth *et al.*, 2009) makes it challenging to set boundaries and identify specific measures for it. Askariazad and Wanous (2009) proposed prioritization of performance measures according to their importance in value-added activities in the entire supply chain. Sengupta *et al.* (2006) examined the effects of eight supply chain management strategic initiatives on the organizational performance measures as well as two performance measures (operational and financial). Supply chain performance measures are usually categorized into four groups: quality (Shepherd and Günter, 2006), time (Whicker *et al.*, 2009), cost (Gunasekaran *et al.*, 2004), flexibility (Angerhofer and Angelides, 2006). They have also been grouped by quality and quantity, cost and non-cost, strategic/ operational/ tactical focus, and supply chain processes (Cai *et al.*, 2009). In the research by Azevedo *et al.* (2011) supply chain performance measures are extracted from literature in terms of environmental, economic, and operational performances (table 2.4). This research classifies operational measures into quality, customer satisfaction, delivery, time, inventory level; economic performance measures: cost, efficiency, environmental revenues, environmental cost; environmental performance measures: green image, business wastage, and emissions. Thus, Performance measures should be comprehensive to cover variety aspect of activities in SCM so that monitoring changes in those measures reflect on the actual behavior of the system.

Table 2.3 Supply chain performance measures – Adapted from Azevedo *et al.* (2011)

	Measures	**Indicators**
Operational Performance	Quality	Customer reject rate In plant defect rate Increment products quality
	Customer satisfaction	After-sales service efficiency Rates of customer complaints Out-of-stock ratio
	Delivery	On time delivery Delivery reliability Responsiveness to urgent deliveries
	Time	Lead time Cycle time Delivery time
	Inventory levels	Finished goods equivalent units Level of safety stocks Order-to-ship
Economic Performance	Cost	New product flexibility Manufacturing cost Cost per operating hour
	Efficiency	Overhead expenses Operating expenses
	Environmental revenues	Revenues from “Green” products Recycling revenue Cost avoidance from environmental actions
	Environmental cost	Cost of scrap/ rework Fines and penalties Costs of purchasing environmentally friendly materials Disposal costs Recycling costs R&D expenses ratio
Environmental Performance	Green image	Number of fairs/symposiums related to environmentally conscious manufacturing the organization participate
	Business wastage	Total flow quantity of scrap Percentage of materials remanufactured Percentage of materials recycled /re-used Hazardous and toxic material output Solid and liquid wastes
	Emissions	Energy consumption Green house gas emissions Air emission

2.2.2.2 Supply Chain Practices

Supply chain is a network of number of firms (owned by the same or different enterprises) containing flow of material, service, and information as well as diverse amount of collaborations. Supply chain practices are employed by firm in order to manage their corresponding issue and handle activities. The selection of practice depends to the characteristics of each specific chain and the context in which it is operating. Since in the current research the correlations between supply chain practices and customer values are investigated, this section reports a list of the practices from the literature.

Tan, Kannan, and Handfield, (1998) explore the relationships between supplier management practices, customer relations practices and organizational performance; Hong, Dobrzykowski, and Vonderembse (2010) shed light on IT integration of lean practices in mass customization context; Kim (2006) examine the causal linkages among SCM practice, competition capability, the level of SCI, and firm performance; Carter *et al*. (2009) dig into challenges and obstacles of SCI and identifies efficient SCM practices; Cook, Heiser, and Sengupta, (2011) examine the relationships between some SCM practices and organizational performance and finds out this relationship is moderated by the role that company assumes in its respective chain. Taken together, these studies are representative of efforts to address various diverse but interesting aspects of SCM practices. However, Li *et al*. (2005) points out the absence of a unifying conceptual framework, which covers upstream, internal and downstream side of a supply chain. Table 2.5 reports and classifies SCM practices.

Table 2.4 Supply chain management practices – Adapted from Remigio (2012)

Supply chain perspectives	Supply chain practices	References
Supply Chain entities	Carrier cost/pricing analysis, performance measurement and routing analysis	a
	Extending supply chain to include members beyond immediate suppliers	b c
	Facility location analysis	a d
	Maintaining geographic proximity with partners	b c e
	Outsourcing	e f
	Reducing supplier base	c g
	Using freight forwarders/consolidators	a
	Using third-party service providers	c h
Relational links	Aiding suppliers to increase their just-in-time capabilities	b i
	Cooperate with product/ production designers to decrease environmental impacts	j
	Coordinating activities with partners	h k
	Creating high level of trust among supply chain partners	c l
	Creating informal information sharing agreements with upstream / downstream partners	i m
	Developing collaboration to achieve collective goals	f k
	Developing organization ethical standards at downstream level	c l
	Establishing long-term relationship with partners	a k
	Establishing strategic partnerships	a c e
	Establishing supply chain management teams that include members from different companies	b h k
	Improving the integration of activities/processes across your supply chain	b h k
	Interacting with customers to set reliability, responsiveness, and other standards	f m
	Involving all partners in product / service development	e h k
	Using collaborative planning, forecasting and replenishment	g
	Using cross functional teams	i

Table 2.4 Supply chain management practices – Adapted from Remigio (2012)

Supply chain perspectives	Supply chain practices	References
Material flow	Delivering materials into production line using flexible transportation equipment and containers	a j h
	Decrease work in process	f h
	Establishing batch size analysis	f n
	Establishing just-in-time procurement	n
	Establishing pull flows	c n
	Increasing delivery frequencies	m
	Internal distribution center layout analysis	a k
	Synchronizing and sequencing transportation with production	h m
	Using transportation management systems	e f
Information flow	Establishing a compatible communication and information systems between partners	k m
	Establishing visibility and tracking systems	k
	Information sharing with partners	k m
	Information sharing with end customers	f k m
	Using electronic data interchange	k
	Using electronic solutions to routine customer problems	f k
Dons stream / Customer perspectives	Contacting the end product / service user to get feedback on performance and customer service	a f h
	Customer segmentation analysis	g
	Demand-based management	b
	Determination of future customer expectations	b g
	Employing routine follow-up procedures for customer complaints	a b g
	Establishing a customer satisfaction measurement system	b i
	Establishing customer service standards	b
	Participating in the marketing efforts of customers	a g h
Inventory	Automated inventory handling	a
	Employing supplier-managed inventories	d f
	Employing vendor-managed inventories	d f
	Flexible means of transportation	a l
	Floating inventory levels	d h
	Implement standards	b
	Inventory management	a k
	Joint logistics planning	a m
	Reducing inventory to expose manufacturing and scheduling problems	c l
	Reducing inventory to release capital investment	c l m
	Visibility of upstream/downstream inventories	
Management policies: Processes	Appling statistical process control	d g
	Apply life cycle assessment	c l
	Bullwhip effect minimization	k m
	Collaborating with just-in-time partners	f l
	Creating a continuous process flow	a m k
	Creating product and lot-level traceability	a j k
	Developing flexibility to meet your customers' changing needs	e g
	Developing flexibility to respond to unexpected demand changes	b g
	Early supplier involvement in new product design and development	M
	Empowering of shop operators to correct quality problems	e i
	Environmentally conscious packaging	j h
	Establishing waste management system	j

Table 2.4 Supply chain management practices – Adapted from Remigio (2012)

Supply chain perspectives	Supply chain practices	References
Management policies: Processes	Integrated factory planning and scheduling	f n
	Internal lean practices implementation	c j k
	Life cycle tracking of sold products	a n
	Participating in the sourcing decisions of suppliers	h l
	Providing high customizations	k m n
	Reducing lot size	n
	Using cross functional operations	i j
	Using cross-docking operations	e i
	Using green sources of energy	f h
	Using preventive maintenance	c g
	Using recyclable materials	f h
	Using worker productivity controls	a
	Utilization of enterprise resource planning	a c
Management policies: Product development	Designing for manufacturing, procurement, order	f h
	Designing quality into the product	i l
	Developing product differentiation	c m
	Employing raw materials and manufacturing process standardization	c f m
	Modularization of components	c f
	Product design for manufacturability and assembly	c
	Quick product development and introduction time	f h
	Simplification of component	
	Using of concurrent engineering parts	c
	Using quality function deployment	i l
	Using standard components	c f
	Using value analysis/value parts engineering	e m
Lead times	Developing in transit acceleration and deceleration to regulate flows	f i
	On-time delivery of products directly to your customers' points	a g k
	On-time delivery purchased materials directly to company points	e g j
	Quick response time in case of emergency, problem, or special request	b g
	Reducing cycle time	f l
	Reducing setup time	c d
	Using cycle time compression	f l n

References: a: Autry, Zacharia, and Lamb (2008), b: Keah Choon Tan, Lyman, and Wisner (2002), c: Narasimhan, Kim, and Tan (2008), d: Melo, Nickel, and Saldanha-da-Gama (2009), e: Chan, Yee-Loong Chong, and Zhou (2012), f: Dabhilkar *et al*. (2009), g: Parmar *et al*. (2010), h: Jayaram and Tan (2010), i: Thapa, Dhamala, and Pant (2011), j: Schliephake, Stevens, and Clay (2009), k: Prajogo and Olhager (2012), l: Nyaga, Whipple, and Lynch (2010), m: Cavusoglu, Cavusoglu, and Raghunathan (2012), n: Wazed, Ahmed, and Nukman (2011)

2.2.2.3 Mass Customization

The notion of mass customization emerged in the late 1980s to emphasize on the need to provide outstanding service to customers by providing products that meet customers' individual needs through unique combinations of modular components (Mikkola and Skjott-Larsen, 2004). In other words, mass customization is the ability to offer a relatively high volume of product options for a relatively large market that demands customization, without substantial tradeoffs in cost, delivery, or quality (Liu, Shah, and Schroeder, 2006). The study by Lia *et al*. (2012) suggest that the development of mass customization could be initiated from the internal core competences and then leveraging external correlations. Pursuing mass customization, however, increases uncertainty in demand, supply and the production process of the firm. Performance integration among chain members is suggested as an effective approach to reduce the negative impact of uncertainty on mass customization and firm performance (Liu *et al*., 2012). Studies have shown that companies with both highly differentiated and highly integrated business functions tend to outperform other companies (Mikkola and Skjott-Larsen, 2004; Liu *et al*., 2006; Li, 2011). It is due to the fact that achieving mass customization is a multi-disciplinary effort (Gligor and Holcomb, 2012), functional areas must be aligned in their goals, have access to appropriate information, and perform in a systematic manner to design, produce, and deliver customized products to customers quickly and cost effectively (Svensson and Barfod, 2002). Therefore, mass customization facilitates achieving performance integration in chain members.

2.2.2.4 Organizational culture

Organizational culture is the pattern of beliefs, values and learned ways of coping with experience that have developed during the course of an organization's history, and which tend to be manifested in its material arrangements and in the behavior of its members (Sun, 2008). Therefore, firms may react differently to the same levels of perceived institutional pressures to adopt SCI due to the differences in their organizational cultures (Liu *et al*., 2010). Organizational culture is identified to be a key factor influencing SCI by many researchers (e.g. Blocker *et al*., 2010; Fawcett and Magnan, 2002; Kanda and Deshmukh, 2008; Sinkovics *et al*., 2011; Tarn, Yen, and Beaumont, 2002; Yeung *et al*., 2009). According to a survey by Sambasivan and Yen, (2010) there is a relationship between the culture type of chain members and the degree of integration (trust, communication, and commitment). However, there is little empirical research that studies the relationship between human resource and supply chain success in detail. Shub and Stonebraker (2009) believes this omission may be due to the notable lack of studies that evaluate the soft variables and their alignment, using high confidence methods.

2.2.2.5 Functional and innovative products

Fisher (1997) and then Ramdas and Spekman (2000) believe that if one classifies products on the basis of their demand patterns, they fall into one of two categories: they are either functional or innovative. Each category requires a distinctly different kind of SCM practices. According to Fishers (1997) functional and innovative products differ in terms of: product life cycle, product variety, average stock rate, average margin of error in the forecast at the time production is committed, average forced end-of-season markdown as percentage of full price, and lead time required for made-to-order products. High performers among innovative-product use practices that enhance revenues more than high performers among functional product. They are more likely to engage in supply-chain management to enhance revenues (Ramdas and Spekman, 2000). Lo and Power (2010) investigate the relationship between product nature and SCM strategy by using Fisher's model as the framework. In contrast, their results indicate that the association between product nature and SCM strategy as articulated in Fisher's model is not significant. Furthermore, as a result of their survey, they found that more than two-thirds of surveyed organizations pursue efficiency and responsiveness strategies simultaneously. Therefore, Lo and Power (2010) recommend a hybrid strategy (pursuing efficiency and responsiveness) which can be employed by most organizations irrespective of the nature of the primary product they supply.

A basic requirement to succeed in both functional and innovative products' context is internal integration, meaning a well structured and reliable information system. Data integration and information accuracy can be assured by the Quality Management System based on a referential standard like ISO 9001:2012. Reliability must be based on a real time information that depends in information technology and team work. The utilization of periodic interdepartmental meetings among internal functions and the use of cross functional teams in process improvement are basic tools for real time integration. Main dependencies for these goals are information system structure and organizational definition.

2.3 Integration models

Existing multi-view enterprise-modeling methodologies have been utilized for the modeling and integration of a single company or within an enterprise, but they do not specifically address the techniques for inter-enterprise modeling and integration (Shunk, Kim, and Nam, 2003). In the literature different terms are used to address integration such as: enterprise modeling (Ganesan, 2011; Xu *et al*., 2008), business process engineering, enterprise engineering (Reijers, Mans, and Van der Toorn, 2009; Weske, 2012), enterprise integration modeling (Chen, Doumeingts, and Vernadat, 2008; Panetto and Molina, 2008), supply chain integration model (Richey *et al*., 2010; Trkman and McCormack, 2009), enterprise collaboration model (Lei *et al*., 2012; Mun *et al*., 2009). Although there is slight difference in the wordings of these terms but the ultimate objective is to integrate inter-enterprise relations. Integration of processes provides the adequate information, in the right place, at the right time for each role. Considering a broad spectrum of the SCM concept, various classification schemes are available to categorize models.

SCI models must be able to represent prime-sub relationships, capable of demonstrating how the functions and information, and it must show metrics. Closer relationships between chain partners need models that support processes which communicate across organizational boundaries. These must complement traditional support for internal business processes (Liu, Kasturiratne, and Moizer, 2012; Shunk *et al*., 2003). SCI models can be classified based on their problem scope or application areas. Supply chain is cross-functionally organized in order to optimize both data sharing and business processes (Angeles, 2009). Therefore, models involve tradeoffs between more than one business process (function) within the supply chain (Eng, 2005; Liu *et al*., 2012; Mennini *et al*., 2011; Min and

Zhou, 2002). SCI models deal with both vertical and functional aspects of integration. However, studies have shown vertical integration may result in improvements in functional performances as well (Olhager and Prajogo, 2012; Zhu, Sarkis, and Lai, 2012). Depending on the direction (see 2.2.1.1) and level (see 2.2.1.2) of integration, it may have different types.

Supply chain modeling approaches can be classified into three main types namely deterministic (all variables are known), stochastic (at least one of the variables is unknown and is assumed to follow a known probability distribution), and hybrid (e.g. simulation models that are capable of handling both deterministic and stochastic variables). Key references in SCI modeling are reported in the table 2.6.

Table 2.5 Key references in supply chain integration modeling

Modeling approach	**Key references**
Deterministic	Cagliano, Caniato, and Spina (2006); Flynn, Huo, and Zhao (2010); Kim (2006); Mohammadi Bidhandi *et al*. (2009)
Stochastic	Agarwal, Shankar, and Tiwari (2006); Aktar Demirtas and Ustun (2009); Chatfield, Harrison, and Hayya (2006); Lam and Ip (2011); Nagar and Jain, (2008); Wang *et al*. (2008)
Simulation and hybrid	Agarwal *et al*. (2006); Aktar Demirtas and Ustun (2009); Chatfield *et al*., (2006); Efendigil and Önüt (2012); Lam and Ip (2011); Trkman, Štemberger, Jaklic, and Groznik (2007); Wang *et al*. (2008); Yao and Liu (2009)

2.3.1 Deterministic models

In a deterministic model no randomness is involved in the development of future states of the system. Thus, such model will produce the same output from a given starting condition or initial state. Deterministic models include single objective and multiple objective models which were dominantly used in the previous century. However, it is still used in sub optimizations. This approach models quantitative variable with deterministic values. For instance, Mohammadi Bidhandi *et al*. (2009) use deterministic supply chain network to determine facilities location and allocation. Another application of deterministic model is the paper by Dumrongsiri *et al*. (2008) that studies a dual channel supply chain in which a manufacturer sells to a retailer as well as to consumers directly. Deterministic models pick specific variables and analyze them in order to get optimum outputs.

2.3.2 Stochastic models

In contrast with deterministic way of modeling, the stochastic approach uses range of values for variables in the form of probability distributions. The use of uncertainty models in SCM problems is a natural extension of the traditional deterministic approach (Mentzer *et al*., 2001). This happens due to the fact that most problems faced by companies have as a characteristic some degree of uncertainty (Kocoglu *et al*., 2011). Thus, the assumptions that all the parameters used in modeling are deterministic is not realistic, especially when considering elements that are in most cases beyond the scope of the company, such as demand, prices, and efficiency rates (Franca *et al*., 2010; Kocoglu *et al*., 2011). Fuzzy logic (Ayag, Samanlioglu, and Buyukozkan, 2012; Kumar, Singh, and Singh, 2012) and Bayesian network (Aloini, 2012; Lockamy and McCormack, 2012) are two examples of stochastic approaches which are widely used in SCM context. In addition, stochastic versions of deterministic approaches are available which cover randomness and uncertainty. For instance, a stochastic Petri net is a stochastic version of a deterministic approach that adds nondeterministic time through adjustable randomness of the transitions (Li and Ding, 2012).

Stochastic or Probabilistic modeling refers to any kind of modeling which employs probability distributions of known inputs to compute the implied probability distribution for chosen output. Apparently, it differs from deterministic approaches (i.e. common spreadsheet) of randomly playing with the input value and observing its impact on outputs.

Two experimental studies conducted by Croson and Donohue (2006) discloses the fact that cognitive limitations of managers and difficulties inherent in managing a complex dynamic system lead to irrational decision making in supply chain. Accordingly, providing a clear picture of the interactions among supply chain members will help them in order to come with rational decisions.

There are two main approaches to perceive probability: objectivist (or frequentist) and subjectivist approach. Objective approach looks at probability as the proportion of observed occurrence of a random event which in another word is statistical perspective. On the other hand, subjective approach considers probability as a degree of personal belief that a particular event will happen. For instance, the probability that financial crisis will cause more machine shut downs. Obviously, in the case of subjective probability the knowledge and experience of the expert who is giving values as an important role. Consider the conceptual example that according to news a company has been successful in meeting milestones in giving services. Then our company initiates collaborative work with it and observes some deviation from promises in its actual behavior. Nevertheless, if the poor behavior continues, we will increasingly put trust on our observation and less on prior knowledge to obtain more refined posterior estimate. The mathematics of this process is called Bayesian estimate which in a complex network will lead to Bayesian Networks. Such analysis may not be done under objective approach.

Manufacturing optimization and corporate management which are one of the main concerns of industrial engineers and managers have been shifted from competition among individual firms to a competition among supply chains (Cho and Soh, 2010). It is due to the fact that many companies have come to the conclusion that in order to survive the global rivalry not only each involved firm should be competitive but also the whole chain should be robust and competitive. Eventually, as the importance of supply chain is being disclosed, strategic decision making in the macro levels has received significant attention. This includes information sharing (Larson and Kulchitsky, 2008), interdependence (Ryu, So, and Koo, 2009), cooperation (Hadaya and Cassivi, 2007), and stressing on the importance of long-term partnership relationship among buyers and suppliers.

Deterministic modeling such as linear programming (LP) had been used as the dominant approach in industrial engineering context. The problem with LP is that it doesn't embrace uncertain entities and also it lacks the capability of incorporating experts' tacit knowledge in the modeling process. This shortcoming of deterministic approaches leaves the potential room for stochastic modeling. Analytical tools such as stochastic modeling has been around for a number of years to deal with uncertainty but companies have not been taking advantage of them due to perceived complexity of modeling techniques and lack of transparency. Nowadays following to the advances in information systems and complex networks, a plethora of data is being automatically collected consequently reasoning approaches have been developed and used to analyze data. Stochastic analysis is among the most welcomed approaches by researchers in this area.

Bayesian network (BN) is a probabilistic model which is capable of computing the posterior probability distribution of any unobserved stochastic variables, given the observation of complementary subset variables. Several authors have recommended BN as a comprehensive method to derive relationships and influences among variables.

It is far away from reality to expect any prediction method to achieve anywhere near perfect predictions (Kiekintveld, Miller, Jordan, Callender, and Wellman, 2009). BN like any other approaches has its own pros and cons. This approach has the strength to truly embrace uncertainty and involve non-deterministic factors in the model. But also, some practitioners have perceived it as to be too difficult and too vague. Data collection for objective probability in a supply chain context can be done through common Enterprise Resource Planning (ERP) systems such as SAP (developed by SAP AG, the German software corporation). But, getting trustworthy inputs for subjective probability is so challenging. Besides, due to the fact that there is a fundamental difference in data used for accounting purposes rather that data required for modeling (Towill *et al.*, 2002), consequently in many cases it is challenging to withdraw required data from ERP systems. However, it depends on the inference which is meant to make.

Due to the significant influence of inventory of the cost, the literature dealing with inventory theoretic model is relatively rich (Khouja, 2003; Liao, Hsieh, and Lin, 2010; Radhakrishnan *et al.*, 2009; Sana, 2011). For instance, Sodhi and Tang (2009) extend deterministic linear programming model for supply chain planning using stochastic programming by incorporating demand uncertainty to consider unmet demand and excess inventory and by incorporating cash flows to consider liquidity risk. And Esmaeili (2009) modeled the relationships between seller and buyer by non-cooperative and cooperative games, respectively.

2.3.3 Simulations and hybrid models

Simulation models facilitate pre monitoring designing, evaluation, and optimizing supply chains. This model has a capability to find a local optimum value within each component through the entire chain. Most SCM simulation models are developed on the basis of discrete-event simulation however they are preferred to deal with stochastic natures existing in the complex systems (Lee *et al*., 2002). Application of simulation and hybrid models has increased in the new century and more specifically during last five years that more chains tend to implement integrated ERP systems. The boost of collected information through ERP systems has provided enough inputs for such models to generate realistic outputs (Ancarani, 2009; Chan and Chan, 2010; Elia, Baliban, and Floudas, 2012).

2.3.4 Obstacles of Stochastic Modeling

Due to the fact that BN has been frequently prized and recommended by researchers in diverse streams and its strengths and advantages have been mentioned and discussed in the literature, the idea of this section is to bring about obstacles and difficulties which practitioners may encounter to employ this tool. In addition, some ways are also provided to deal with each obstacle. It worth noticing that in some cases such difficulties are indispensible, such as the requirement of too many inputs in BN, but still practitioners can take advantage of this tool through using some techniques.

Bayesian network is very much referred as a strong tool to deal with uncertainties and withdraw inference out of complex networks. However, there are some obstacles and difficulties in implementing BN which will be discussed in this section. Firstly, it is sometime vague to define uncertainty in system and indentify uncertain factors. Secondly, when there are many parent nodes to a node, BN requires too many inputs to draw inference. The other obstacle is rooted in the nature of supply chain which encompasses a considerable number of role players. Finally, the last obstacle which is discussed in this section is difficulty in determining prior probability and likelihood of nodes in BN. Together with explaining the obstacles, an idea is also presented to deal with them.

This section discusses about obstacles of BN in situations where it is recommended to use. For instance, BN is not recommended to represent a deterministic process. If a problem can be completely described analytically, it is absolutely not interesting to use a Bayesian network. However, if uncertainty exists in your model, BN are recommended.

2.3.4.1 Perceiving Uncertainty

It has happened quite often that people use uncertainty and risk interchangeably which is not always true. According Merriam Webster dictionary uncertainty is defined as “lack of sureness about someone or something” while risk is “the chance of loss or the perils to the subject matter of an insurance contract, or the degree of probability of such loss” (Merriam-Webster Collegiate Dictionary). Having a look at the definitions of these two words clarifies that uncertainty is in the nature of an element whereas risk is its consequence. For instance, rain has an uncertain nature which means it may rain or not. But consequences of rain will be discussed under its risk. Supply chain has a broad context which includes a considerable number of uncertainty sources (table 2.7).

Truly identification of uncertainty helps to avoid adding extra nodes and to keep the network in a manageable size (Bravo Vergel and Sculpher, 2006). Besides, Table 2.7 can be used to classify network nodes into four main categories to reduce complexity of the network.

Table 2.6 Uncertainty sources in supply chain – Adapted from Towill *et al*. (2002)

Uncertainty Source	**Typical primary data used during quick scan investigation**
Supply side	Invoices, call-offs, BOM, forecasts, receipts, supplier quality reports, MRP, lead times, stock reports.
Demand side	Delivery frequency, echelons to end customer, market fluctuation, stage of product life cycle, customer ordering procedures, forecast accuracy.
Process side	Scrap reports, cycle times and variability of cycle times, production targets and output, downtime reports, stock consolidations, capacity planning, asset register
Control side	Time series of customer orders, supplier orders, demand forecasts, kanban logic, batching rules, MRP logic, call-offs, purchase orders, BOM number of variants, delivery frequency, number of completing PDPs (Product Delivery Process)

2.3.4.2 Too many inputs

Data is usually collected from information system of enterprises which is used to handle their transactions. One of negative aspect of BN is that it easily gets complicated and requires too much data to draw inference. For instance in the world wide web each node has a plethora of child nodes or parent nodes. Considering the fact that in a BN we need to provide data for conditional dependencies of all those connections, too much of information is needed to import to the model. In many cases, such data may not be available. So, the typical suggestion will be to use Markov blanket but still it gets into a lot of looping. It worth noticing that some authors suggest pruning redundant nodes to decrease complexity and need of extra inputs. For example, if five values can be assigned to a node and it has three parent nodes each of which can be assigned one of four possible values, then a collection of $5*4^3=320$ values will be needed.

2.3.4.3 Domain complexity

Supply chain context covers a broad area including issues such as financial, manufacturing, logistics, policy, etc. The variety of effective factors increases the complexity of the network and makes it difficult to build up Markov blanket of nodes. Consequently, there is always a chance of missing effective nodes which may miss lead the inference drawn from such network. Nodes classification helps very much to classify the domain (Abad-Grau and Arias-Aranda, 2006; Bie *et al*., 2010). In the research by Yuan *et al*. (2009) an index system with Bayesian network has been used to select supplier the typology of their system is illustrated in figure 2.2.

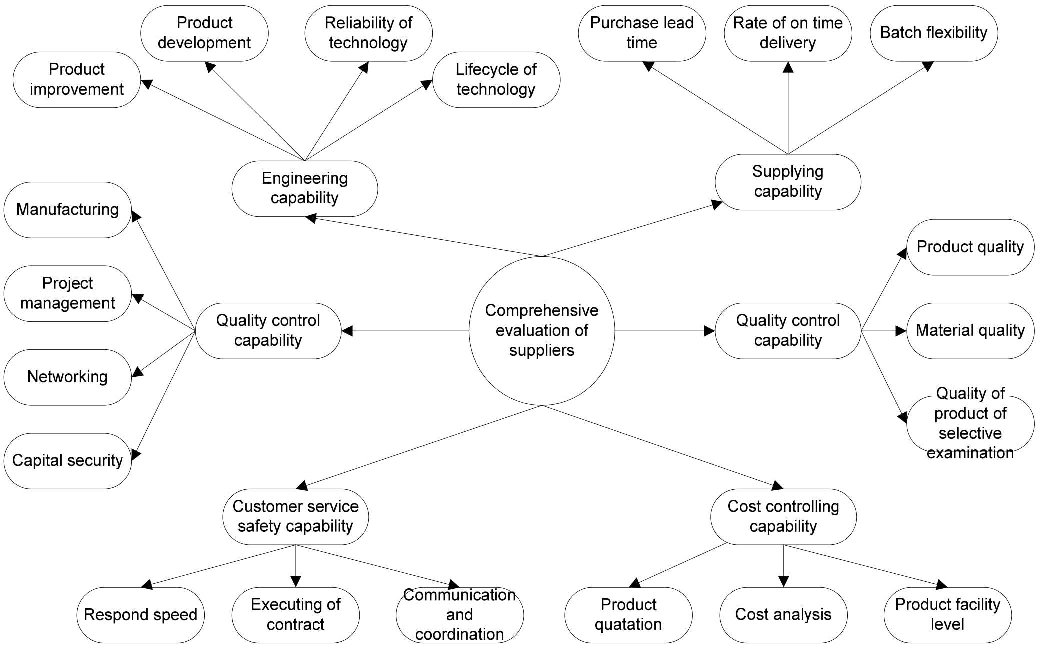


Figure 2.2 Bayesian network typology chart

2.3.4.4 Prior probability and likelihood determination

One of the major challenge in developing BN is the determination of prior probabilities and likelihoods (conditional probabilities) given available data (Abad-Grau and Arias-Aranda, 2006). However, generalized interval probability approach has the advantage of providing "rough" estimate of both priors and conditional probabilities without hurting the robustness of posterior estimates, even though the actual correlation/dependency is unknown. Generalized interval is defined as a pair of real numbers $x:=[\overline{x},\underline{x}]$ ($\overline{x},\underline{x}$ from R) instead of traditional set-based definition (Wang, 2010). Generalized interval helps to determine prior probability and likelihood when there is a shortage of data in directly identifying them. This also implies the requirement of a considerable amount of data in constructing BN.

2.4 Bayesian Network

Bayesian network (BN) is rooted in Bayes Theorem which firstly reflected on scientific literature after death of Thomas Bayes who developed it but did not believe that mathematics scientists would accept his idea as a scientific approach. Richard Price, a friend of Bayes, took action to introduce his research to the body of knowledge (Bayes and Price, 1763). BN also known as belief networks or Bayes nets in short form, belong to the family of probabilistic graphical models which are employed to represent knowledge about uncertain domain. BN combine principles from graph theory, probability theory, computer science, and statistics (Gopnik and Tenenbaum, 2007). BN can reflect dependency relationship between variables under uncertain condition and can unify expert's prior experience, BN have sound probabilistic semantics, explicit encoding of relevance relationships which led BNs to be one of the best methods for dealing with uncertainty in the artificial intelligence domain (Bhatti, Kumar, and Kumar, 2010; Ling *et al.*, 2011).

BN has been appeared as a powerful practical tool to represent knowledge. A BN is a directed acyclic graph that encodes probabilistic relationships among variables of interest. BN is a statistical model which is capable of computing the posterior probability distribution of any unobserved stochastic variables, given the observation of complementary subset variables (Gambelli and Bruschi, 2010). A BN defines a joint probability distribution over all random variables. Virtually any probabilistic query (e.g. probability of random variables X and Y to be in state x and y, respectively) can be answered once the joint probability distribution is known. Random variables can either be continuous or discrete. In this research will only consider discrete random variables (Li and Wang, 2011). Nodes without parents are called root nodes and nodes without child nodes are called leaf nodes. Root nodes have marginal prior probability associated with them, and all other nodes have conditional probability associated with them. The joint probability distribution is determined using the chain rule, and assuming the conditional independencies, encoded in the BN structure (Boudali and Dugan, 2005). The joint probability distribution of a set of variables $\{X_1,...,X_n\}$ is:

$$P[X_1, \dots, X_n\} = \prod_{i=1}^{n} P[X_i | parents(X_i)]$$

BN model has following advantages in data analysis (Neapolitan, 2003): because the model encodes dependencies among all variables; it readily handles situations where some data entries are missing; it can be used to learn causal relationships, and hence can be used to gain understanding about a problem domain and to predict the consequences of intervention; Since the model has both a causal and probabilistic semantics; it is an ideal representation for combining prior knowledge (which often comes in causal form) and data. Several authors (Boudali and Dugan, 2005; Langseth and Portinale, 2007; Lockamy and McCormack, 2012; Mahadevan, Zhang, and Smith, 2001; Muller, Suhner, and Iung, 2008; Shevtshenko and Wang, 2009) have recommended this approach as a comprehensive method to derive relationships and influences among variables in SCM context. This approach has also been successfully used in a variety of topics related to SCM.

According to the practical experiences, it is highly recommended to develop a true and comprehensive knowledge of the system before building BN model (Baesens *et al.*, 2004; Kao, Huang, and Li, 2005; Shevtshenko and Wang, 2009; Zhu and Deshmukh, 2003). BN model can be so diverse to encompass almost all elements in the system as well as environmental elements but clarifying boundaries of the model and establishing enough knowledge of inside boundaries will effectively helps to avoid further complexities. In addition, enough understanding of the system contributes to exclude some issues from the model due to the fact that they are not influencing the system effectively. This leads to simplification of model and reduction of number of inputs. Employing BN classifier is another way to avoid aforementioned difficulties. BN classifier divides the system into some classes and makes the model more illustrative and understandable. Besides, even if the whole model is not ready (because of any of mentioned obstacles) it helps to draw inference from the available part of the model. Finally, generalized interval is a practical technique to skip difficulties in determining prior probability and likelihood. This technique is well explained by Wang (2010) to be used when not enough data is available to calculate prior probability and likelihood. Table 2.8 justifies application of BN in the current research through presenting demands of the research questions from tool as well as BN characteristics.

Table 2.7 Research question demands and Bayesian network characteristics

Research question demands from tool	BN Characteristics
• Dealing with uncertainty • Different units • Incomplete information • Measurements • Not very sensitive to small changes or minor incorrect inputs • External factors • Decision support system • Scenario planning • Complex network analysis	• Consistent, theoretically solid mechanism for processing uncertain information • Different variable types can be modeled in BN • Allows one to learn about causal relationships • Facilitates use of prior knowledge • Small alterations in the model do not affect the performance of the system dramatically • Missing data is marginalized out by integrating over all the possibilities of the missing values • Efficient model learning algorithm

2.4.1 Inference in BN

Inference is "the act of passing from one proposition, statement, or judgment considered as true to another whose truth is believed to follow from that of the former" (Merriam-Webster Collegiate Dictionary).There are two types of inference support: predictive and diagnostic support for nod X_i. Predictive support for nod X_i is a top-down approach which is based on evidence nodes connected to X_i through its parent nodes. In contrast, diagnostic support for node Xi is a bottom-up approach which is based on evidence nodes connected to Xi through its child nodes (Gopnik and Tenenbaum, 2007). Another approach is to group structure learning algorithms into unsupervised and supervised learning algorithms. Unsupervised structure learning algorithms are used to find the links between the variables. There are two major families of unsupervised learning algorithms: Constraint based methods (use the semantic of BN and are based on statistical tests) and Score based methods (use a metric to qualify the BN of the dataset). As the search spaces are impossible to exhaustively explore, learning algorithms are based on heuristics, and, depending on dataset, the relative performances of those algorithms can vary. On the other hand, if your goal is to predict one specific target variable, you will then have to use supervised learning algorithms such as Naive-Bayes, Tree augmented Naive-Bayes (TAN), BN Augmented Naive-Bayes (BAN), Bayesian multi-nets and general Bayesian networks (GBN). In that case, the learning algorithms do not try to find the best representation of the joint probability distribution but try to find the best probabilistic characterization of the Target Variable (figure 2.3).

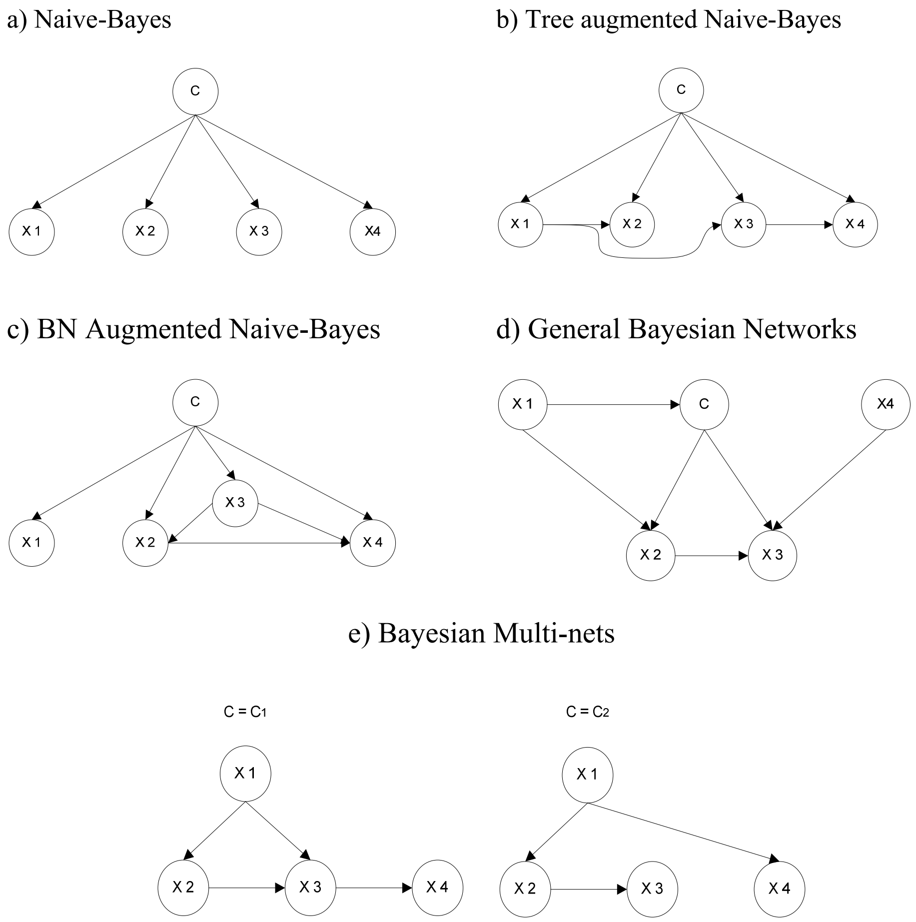


Figure 2.3 Bayesian network supervised learning algorithms

Inference algorithms are available and they are also implemented in some software to draw inference from BN. Due to the plethora of nodes and arcs in this network, without such algorithms and software it is close to impossible to get this done. Algorithms which are used by available software are: clustering, polytree, stochastic sampling (such as relevance based decomposition, backward sampling, self-importance sampling, adaptive importance sampling), variable elimination (varelim), and Monte Carlo method are used to draw inference from a BN. However, in situations where the network is so large and complex approximate and stochastic algorithms such as stochastic sampling algorithms can be used to save time and memory. The clustering algorithm is used in compilation of a directed graph into a junction tree and update probability in the junction tree.

2.4.2 Application of BN in SCI

BN is used in diverse fields in the context of SCM in general. However, there is a lack in applying this tool in SCI topics. Looking into SCM, BN has been used to identify product failure rate (Cai *et al.*, 2011), assess risk of new products (Chin *et al.*, 2009), analyze scenarios (Cinar and Kayakutlu, 2010), find order quantity (Dada, Petruzzi, and Schwarz, 2003), forecast customer demand (Kiekintveld *et al.*, 2009), analyze sensitivity of collaboration among enterprises (Li and Gao, 2010), develop decision support system under uncertainty (Shevtshenko and Wang, 2009), measure the SC performance with combining data envelopment analysis and Monte Carlo simulation (Wong, 2009), supplier evaluation (Yuan *et al.*, 2009). Table 2.9 presents focus of selected works in the context of SCI which have benefited from BN.

Table 2.8 Focus of researches in the SCI context which have uaed Bayesian network (selected works)

Selected research works	**Field of Focus**
Kao *et al*. (2005)	This research proposed a dynamic BN to represent the cause-and-effect relationships in industrial chains. The proposed approach can be utilized as a knowledge base of the reasoning systems where the diagnostic tasks are conducted.
Santoso *et al*. (2005)	It suggests a stochastic programming model and solution algorithm for solving supply chain network design problems of a realistic scale. This approach integrates the sample average approximation scheme, with an accelerated Benders decomposition algorithm to quickly compute high quality solutions to large-scale stochastic supply chain design problems with a potentially infinite number of scenarios.
Li and Chandra (2007)	Complex supply chains contain heterogeneous information and correlation among their components, and are distributed across a large geographical region. This research proposed a BN approach for knowledge integration that can handle the challenges posed in complex networks.
Leary (2008)	Sustainable integration requires real time decision making. This research proposes a mechanism and architecture necessary to create an autonomic supply chain for a real-time enterprise. It includes knowledge-based event managers, intelligent agents, radio frequency identification, database and system integration, and enterprise resource planning systems.

Table 2.8 Focus of researches in the SCI context which have uaed Bayesian network (selected works)

Selected research works	Field of Focus
Lockamy and McCormack (2010)	This research looks into risks of outsourcing for integration of supply chains. It argues that it is essential that organizations have the means to analyze the risks associated with a supplier of outsourced materials. It proposes a BN approach to develop risk profile of suppliers. The proposed BN is used to analyze a supplier's external, operational and network risk probabilities, and the associated revenue impact on the organization.
Lockamy and McCormack (2012)	Many organizations has extended their enterprises into different supply chain networks which have resulted in increasing their dependency and therefore become more vulnerable. This research proposed a BN approach to keep chains integrated in case of disturbances. This research digs more into upstream integration.

2.5 Analytic Network Process

The Analytic Network Process (ANP) is a generalization of the Analytic Hierarchy Process (AHP). AHP is a structured technique for organizing and analyzing complex decisions which was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined since then. The AHP is a theory of relative measurement with absolute scales of both tangible and intangible criteria based on the judgment of knowledgeable and expert people. How to measure intangibles is the main concern of the mathematics of the AHP. The AHP breaks down a problem into a hierarchy in which each decision element is considered to be independent; thus, it cannot accommodate interrelationships among elements (Chung, Lee, and Pearn, 2005; Ambroggi and Trucco, 2011; Tseng, Chiang, and Lan, 2009; Wu and Lee, 2007). The ANP extends the AHP to problems with dependence and feed- back. Contrary to AHP, ANP provides a more generalized model in decision-making without making assumptions about the independency of the higher-level elements from lower-level elements and also of the elements within a level (Jharkharia and Shankar, 2007). In term of the structure of the network, ANP doesn't have a goal cluster. Mathematical background of AHP and ANP is presented with examples by Saaty (2008). Although AHP gain almost immediate attention by both academics and practitioners, but also there have been number of debates about it. Critics against AHP were answered by Saaty (1996) and other academics during the evolution of this technique. Saaty (2004) also improved the theoretical foundation of AHP as well as ANP. Researchers using AHP/ ANP should consider some practical points in development of their work. The first practical point is that researchers should be conscious about the number of alternatives. Since this methodology works based on pairwise comparisons, Given I as the number of alternatives, there will be I×(I-1)÷2 comparisons for every criteria. High number of criteria will increase the number of comparisons which may confuse the respondent. The other point is concern with theoretical aspect. Although it is not necessary to give value for all comparisons however, no row or column in the comparison matrix should include only zeros. Therefore, researchers should be careful to have at least one number in every row and column.

According to the study by Chung *et al*. (2005) ANP is a comprehensive decision-making technique that has the capability to include all the relevant criteria, which have some bearing, in arriving at a decision. ANP allows for more complex interrelationships among decision elements by replacing the hierarchy in the AHP with a network (Kim *et al*., 2011). This method portrays a real world representation of the problem under consideration by prioritizing not only just the elements but also groups or clusters of elements as is often necessary. ANP has non-linear structure and allows interdependencies, therefore it goes beyond AHP (Agarwal and Shankar, 2002; Ravi, Shankar, and Tiwari, 2005). Table 2.10 justifies application ANP in the current research through presenting demands of research questions from the tool and strength of ANP as a tool in dealing with them.

Table 2.9 Research question demands and analytic network process

Research questions' demands from tool	**ANP Characteristics**
• Pairwise comparisons of SCM practices with respect to customer values • Reflecting quantitative outputs as a result of pairwise comparisons • Identifying priorities of SCM practices • Synthesize judgments / pairwise comparisons to yield a set of overall priorities • Identifying the relative priority of SCM practices as opposed to others • Monitoring sensitivity of SCM practices in case of the changes in the network	• The selection of one alternative from a given set of alternatives, usually where there are multiple decision criteria involved. • Putting a set of alternatives in order from most to least desirable • Determining the relative merit of members of a set of alternatives, as opposed to selecting a single one or merely ranking them • Comparing the processes in one's own organization with those of other best-of-breed organizations • Dealing with the multidimensional aspects of preferences

2.6 Discussion and remarks

This chapter reviewed and reported relevant literature in the context of SCI. It starts with pointing out important findings of key research works in the SCI context then discusses those issues in order to identify obstacles and missing points regarding the current state of SCI. It continued with introducing and explaining BN and ANP as the two tools which will be used in the following chapters to develop SCI model. In this section, findings and scope of key references from the year 2005 till 2012 are classified according to the publication year (this literature review and the forth coming discussion is published in Maeki and Cruz-Machado, 2013c). Following the chronological sequence of references reflects the evolution of the topic and main concern of researchers in this time frame. After review of the key references an overall discussion on the SCI context is presented which points out gaps and missing point in the literature.

Key references of the year 2005

Briscoe and Dainty (2005): They empirically investigate the problems encountered in trying to integrate supply chains in the UK construction industry. The findings reveal that the large number of supply chain partners and the significant level of fragmentation limit the levels of integration that are achievable. The interplay of environmental and procurement related factors renders the realization of truly integrated supply chains very problematic and difficult to achieve.

Petersen *et al*. (2005): They look at the issue of what managerial practices affect new product development team effectiveness when suppliers are to be involved. They also consider whether these factors differ depending on when the supplier is to be involved and what level of responsibility is to be given to the supplier. Finally, they examine whether supplier involvement in new product development can produce significant improvements in financial returns and/or product design performance. They used survey in data collection.

Power (2005): It reviews a sample of the literature relating to the integration and implementation of SCM practices from a strategic viewpoint. According to this research an important emergent theme from the literature is the importance of taking a holistic view, and the systemic nature of interactions between the participants. At the same time, it is also apparent that this requirement to take such an holistic and systemic view of the supply chain acts as an impediment to more extensive implementation. This research serves to highlight the inter-dependence between integration (technologies, logistics, and partnerships), a strategic view of supply chain systems, and implementation approach.

Zailani and Rajagopal (2005): They point out the need to react to market changes and the critical role of the supply chain in meeting this need, and the potential benefits of integrating the chain, can no longer be ignored. This potential, however, will be realized only if the interrelationships among different parts of the chain are recognized, and proper alignment is ensured between the design and execution of the company’s competitive strategy.

Key references of the year 2006

Agarwal *et al*. (2006): It presents a framework which encapsulates the market sensitiveness, process integration, information driver and flexibility measures of SCM performance. The paper also explores the relationship among lead-time, cost, quality, and service level and the leanness and agility of a case supply chain in fast moving consumer goods business. It employed analytic network process to do quantitative analysis of decisions.

Cagliano *et al*. (2006): They study the links between SCI and manufacturing improvement programs. Evidence of this research is drawn from a sample of 297 European companies from the third edition of the International Manufacturing Strategy Survey. Data are analysed using exploratory factor analysis and hierarchical regression. Results show that the adoption of the lean production model has a strong influence on the integration of both information and physical flows, while no significant influence emerged from the adoption of ERP.

Chatfield *et al*. (2006): They introduced SISCO, an object-oriented simulation tool for the simulator for SCI operations. The user specifies the structure and policies of a supply chain with a GUI-based application and then saves the supply chain description in the open, XML-based supply chain modeling language format. SISCO generates the simulation model to a library of supply-chain-oriented simulation classes.

Das *et al*. (2006): They operationalize supplier integration as a bundle of practices that include a set of internal and external practices. They find that practices in specific configurations can be as important a source of performance differentials as the adoption of individual practices themselves. They show that deviations from the optimal profile are associated with performance deterioration, and that indiscriminate and continued investments in integration may not yield commensurate improvements in performance.

Kim (2006): He finds that in small firms, efficient chain integration may play a more critical role for sustainable performance improvement, while, in large firms, the close interrelationship between the level of SCM practices and competition capability may have more significant effect on performance improvement. It is concluded that, in early stage, the emphasis on systemic SCI may be more crucial. Once SCI has been implemented, it may be advisable to focus on SCM practice and competition capability.

Koh, Saad, and Arunachalam (2006): It investigate the integration of SCM and enterprise resource planning systems. This research concludes that breaking the traditional decentralized system and introducing the concept of a single, integrated plan, which a company could work together with their suppliers has led to cost reduction, lead-time reduction, improved visibility, reduced time to market, and increased efficiency in the company. This research is based on a single case study in manufacturing industry in china.

Stonebraker and Liao (2006): This study argues that the stage of life cycle variables is associated with the various dimensions of SCI, and that environmental complexity and munificence have significant moderating effects on the relationships. This research posits that, for efficiency and success, a strategic fit must exist between environmental, strategic and operations variables, and that specific dimensions of integrative effort are appropriate for given situations. That fit would attenuate bullwhip inefficiencies, either of inventories and other mechanical decisions, or of the less tangible human and structural interaction.

Key references of the year 2007

Barnes, Naudé, and Michell (2007): They develop a conceptual framework to explore dyadic relationships across a range of industries, involving firms of different size. Their findings suggests: significant perceptual differences are more apparent in shorter term relationships; suppliers have stronger views of the relationship; relationships may not necessarily follow a linear development path over time.

Fabbe-Costes and Jahre (2007): The departure point of this research is a controversial hypothesis: the contribution of SCI is not as obvious as logistics and supply chain researchers usually think. Through a review on literature they realized that empirical evidence cannot permit to clearly conclude and that integration as well as performance is defined, operationalised and measured in different and often limited ways.

Forslund and Jonsson (2007): The purpose of this reseach is to explore how to integrate the performance management process of delivery service in customer/supplier dyads. This research focuses on describing and comparing the activities of the performance management process. Most activities show low levels of integration in the dyads studied. Defining metrics and target setting are considered most important to integrate. Lack of common metrics definitions and ERP deficiencies were important obstacles for integration. Research issues related to areas of supply chain performance management are discussed.

Kang, Kim, and Park (2007): This research tries to solve the trade-offs between marketing and R&D domains and to minimize information loss in new product development. It benefits from the house of Quality integrated with multivariate statistical analysis is used for determining important design features. The integrated design process determines a point of compromise between the optimums of conjoint analysis and Taguchi method. Sequential application of two methods ensures full utilization of both methods and no loss of information.

Trkman *et al*. (2007): The aim of this research is to find out how the performance of the supply chain can be improved with the renovation and integration of processes at various tiers in the chain and by the sharing of information between companies. They show that effective utilization of information technology and the role of business process modeling and simulation are all vital in supply chain integration projects. The presented combination of business process and demand/ supply simulation in this research enables an estimation of changes in lead-times, process execution costs, quality of the process and inventory costs.

Key references of the year 2008

Aryee, Naim, and Lalwani (2008): Outsourcing of non-core activities and the subsequent vertical disintegration within manufacturing organizations is necessary for process integration in SCM. The findings show that the "soft" collaboration rather than the "hard" technical issues are the main improvement drivers. It also developed a maturity scale for SCI.

Wang *et al*. (2008): This paper examines an agent-mediated approach to on-demand e-business supply chain integration. Each agent works as a service broker, exploring individual service decisions as well as interacting with each other for achieving compatibility and coherence among the decisions of all services.

Nagar and Jain (2008): This research develops a multi-period supply chain model for new product launches under uncertainty. The model allows simultaneous determination of optimum procurement quantity, production quantity across the different plants, transportation routes and the outsourcing cost in case of shortages.

Sezen (2008): This study investigates the relative effects of SCI, supply chain information sharing and design on performance. The only significant effects on resource and output performances belong to design of the chain. Integration and information sharing are correlated with performance measures, but their relative effect sizes are lower than chain design.

Van der Vaart and Vandonk (2008): This paper analyses relationship between SCI and performance through a survey-based research approach. Findings show that three categories can be distinguished: attitudes, practices and patterns. This research argues on further research direction based on the aforementioned categories.

Key references of the year 2009

Aktar Demirtas and Ustun (2009): It proposes a two-stage mathematical model to evaluate the suppliers and to determine their periodic shipment allocations given a number of tangible and intangible criteria. It employed analytic network process and Archimedean goal programming modeling approaches.

Chen, Daugherty, and Roath (2009): It discusses the ambiguity associated with SCI. To clarify it addresses internal and external process integration. The research emphasized the importance of taking a process approach to gain efficiencies rather than viewing functional areas and departments in isolation.

Eltantawy *et al*. (2009): The empirical results of this study suggest strategic skills and perceived status are essential antecedents to SCI and subsequent performance. Further, the relationship between strategic skills and performance is mediated by SCI.

Forslund and Jonsson (2009): Through an empirical approach it identifies relationship and operational obstacles as main hinders of SCI. Studies relationship obstacles are: lack of trust, different goals and priorities and lack of parallel communication structure. Operational obstacles: manual performance data management and non-standardized performance metrics.

Jr *et al*. (2009): The study finds that firms with a desire to improve, operating in a challenging competitive environment typically experience high levels of performance. Further, barriers to SCI can actually increase the firm's ability to achieve firm performance as the firm is required to make greater efforts to overcome those barriers and develop effective linkages.

Kim (2009): It looks into linkages among SCM practice, competition capability, the level of SCI, and firm performance. Through a case study approach it shows that efficient SCI may play more critical role for sustainable SCM competitiveness, while, in Japanese firms, the close interrelationship between the level of SCM practices and competition capability may have more significant effect on SCM competitiveness.

Mohammadi Bidhandi *et al*. (2009): It proposes a mixed integer linear programming model and solution algorithm for solving supply chain design problems in deterministic, multi-commodity, single-period contexts. The model integrates location and capacity choices for suppliers, plants and ware- houses selection, product range assignment and production flows.

Villena, Gomez-mejia, and Revilla (2009): This research argues and empirically confirms the notion that an employment and compensation system that increases executives risk bearing reduces willingness to make risky decisions and thus discourages supply SCI.

Yao and Liu (2009): This research focuses on the contradictions between scale production, customized demand, and mass customization. A dynamic and multi-objective optimization mathematical model and the appropriate solving algorithm are set up by introducing these relieving methods into the operating process.

Key references of the year 2010

Asif, Fisscher, Bruijn, and Pagell (2010): This study focuses on how the integration process unfolds in practice to give rise to a number of socio-technical changes essential to the integration of management systems. It reveals that integration streamlines operational processes through a number of structural, functional, and operational changes. Integration reforms bureaucratic structures, further giving rise to operational excellence and strategic flexibility.

Flynn *et al*., (2010): They study the relationship between dimensions of SCI, operational and business performance, from both a contingency and a configuration perspective. They use a hierarchical regression to determine the impact of individual SCI dimensions (customer, supplier and internal integration) and their interactions on performance. Results indicated that internal and customer integration are more strongly related to improving performance than supplier integration.

Hong *et al*. (2010): The purpose of this research is to examine the use of supply chain information technologies for e-commerce, e-procurement, and enterprise resource planning, when implementing lean practices to achieve mass customization performance. It explores SCI e-technologies to achieve mass customization. The findings suggest that lean practices can reasonably predict mass customization performance whereas ERP doesn’t.

Jayaram and Tan (2010): This study uses the support of extant theory to propose that there are significant differences in the postures of firms that include logistics providers in their supply chain management efforts versus those that do not. It identifies four SCM constructs as being important factors in predicting firm performance: information integration, 3PL selection criteria, performance evaluation, and relationship building.

Lau, Yam, and Tang (2010): It examines the relationship between SCI and modular product design, as well as their impact on product performance. By surveying 251 manufacturers in Hong Kong, structural equation modelling is in this study used to test the research constructs and the hypothesized model. The results confirm that information sharing, product co-development and organizational coordination are crucial organizational processes within SCI.

Lau *et al*. (2010): This research explores the relationship between product modularity and SCI. Findings of this paper increase the understanding of the dynamics of modular product design and supply chain management. The paper also explores four contingency factors affecting the relationship.

Lockstrom *et al*. (2010): This research identifies factors that facilitate and inhibit upstream aspects of SCI. The results indicate that buyer-side leadership is an important antecedent for building motivation, trust, and commitment among suppliers and for shaping their mindsets. This, in turn, facilitates strategic alignment and enables suppliers to build collaborative capabilities, which are finally shown to be a key enabler for successful supplier integration.

Mendes Primo (2010): It studies the role of integration mechanisms to enhance interaction and collaboration in the firm’s chain, especially in the buyer-supplier interface. Findings suggest internal integration between purchasing and manufacturing groups plays a significant role in supplier collaboration. Customer integration is more important to address supply problems for contract manufacturers than for original equipment manufacturing firms

Wang and Chan (2010): This study presents two cases in the textile industry to exemplify how the focal firms make use of virtual organization approach to integrate their activities in order to balance the demand from market side and supply from the manufacturing side. After the integration, the responsiveness of the supply chains has improved, and flexibility in response to the market demand is satisfactory.

Key references of the year 2011

Danese and Romano (2011): This research investigates whether there are synergies that a firm could or should exploit by simultaneously implementing customer and supplier integration. It analyzes data from a sample of 200 manufacturing plants. This study reveals that supplier integration positively moderates the relationship between customer integration and efficiency, whereas its analyses do not support the hypothesis that in general customer integration positively impacts on efficiency. It also shows that when supplier integration is at a low level, customer integration can even make efficiency worse.

Lam and Ip (2011): This study proposes a customer satisfaction inventory (CSI) model that incorporates customer relationship management into an inventory model, where the probabilistic concepts of Markov chains of uncertainties in customer relationships of retention or migration are adopted. They argue that the proposed model enables to determine both a CSI level for replenishing the inventory level to best fit future customer demand and a customer CSI value of the net profit or loss of an organization from a customer over its purchasing life against the inventory cost of an organization.

McCarthy-Byrne and Mentzer (2011): It expands models of integration by developing and testing a multi-dimensional theory of SCM value integration that explains the relationships between resource dependency theory, resource-based view of the firm, and relational exchange theory.

Mondragon *et al*. (2011): This paper identifies the level of existing integration between parties, as this has been associated with performance. It proposes a set of measures for auditing purposes to provide an overall picture of the performance of a closed-loop supply chain by revealing high levels of stock for the products analyzed, consequence of the difficulty to generate accurate forecasts and the accumulation of high quantities of product prior to launch.

Saeed, Malhotra, and Grover (2011): They develop a conceptualization of inter-organizational systems characteristics. They also empirically examine their proposed configuration choices made by firms with different SCI profiles. Their results support the notion that successful firms sequence the configuration of inter-organizational systems characteristics toward effectively developing and supporting their supply chain process capabilities.

Wilhelm (2011): This paper explores the interplay of the supplier–supplier and network of analysis by focusing on the inherent tension between cooperation and competition, using a multiple case study design in the Japanese and German automobile industries. It argues that the buyer is able to exert influence not only on the coopetition level but also in the coopetitive tension in the overall network.

Wong, Boon-itt, and Wong (2011): They build and empirically test a theoretical model of the contingency effects of environmental uncertainty on the relationships between three dimensions of

SCI four dimensions of operational performance. They argue that under high uncertainty, the associations between supplier/customer integration, and delivery and flexibility performance, and those between internal integration, and product quality and production cost, will be strengthened.

Key references of the year 2012

Cheung, Cheung, and Kwok (2012): This paper presents a Knowledge-based Customization System for SCI which is developed based on three core technologies: visualization of topologies, network analysis, and knowledge-based system so as to obtain quantified actionable information and formulate configuration strategies for long term success.

Droge, Vickery, and Jacobs (2012): This study investigates the role of SCI in mediating the effects of product and process modularity strategies on service performance. The results demonstrate that customer integration mediates the linkages from product modularity and process modularity to delivery performance, as well as mediating the relationship between process modularity and support performance. In contrast, supplier integration mediates the relationship between process modularity and delivery performance only.

Efendigil and Önüt (2012): This paper proposes a methodology for SCI from customers to suppliers through warehouses, retailers, and plants via both adaptive network based fuzzy inference system and artificial neural networks approaches. The methodology is to find the requested supplier capacities using the demand and order lead time information across the whole chain in an uncertain environment. It also does sensitivity analysis by comparing the obtained results with the traditional statistical techniques. The applicability of this approach was examined in an electronics company in Turkey.

Gimenez, Van der Vaart, and Donk (2012): This research investigates the effectiveness of SCI in different contexts. This study uses a survey-based research design to measure dimensions of integration and complexity in SCM. It shows that SCI increases performance if supply complexity is high, while a very limited or no influence can be detected in case of low supply complexity.

Guan and Rehme (2012): This study finds that the most important driving factors of manufacturer's to vertical integration are the demands of large retail chains and the manufacturer's decisions to focus on developing its positioning strategy in the chain. Vertical integration has transformed the manufacturer into a supplier to large timber products resellers, offering the firm a greater potential to provide integrated solutions and, therefore, become a strategic partner to its customers.

He and Lai (2012): This study builds a conceptual model to describe the relationships among operational integration and strategic integration, product-based and customer action-based service provided by industrial manufacturers, and firm performance. It shows that operational perspective on SCI has positive direct effect on product-based service, while strategic perspective has positive direct effect on customer action-based service.

Huo (2012): This study uses data collected from 617 companies in China and the structural equation modelling method, the research investigates the relationships among internal integration, customer integration, supplier integration, supplier-oriented performance, customer-oriented performance, and financial performance from the perspective of organizational capability. Results of this study show that internal integration improves external integration and that internal and external integration directly and indirectly enhance company performance.

Liu *et al*. (2012): This paper proposes a hub-and-spoke model to integrate green marketing and sustainable SCM from six dimensions: product, promotion, planning, process, people and project. Empirical results of this research show that multi-dimensional integration has been in practice in industries, this is particularly true in large companies. It also put forwards various corresponding strategies for the product-, promotion-, planning-, process-, people- and project-based integration.

Näslund and Hulthen (2012): This paper studies various aspects of integration in order to structure and define the concept of SCI. They realized that there is limited empirical research discussing SCI and there is a lack of empirical evidence supporting the claimed benefits, especially beyond the relationship level. There is also a lack of detailed frameworks and concrete recommendations for how chains can become more integrated. It points out there is significant confusion regarding the term SCI and thus the paper proposes a definition of SCI.

Prajogo and Olhager (2012): This research investigates the integrations of both information and material flows between partners and their effect on operational performance. It concludes that logistics integration has a significant effect on operations performance. Information technology capabilities and information sharing both have significant effects on logistics integration

Terjesen, Patel, and Sanders (2012): This study proposes a differentiation-integration duality and contingency theory to suggest that manufacturing firms should seek to achieve both integration through supply chain coordination activities and differentiation through modularity-based manufacturing practices.

Overall discussion

The initial challenge in reaching a comprehensive SCI is the lack of clear definition for it. This challenge is pointed out in the literature (e.g. Bozarth *et al*., 2009; Fawcett and Magnan, 2002b; Gligor and Holcomb, 2012; Yeung *et al*., 2009) but an appropriate action has not been taken. SCI definition depends on the way SCM is defined. Available SCM definitions (dominant definitions are presented in table 2.1) are inclusive but not exclusive. In other words, most definitions are broad enough to embrace SCM related issues but not appropriately strict to set boundaries clarify the scope of it. Such loose definitions have resulted in confusions in SCI. Therefore, researchers frequently state that their works throw light on some aspects of SCI, yet there is no consensus on what are all aspects of SCI. The lack of integration may result in poor performance. Ramdas and Spekman (2000) found consequences of lack of integration as: inaccurate forecasts, low capacity utilization, excessive inventory, inadequate customer service, inventory turns, inventory costs, time to market, order fulfillment response, quality, customer focus and customer satisfaction. Here we should emphasize that as Chiu and Okudan (2011) found, truly implementation of different aspects of integration need to be initiated from the design phase.

SCM and the associated idea of seamless integration is such dominantly discussed in the literature that one of the often-stated beliefs is that companies no longer compete but that supply chains or supply networks do (Christopher, 2000; Mentzer *et al*., 2001; Moore, Bruce, and Birtwistle, 2012). This notion may make sense for some chains, such as the automotive industry where all different partners in a chain are attuned. It is due to the fact that in such specific context, one often encounters supplying plants that deliver all production to one final assembly automotive line. In addition, it makes competition in the automotive industry. In contrast, in some other industries, suppliers deliver to different (probably competing) companies and have to balance their capacity to be able to deliver to different customers.

Most supply chains are not totally owned by the same company. In contrast, they are network of variety of companies with different core expertise which are benefiting from the product or service of one another. It causes lack of visibility which is required in both vertical and functional integration. Some researchers (e.g. Dawes, Cresswell, and Pardo, 2009) address this problem as lack of trust and since trust influences how culture, values, and personal and organizational relations influence the processes and outcomes of knowledge sharing. It is necessary in the face of the dynamic risks and interdependence inherent in information sharing. Although lack of trust might be a reason but we believe it is mostly rooted in lack of reliability in information security. Value adding activities in a chain are often triggered by information flows such as demand, inventory status, order fulfillment, product and process design changes and capacity status. Even some researchers look at information flow as the bonding agent between material flow and financial flow (e.g. Tang and Nurmaya Musa, 2011). Therefore, issues such as information accuracy, information system security and disruption, intellectual property and information outsourcing risk are critical in establishing trust and having healthy flow of information among chain partners.

Review of literature associated with vertical integration (Braunscheidel, Suresh, and Boisner, 2010; Guan and Rehme, 2012; Jayaram and Tan, 2010; Rothaermel *et al*., 2006; Vijayasarathy, 2010) reveals that it is not limited to altering industry structure and minimizing cost which are its traditionally accepted explanation. Most important driving forces toward vertical integration are the demands of large retail chains and the manufacturer's decisions to focus on developing its positioning strategy (through preventing bullwhip effect and establishing network of suppliers and retailers) (see also Guan and Rehme, 2012). Vertical integration has transformed the manufacturing firms into a supplier to large timber products resellers, offering the firm a greater potential to provide integrated solutions and, therefore, become a strategic partner to its customers. Report of fail stories and causes of failures put forwards a realistic picture of SCI covering its contributions and pitfalls.

A misleading fact in the literature is that it commonly reports success stories while failures are rarely reflected. One of the few is the study by Osegowitsch and Madhok (2003) which reports some cases of vertical integration and indicate that explanations such as market power, monopoly profit, and transaction cost are increasingly seen as insufficient to explain vertical integrations strategies, especially for those companies that move down to the customer interface. Another report by Jr *et al*. (2009) reflect upon both vertical and functional integration failures in terms of internal and external failures. They argue that especially internal failure is the major barrier to SCI. Internal failure refers lack of an effective planning mechanism that facilitates the synergy of business processes. Their findings show implementation of SCI requires comprehensive internal planning and external monitoring.

Mass customization as a practical approach toward SCI is advocated in the literature (see Bask *et al*., 2011; Cheung *et al*., 2012; Hong *et al*., 2010a, 2010b; Lai *et al*., 2012; Liu *et al*., 2006; Svensson and Barfod, 2002). Achieving mass customization is a multi-disciplinary effort that requires experts from different areas to act adequately and in cooperative manner to resemble a unified body. Although the positive influence of mass customization is known, however presence of practical barriers hinder firm from its benefits. Different disciplines have their specific perspective of observing procedures and they suffer from lack of common qualitative and quantitative units. For instance, monitoring units used in quality check, finance, logistics, and production planning are incompatible. Such barriers have less to do with manufacturing machinery and more to do with the planning in management level. In addition, mass customization environment increases uncertainty in terms of demand and supply uncertainties as well as scheduling and coordination complexities. Mass customization is a response to heterogeneous demand in most industries. Meanwhile it is challenging to match internal procedure with it. In addition, it requires extended network of suppliers which leads to higher uncertainty in forecasting demand of each type of component. The inevitable prerequisite of mass customization is a well defined information system which connects up stream suppliers and downstream retailers with effective information processing capabilities.

There are theoretical studies on application of electronic and virtual integration methods to approach SCI (e.g. Gunasekaran, Lai, and Edwincheng, 2008; Saeed *et al*., 2011; Terjesen *et al*., 2012; Wang and Chan, 2010; Zook and Shelton, 2012). However, the majority of such methods are concentrated on performance measures and little research is conducted to move toward vertical integration. Critical issues such level and direction of integration, dyadic relations, and resilient methods to sustain against disturbances are elements of vertical integration which are missing when the scope of research is limited to performance measures. In addition, when it comes to performance measures, as it is also argued by Mondragon *et al*. (2011), SCM experts face a barrier if there is a shortage of relevant measures. Several researchers have come across different framework and approaches for SCM performance measures (e.g. Angerhofer and Angelides, 2006; Sambasivan, Nandan, and Mohamed, 2009). But a lot of proposed measures are too general and they lack customizable components. This fact is also pointed out by Gunasekaran *et al*. (2004) that performance measurement and metrics pertaining to SCM are generally discussed in the literature but a few practical examples are reported.

The ability to effectively and efficiently make strategic decisions is critical in the development of SCI. According to Lambert and Cooper (2000) and Kanda and Deshmukh (2008) there seems to be a general lack of managerial ability to determine level of integration and consequently integrate the intricate network of business relationships among chain partners. Lack of indicators for level and direction of vertical integration may lead to putting functions in competition with each other which certainly harm SCI.

Although deterministic approaches such as linear and integer programming or mixed integer programming, etc., are reliable in understanding well-defined supply chains, which involve few decision variables and restrictive assumptions. However modeling complex environments such as SCM requires involving uncertainty and benefiting from implicit experts knowledge; therefore, stochastic approaches suit more for this context. Another modeling approach is agent-based modeling in which interacting players can be modeled as the agents who negotiate with its immediate pushing/pulling a part or product through the chain. It can effective in SCM context due to the large number of individuals interact with each other using specific internal decision structures. There is a lack of strong academic work on agent-based modeling in SCM however some researchers (e.g. (Amini *et al*., 2012; Giannakis and Louis, 2011; Panchal and Jain, 2011) have recommended it.

The majority of empirical SCI studies seem to be either single case (e.g. Du, 2007; Ho *et al*., 2007; Smith, 2012) or survey-based research (e.g. Bagchi *et al*., 2005; Vandervaart and Vandonk, 2008); they are limited in terms of customization and generalization potentials so that further works can be built upon their findings. Another downside to such approaches is the open and uncontrolled environment in which they take place. This eliminates their usefulness as an indicator of cause and effect since the variables in the study are uncontrolled. This makes it too difficult or presumptuous to state that one value correlates in any way to another.

Without effective SCI, error and mistakes transform along among chain partners. However, SCI mistake proofs the chain through real time sharing information (see Hsien-Jen, 2012; Serdarasan and Tanyas, 2012; Vallejo, Romero, and Molina, 2012). Mistake-proofing falls into the next three categories: physical, operational, and philosophical to prevent errors and deviations from the standard. Preventing human mistakes in different decision making and operational levels takes place in comprehensive SCI.

2.7 Conclusion

This chapter was dedicated to review literature in context of research question and methods which will be used to answer those questions. It reviewed related topics in the area of supply chain integration; more specifically in the section 2.6 a comprehensive table of exploring findings of key references was presented. In doing so, it identified gaps and missing points in the literature and position the dissertation to address those gaps. In addition, theoretical background related to Bayesian network and analytic network process, were provided; they will serve as tools to answer research questions. The following chapter discusses the methodology through which research questions will be answered and objectives will be accomplished.

3 Research Methodology

The previous chapter presented state of the art on supply chain integration as well as integration models and the two methods (BN and ANP) which are used to develop the integration model. The current chapter discusses the methodology which is perused to answer research questions and achieve expected output. Since the objective is to build theory through survey and case studies, an inductive approach is followed. Thereafter data collection, sample size determination, data analysis, survey and case studies are discussed.

3.1 Methodology selection

3.1.1 Inductive and deductive approaches

In general there are two methodologies in conducting research: inductive and deductive approaches. Deductive approach starts from the more general to move in the direction of the more specific. It can also be a top-down approach. Deductive approach begins with thinking up a theory then narrow it down into more specific testable hypotheses. Then comes data collection and observations to address the hypotheses. This ultimately leads to test the hypotheses with specific data as confirmation of the original theories. An example for deductive approach can be seen in this statement: reduction of work in process (as a practice) decrease the manufacturing cost of products. Therefore, if one company reduces its work in process, it will be able to reduce manufacturing cost. In contrast, the inductive methodology is a bottom-up approach. It moves from observations to broader generalizations and theories (figure 3.1). Inductive approach begins with observations and measures to detect patterns and regularities and formulate some hypotheses that we can explore, and finally end up developing some general conclusions or theories (Tracy, 2012). Due to the fact that inductive approach is rooted on experiments, it is widely used in science. However, it is not always logically valid because it is not always accurate to assume that a general principle is correct. In the example above, perhaps reduction of work in process in some contexts can lead to reduction of cost but some scenarios can be also imagined that production cost is not influences by it. By nature, inductive approach is more open-ended and exploratory. This approach evolves based on observations, experiments, and case studies thus it allows potentials for further researches to expand its coverage.

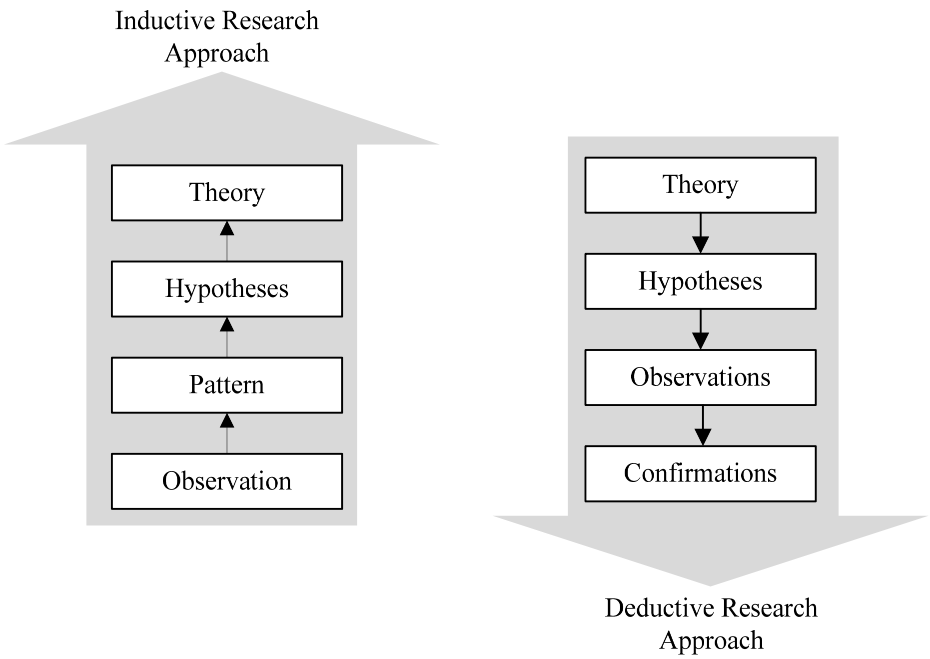


Figure 3.1 Inductive and deductive research approaches

3.1.2 Theory building and case study

Building theory from case studies is a research strategy that involves using one or more cases to create theoretical constructs, propositions and/or midrange theory from case-based, empirical evidence. A Case is an empirical inquiry focusing on describing, understanding, predicting, and/or controlling the individual process, person, equipment, organization, group, industry. A substantial portion of research in industry related fields focuses on decisions and behaviors of individual and groups within and between organizations. In order to do so, the most frequent methodology is case study which involves sending questionnaires to relevant experts in firms. Each case serves as a distinct experiment that stands on its own as an analytic unit (Woodside and Wilson, 2003).

A major reason for the popularity and relevance of theory building from case studies is that it is one of the best (if not the best) of the bridges from rich qualitative evidence to mainstream deductive research. Its emphasis on developing constructs, measures, and testable theoretical propositions makes inductive case research consistent with the emphasis on testable theory within mainstream deductive research (table 3.1). The theory is emergent in the sense that it is situated in and developed by recognizing patterns of relationships among constructs within and across cases and their underlying logical arguments (Eisenhardt and Graebner, 2007).

In the current research theory building through employment of case studies is selected as the appropriate methodology. Two case studies are used. They get inputs from a survey which is dedicated to data collection and analysis of the data about customer values. The two case studies follow the proposed approach to develop integration model.

Table 3.1 Match research strategy with theory-building activities – Adapted from Handfield (1998)

Purpose	Research question	Research structure
Discovery: Uncover areas for research and theory development	What is going on here?	In-depth case studies
	Is there something interesting enough to justify research?	Unfocused, longitudinal field study
Description: Explore territory	What is there?	In-depth case studies
	What are the key issues?	Unfocused, longitudinal field study
	What is happening?	
Mapping: Identify/describe key variables	What are the key variables?	Few focused case studies
	What are the salient/critical themes, patterns, categories?	In-depth field studies
		Multi-site case studies
		Best-in-class case studies
Relationship Building: identify the linkages between variables	What are the patterns or linkages between variables?	Few focused case studies
	Can an order in the relationships be identified?	In-depth field studies
	Why should these relationships exist?	Multi-site case studies
		Best-in-class case studies
Theory Validation: Test previously developed theories, predict future outcomes	Are the theories we have generated able to survive the test of empirical data?	Experiment
	Did we get the behavior that was predicted by the theory or did we observe another unanticipated behavior?	Large scale sample of population

3.2 Data collection

The data collection phase contains two streams. On the first stream, data about customer value is collected from end customers. Since the collected data will be data mined using probabilistic methods therefore the volume of the data should be larger than a threshold. The threshold is calculated in the next section. On the other stream, comparative data about SCM practices is required. This data is collected through interviews with experts. Both stream of data collection employ comparative approach in collecting data (figure 3.2). In the first stream each pair of customer values are compared and in the other stream SCM expert compares pairs of practices. The point which connects these two streams is experts do their comparison with respect to customer values. For instance the expert compares practice A and B with respect to customer value C whereas customer value C was already compared by other customer values by the customer.

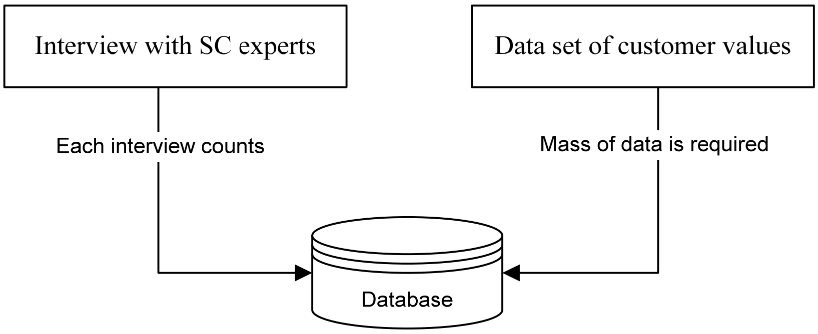


Figure 3.2 Data collection in two streams

Comparative analysis approaches prevent subjectivities to considerable extent. Subjectivity in qualitative data collection methodology is not a new phenomenon nor is it one which has not been investigated before. Apparently, subjectivity varies from person to person. However, the negative influence of this phenomenon harms the research in case respondents are expected to give their preferences in the absence of any criteria. In this case individual experiences will be strongly involved in the judgments procedure. Comparative approaches prevent subjectivity by giving one or more criterion in the comparison procedure. Respondents are not only giving their preferences, but actually they present their expertise in the lights of specific criterion (Smith *et al.*, 2008).

3.3 Sample size determination

Sample size determination is the act of choosing the number of observations or replicates to include in a statistical sample. The sample size is an important feature of any empirical study in which the goal is to make inferences about a population from a sample. Determining sample size is a very important issue because samples that are too large may waste time, resources and money, while samples that are too small may lead to inaccurate results. From statistical perspective the minimum sample size should be accurately identified so that statistical methods are applicable to draw inference from collected data. Sample size is influenced by a number of factors, including the purpose of the study, population size, the risk of selecting a bad sample, and the allowable sampling error. In this model we use interval variables formula (2) which is using confidence intervals to calculate the sample size. Confidence interval is a type of interval estimate of a population parameter and is used to indicate the reliability of an estimate (Almukkahal *et al.*, 2011). More specifically, if confidence intervals are constructed across many separate data analyses of repeated (and possibly different) experiments, the proportion of such intervals that contain the true value of the parameter will match the confidence level.

$$n = \frac{Z^2 \sigma^2}{d^2} \qquad (2)$$

In which for 0.05 level $Z = 1.65$, and σ is the ratio of standard deviation to mean. To estimate σ a small sample of 20 was considered accordingly the mean and standard deviation of the variables were found as M=10.98 and SD=3.70 which gives $\sigma = 0.337$. Thereafter, taking the error as $d = 0.05$, we get the sample size:

$$n = \frac{1.65^2 \times 0.337^2}{0.05^2} \approx 124$$

A sample size of minimum 124 responses for end customer is required so that the statistical analysis is significant.

3.4 Analysis

Two methods are used in data analysis and model development. Bayesian Network (BN) is used to data mine customer value also to build the integration model and Analytic Network Process (ANP) is used quantify expert opinions about SCM practices. BN is a strong tool especially when it comes to identifying mutual influences between variables. ANP also shows its strength when the objective is to quantify tacit knowledge and conduct a comparative analysis. Both BN and ANP are used in the procedure of model development however the final model is a BN (figure 3.3).

Input data to both BN and ANP are comparative data. BN gets pairwise analysis of customer values done by end customers as inputs. As it was calculated in the section 3.3 the minimum size of dataset is 124. The input to ANP is pairwise comparison of supply chain practices which is done by supply chain expert. These two analyses methods meet in the integration model which is managed by BN.

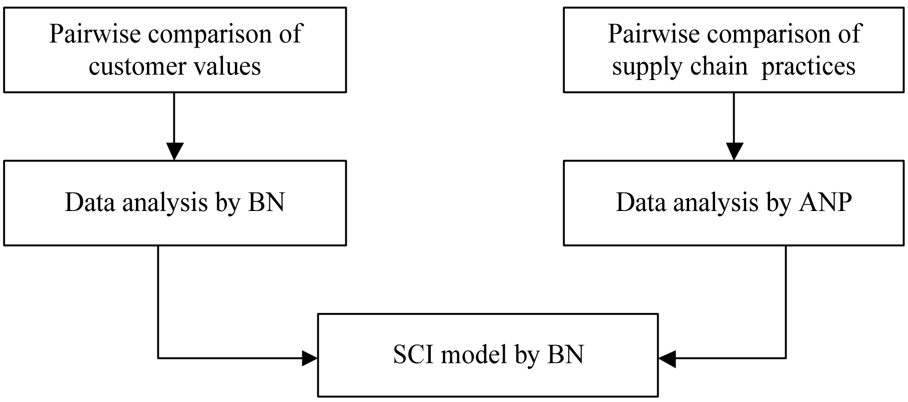


Figure 3.3 Data analysis methods

3.5 Survey and Case studies

The survey presents collected data and analysis of the data using Friedman test and BN. It makes inputs for the two case studies which are dedicated to development of SCI model for fashion and food industries. In each of these two case studies a number of relevant SCM practices are selected and their importance level is analyzed through interview with experts (figure 3.4). As a result of the case studies

SCI model is developed and a scenario is tested in that industry. In order to ensure the output of model meets real world setting, outcomes are verified by experts. Table 3.2 presents general information about the case companies.

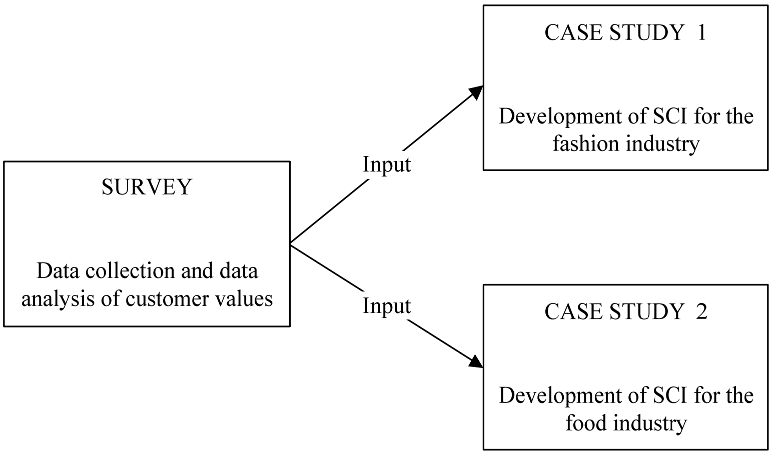


Figure 3.4 Relations between survey and case studies

Table 3.2 General info about case companies

	Company name	Position of the interviewee	Country	Industry sector
Case study 1	Upward Unlimited	Supply Chain Specialist	USA	Fashion industry
Case study 2	Sopplan	Director	New Zealand	Food industry

3.6 Case study quality and limitations

Case study research is a research methodology in its own right. When applied to theory building, case study research is a research method and not by itself a theory-building methodology (Dooley, 2002). However, well structured case studies provide practical (context-dependent) knowledge that can contribute to development of theory. Case studies are planned to validate the proposed model. According to Stuart *et al*. (2002) a method is considered valid if it measures what it intends to measure. In the current research, outputs are double checked with experts to ensure they are beneficial and valid for the studied case. Figure 3.5 presents the purpose and limitations of the survey and case studies. Since the survey is dedicated to data collections and data analysis in order to provide inputs for the case studies, therefore they are divided respectively.

	Purpose	Limitations
Survey	Identify customer values from the literature. Pairwise comparison of the values. Identify correlations between values Identify the most important value in each industry.	Different researchers have identified different customer values. Here we selected the frequently used values. Data analysis can be done on the collected data set. Input data may change over time
Case studies	Develop SCI model for corresponding industry. Identify relations between practices and customer values Conduct a scenario to test the model	Input data is managed based on interview with experts: quantified tacit knowledge There might be some practices which are not introduced in the current model Input data may change over time.

Figure 3.5 Purpose and limitation of case studies

This chapter presented the methodology which is followed to answer research questions and reach objectives. This included data collection methodology, sample size determination, data analysis approach, and case studies. The next section goes through this methodology and digs into its detail in order to propose supply chain integration model.

3.7 Conclusion

The current chapter served the methodology through which research objectives will be accomplished. It included methodology selection, data collection, sample size determination, data analysis, and case studies. The current dissertation follows inductive research approach and theory building through case study. It collects data from end customer through questionnaire and from experts through interviews. Bayesian network is suggested to be used to data mine end customer preferences (customer values) and analytic network process is suggested to withdraw quantitative data from interview with experts (comparative analysis of supply chain practices). The proposed supply chain integration model imports analyzed data and uses Bayesian network to quantitatively present relations between customer values and supply chain practices. One survey and two case studies are managed: the survey goes through analysis of customer values, the case studies import customer value data and develop supply chain integration model for fashion and food industries. The next chapters put forwards details of the proposed conceptual supply chain integration model.

4 Conceptual Model

This chapter introduces the proposed supply chain integration model. It starts with discussion on the presence of randomness and uncertainties in the context of this research. Modeling approaches are presented to handle randomness. It is followed by development of the model in three phases: identifying customer values, interview with experts, and development of the model. One survey and two case studies are planned at the end of this chapter which go through the proposed modeling approach.

4.1 Randomness and uncertainty

Randomness and uncertainty is inherent in most real-world system performances including supply chain. One approach used to understand uncertainty is data mining also referred as knowledge discovery (figure 4.1). Data mining extracts information of nontrivial, previously unknown, and implicit and potential information from available data (Witten and Frank, 2005). Different tools can be used in data mining. For instance Algarni *et al*. (2006) developed an artificial neural network model to predict the failure rate of De Havilland Dash-8 airplane tires. Chen, Tseng, and Wang (2005) defined the root-cause machine set identification problem to analyze correlations between combinations of machines and the defective products. Kumar, Singh, and Singh (2011) used analytic hierarchy process based on fuzzy simulation to deal with supply chain issues. Meena, Sarmah, and Sinha (2012) took suppliers' perspective to identify satisfaction factors in buyer-supplier relationships. Balanced score is another approach which articulates the links between leading inputs, processes, and lagging outcomes and focuses on the importance of managing these components to achieve the organization's strategic priorities (Bullinger, Kühner, and Van Hoof, 2002). For example, Ketchen *et al*. (2008) took resource-based view and examined the links between a higher-order latent construct to label supply chain orientation and four Balanced Scorecard outcomes: customer performance, financial performance, internal process performance, and innovation and learning performance. Balanced scorecard can be employed as a strategic performance management tool but it does not encompass the inherent uncertainty of complex environments (Bhagwat and Sharma, 2007).

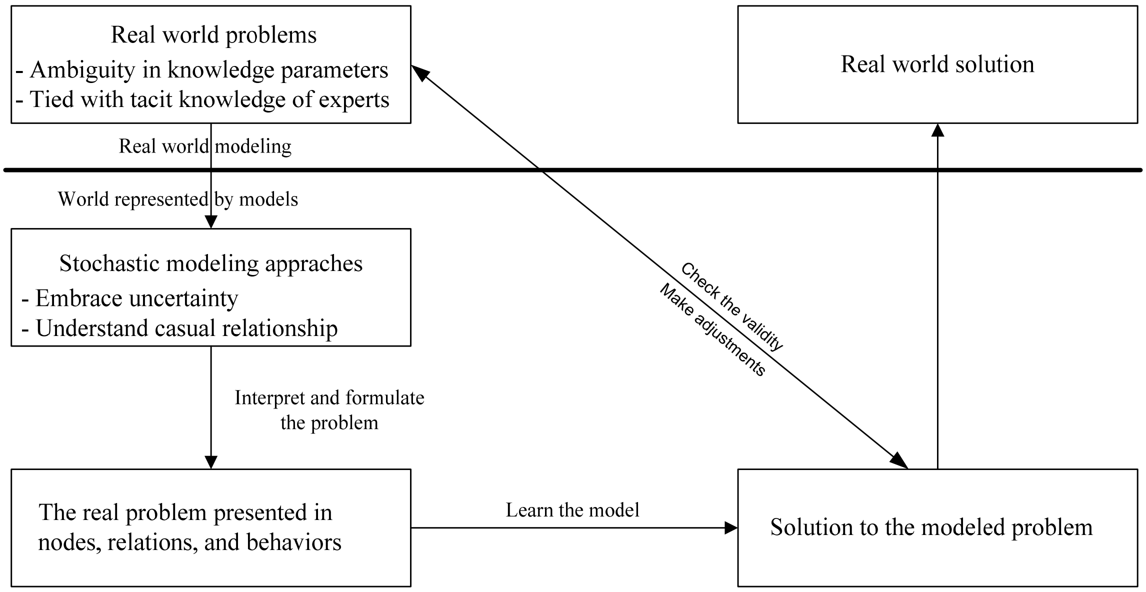


Figure 4.1 Transition of real world problems into models and generation of real world solutions

In this research the attempt is to model real world scenarios and employ the model to produce outcomes which makes sense both in the model and real world. Real world scenarios have complex network with infinite influential factors many of which are ambiguous and not feasible to grasp. Transferring such scenarios into a model makes it possible to control variables resembling the real world system. The type of modeling approach depends on the specifications of the real world problem. In case the nature of variables is probabilistic and there is conditional dependencies among factors, Bayesian network (BN) is recommended as a comprehensive method of indicating relationships and influences of factors in system (Cai *et al*., 2011). In addition, in case it is required to make decision across multiple criteria, ANP is a robust tool. The current research benefits from both BN and ANP. BN is a rigorous tool in data mining large number of data and identifying casual relations and patterns. ANP has the capability to transfer the tacit knowledge into quantities. Therefore, putting together these two put forwards the theoretical foundation of the SCI model.

4.2 Modeling approaches

Two modeling approaches are used in this research: BN and ANP. BN is used to data mine customer value data and identify casual relations and patterns among them. ANP is used on the other side to quantify experts' tacit knowledge about SCM practices. Thereafter, the SCI model is built through taking the inputs of these models and developing another BN (figure 4.2).

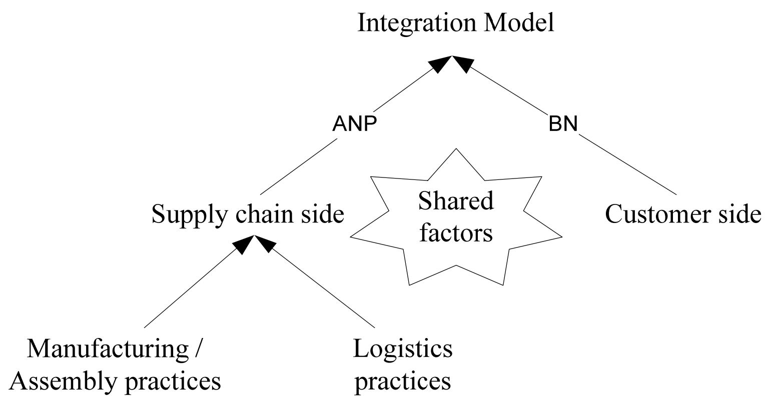


Figure 4.2 Modeling approaches

4.2.1 Bayesian Network

BN is a strong tool in identifying correlations between variables and representing influences of changing one parameter on others nodes of the system. It has been proven as a strong tool in the field of operation management to data mine quantitative data as well as to construct belief network based on experts' tacit knowledge (Gregoriades and Mouskos, 2013; Maleki and Cruz-Machado, 2013a). In addition, BN have given widespread attentions as a method for analyzing and predicting future states based on give current states. Thus, it can represent different situation and scenarios.

In data mining of customer values with BN, the data set is introduced to BN and PC method is used. This method looks into joint probability distributions of elements of dataset to learn the network. Customer values are indentified as: time, quality, cost, customization, know-how, and respect environment. One of the most fundamental properties of variables is their domain, i.e., the set of values that they can assume. While there are infinite numbers of possible domains, they can be divided into two basic classes: discrete and continuous.

Discrete variables describe a finite set of conditions and take values from a finite, usually small, set of states. An example of a discrete variable is application of a specific practice. This variable can take two values: recommended and not recommended. Continuous variables can assume an infinite number of values. An example of a continuous variable is Body temperature, assuming any value between 30 and 45 degrees Celsius. Another might be financial, assuming any monetary value between zero and $50K. While the distinction between discrete and continuous variables is crisp, the distinction between discrete and continuous quantities is rather vague. Many quantities can be represented as both discrete and continuous (Druzdzel, 1999). Discrete variables are usually convenient approximations of real world quantities and sufficient for the purpose of reasoning. Therefore, most BN algorithms are designed for discrete variables.

BN makes managers capable of monitoring the performance of their supply chain (or a particular part of their chain) or / and try different scenarios to ensure the sufficiency of their outcomes before actually implementing them.

The prerequisite of making BN of a supply chain is to define what type of entities should be considered. Since BN is based on probability theory, its entities (represented by nodes) have probabilistic nature. For instance the frequency of production planning that might be once or twice a week will not be considered as an entity. However, the efficiency of production planning which has a probabilistic presentation can be included in the network. Connections among nodes are defined based on the influence among them which is dependent on the context. As an example, efficiency of production planning might be influenced by availability of raw materials. As it has been implied by this example, accuracy of BN is tightly dependent to the understanding of the supply chain so it should be done by someone who knows about the behavior and interactions among entities of the system.

The adjacency size is set higher than the number of nodes (customer values) to enable max amount of neighbor nodes and the significance level is set as 0.05. BN model of customer values will be prepared as a result of this procedure (figure 4.3). Thereafter, SCM practices will be added to this model to track the influential relations between customer values and practices.

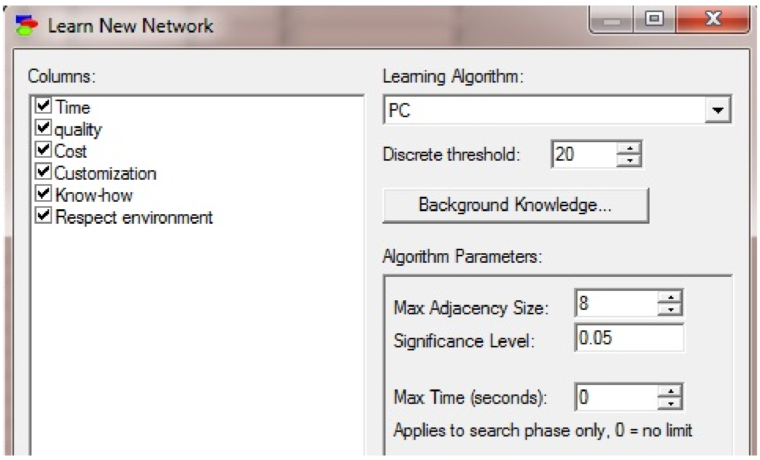


Figure 4.3 Bayesian network learning specifications – Screenshot from GeNie 2.0

4.2.2 Analytic Network Process

AHP includes an assumption about the independence among elements under a hierarchical structure. To solve the independence assumption of the AHP, the ANP was developed by Saaty (2004). ANP has been integrated with different approaches such as linear programming, fuzzy set theory, quality function deployment, and BN. From practical perspective, AHP uses hierarchical structures with a goal at the top, criteria influencing the goal in the next level down, possibly sub-criteria in levels below that and the alternatives of choice at the bottom of the model. Judgments are made on pairs of elements throughout the structure and synthesized to prioritize the alternatives. However, ANP uses network structures that do not have goals or levels; any factors in the model can be linked and influence each other - it is a relative world rather than the top-down world of the AHP. Priorities are established in both AHP and ANP for the factors in the model and they are then synthesized to give the overall priorities for the alternatives of the decision. Often, though not always, the priorities are established by pairwise comparing factors using judgments. The comparison scaled considered in this study is in nine levels where nine is the highest importance (table 4.1 and 4.2).

Table 4.1 Rational numbers and reciprocals of analytic network process – Source: Saaty (2012)

Decimals	**1, 2, 3, . . . , 9**	**For comparing elements that are very close**
Rational numbers	Ratios arising from the scale above that may be greater than 9	Use these ratios to complete the matrix if consistency were to be forced based on an initial set of n numerical values
Reciprocals	If element i has one of the above nonzero numbers assigned to it when compared with element j, then j has the reciprocal value when compared with i	If the judgment is k in the (i, j) position in matrix A, then the judgment 1/k must be entered in the inverse position (j, i).
To compare n elements in pairs construct an n x n pairwise comparison matrix A of judgments expressing dominance. For each pair choose the smaller element serves as the unit and the judgment that expresses how many times more is the dominant element .Reciprocal positions in the matrix are inverses, that is, aij= 1/aji.		

Table 4.2 Scales of the analytic network process – Source: Saaty (2012)

Intensity of importance	**Definition**	**Explanation**
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong importance	Experience and judgment strongly favor one element over another
7	Very strong importance	An activity is favored very strongly over another
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	Used to express intermediate values	

The nine scale comparison is used to compare SCM practices in a pairwise approach. Each pair of practices goes through this comparison to identify their relative importance with respect to others. Table 4.2 presents the definition of each intensity level. It starts with 1 as the equal importance between the two compared practices till 9 as the absolute importance of one practice over another.

ANP part of the model is focused on comparative analysis of practices with respect to customer values. In addition, customer values are also compared pair wisely with respect to the specific industry sector (figure 4.4). In other words, each pair of manufacturing practices (P_{mi}) is compared with others with respect to customer values (CV_n). The same happens to each pair of logistics practices (P_{Lj}) which are compared with each other with respect to customer values (CV_n).

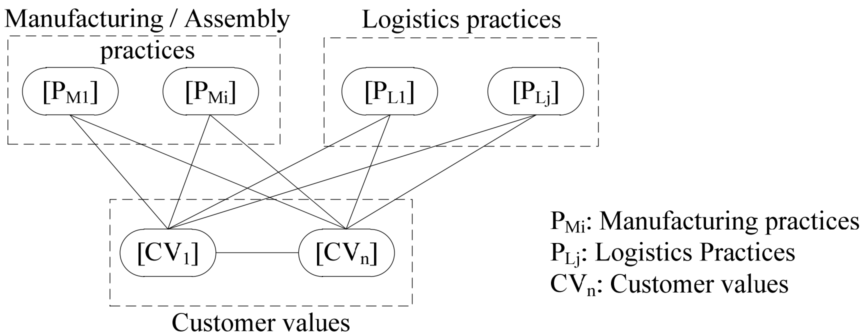


Figure 4.4 Relationships between clusters

4.3 Model development

Development of the SCI model takes place in three phases. Phase 1 focuses on data collection and data mining of customer values. This phase benefits from BN in data mining. The second phase concentrates on interview with experts and prioritization of SCM practices according to interviews with respect to customer values. Customer values have the role of bond between phase one and two. ANP is employed in this phase in order to achieve a quantitative prioritization (figure 4.5). Both phases use pairwise structure in data collection therefore if the number of elements to be compared is I, the total number of possible pairwise comparisons (number of questions) is $I \times (I-1)/2$. Phase three receives inputs from the preceding phases in order to build up the model. In this phase customer values and practices are connected through a BN model.

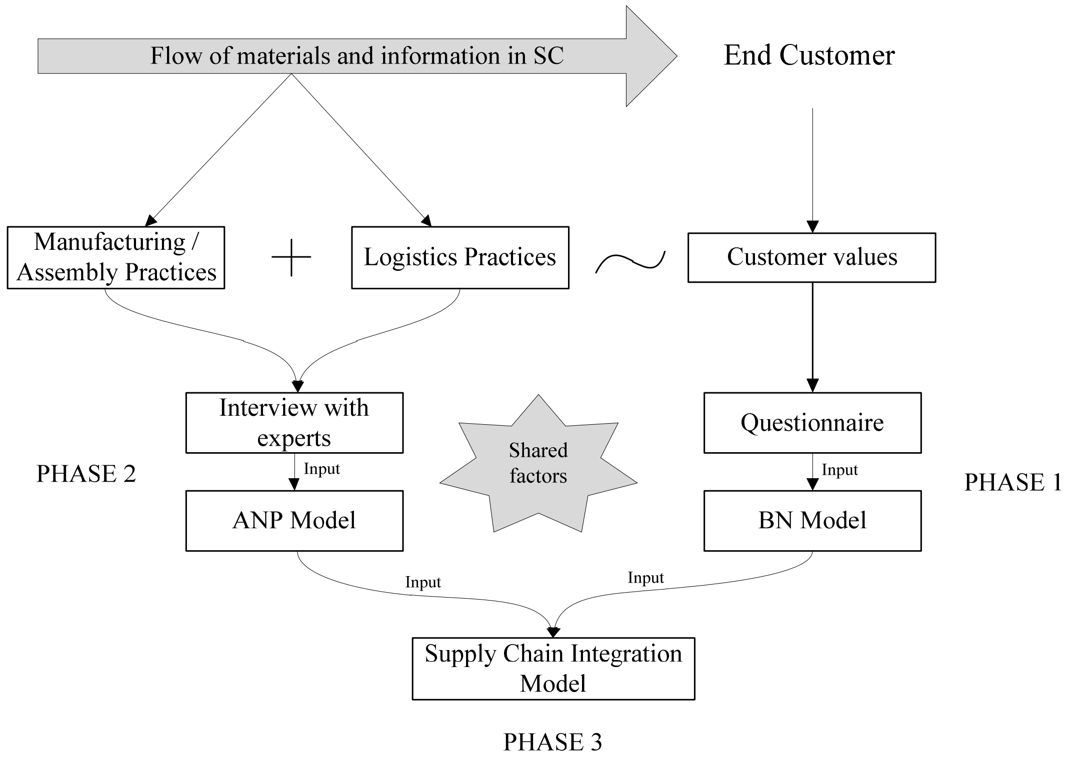


Figure 4.5 Three phase structure to develop the integration model

4.3.1 Phase 1: Customer values

This phase goes through data collection and analysis of customer values. Customer values are identified from the literature and any pair combination of them are considered. Due to the fact that data is collected in a pairwise approach, Friedman test is recommended in data analysis. The Friedman test is a non-parametric test which can test the ordering importance of each factor (Howitt and Cramer, 2010).

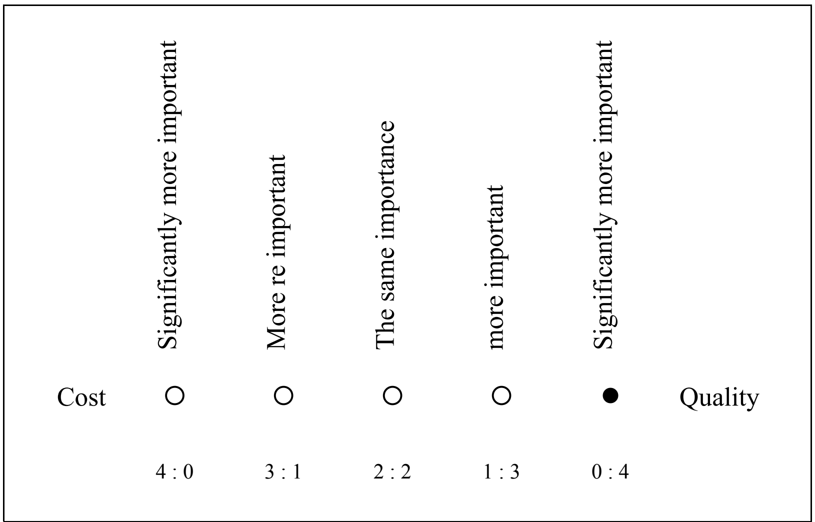
Approaches and paradigms in industrial engineering claim to provide value for the end customer. Marketing scholars also emphasize the need for a better understanding of customer values as a key point to be successful in the market (Flint, Blocker, and Boutin, 2011). Blocker (2011) emphasizes the fact that customer value research in business-to-business markets has been prolific, but notes that most research is restricted to the study of domestic and western markets, and that there is a lack of consensus on how to model customer value. Blocker (2011) develops a conceptual framework for measuring customer value and value drivers in business service relationships which builds upon his earlier work on assessing the impact of proactive customer orientation on value creation (Blocker *et al.*, 2010). Table 4.3 presents a number of identified customer values in the literature.

Table 4.3 Selected research works on customer values

Authors	Main focuses on customer values
Wheel Wright (1984)	Price, quality, dependability, flexibility
Roth and Van Der Velde (1991)	Quality, delivery, flexibility and cost
Lapierre (2000)	Customer perceived value, driving forces, trade-offs among values, price, time
Yang and Peterson (2004)	Price fluctuation
Alam (2006)	Service quality, rapid response
Graf and Maas (2008)	Conceptualized customer perceived value
Kuo, Wu, and Deng (2009)	Quality, visual design, reliability, connection
Worm, Ulaga, and Zitzlsperger (2009)	Customization, recyclable components, cost
Blocker *et al*. (2010)	Quality, personal interactions, service support, general satisfaction
Ulaga (2011)	Modeling, Value perceptions, cultural influences
Blocker (2011)	Quality, personal interactions, service support, know-how, cost
Gallarza *et al*. (2011)	Quality, satisfaction, trade-off approach
Hunt, Geiger-Oneto, and Varca (2012)	Customer behavior, the influence of personal specifications, satisfaction measures

Wheel Wright (1984) adopts the company perspective and identifies customer values as price (cost), quality, dependability and flexibility. Taking the same perspective Roth and Van Der Velde (1991) identify four factors in their research, namely quality, delivery, flexibility and cost. The current research categorizes customer value into six factors taken from the literature, namely Time (Droge, Jayaram, and Vickery, 2004), Quality (Blocker *et al*., 2010), Cost (Whicker *et al*., 2009), Customization (Bask *et al*., 2011), Know-how (Tseng, 2012), and Respect for the environment (Dibrell, Craig, and Hansen, 2011).

Customer value data is collected through an innovatively designed questionnaire in which pairwise comparisons among customer values are investigated. Five different states are given to the respondent to select according to his / her preferences. As the respondent picks one state two digits will be stored. For example, in case if quality is much more important than cost to the respondent then quality receives a score of 4 and cost receives score of 0 that are stored in the database (figure 4.6). In the figure 4.6 the closest importance level to each side of comparison is “significantly more important”, after that there is “more important”, then there is “the same importance” in the middle. Therefore, this figure should be read by starting from the customer value which is closer to the bullet.



In order to read this figure, start from the customer value which is closer to the bullet.

Example: if the respondent selects “Quality is significantly more important than Cost” then Quality will receive a score of 4 and Cost will receive a score of 0.

Figure 4.6 The customer value questionnaire design

4.3.2 Phase 2: Interview with experts

Interviews are conducted with SCM experts who satisfy two criteria: interviewee should have practical knowledge about SCM practices; and should be in touch with marketing departments to have sufficient knowledge about customer expectations. Since one of the case companies is in the USA (case study1) and the other one is located in New Zealand (case study 2), interviews were conducted through video conference meetings and data was exchanged through e-mails. However, in order to make sure geographical barriers don’t harm the research, experts were kept posted about the progress of the research (figure 4.7). Interview data resulted in development of case studies which are presented in the section 5.2 and 5.3. Each interviewee received different phases of the case study to ensure that the output presents real case scenarios. Case companies and interviewees are introduced in the section 4.4.2 and 4.4.3.

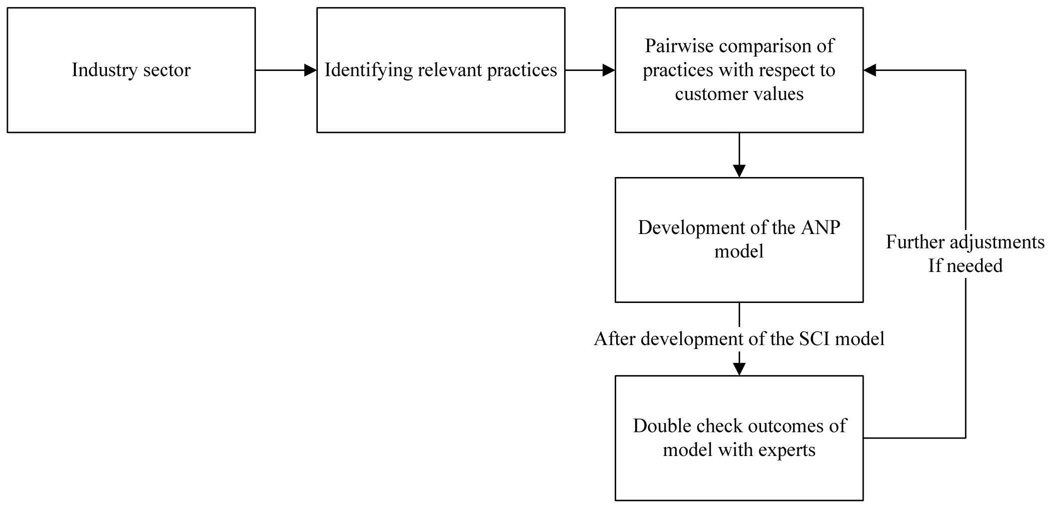


Figure 4.7 Procedure of interviews

4.3.3 Phase 3: Development of the conceptual model

The third phase takes inputs from previous phases into a BN model to identify relations between SCM practiced and customer values. Figure 4.8 illustrates the framework through which the conceptual model is developed. This model provides quantitative output which can lead to visual output through BN platforms. In addition, the potential of doing sensitivity analysis and planning scenarios in the BN model, makes it a strong decision making tool. It works in both directions from SCM practices to customer values and vice versa. In other words, the model gives quantitative outputs to questions such as: if we implement one specific practice, how does it contribute to the customer values? Or, if the aim to contribute to one specific customer value, which SCM practices should be implemented? Consequently, the output of the model is limited to the introduced SCM practices and customer values to it.

The conceptual model starts with selecting the corresponding industry which will be the context of the integration model. Then, the customer values (CV_n) of this industry will be identified and comparative data about them will be collected from end customers. Data analysis of customer values will be done using BN to quantify correlations among them. In parallel, interview with experts take place to find out relative importance of manufacturing practices (P_{Mi}) as well as logistics practices (P_{Lj}) in the selected industry sector. ANP is used to calculative priorities and synergies among practices. Comparison among practices goes through pairwise analysis with respect to customer values. Thus, customer values are considered as shared values which put together SCM practices and end customer preferences. SCM practices (from ANP model) will be represented as nodes on the network in BN. Each SCM practices gets two states as "recommended" and "not recommended". The value of each state depends whether or not that node (SCM practice) changes in that node leads to changes in the related CV_n or not. In other words, in case a customer value is positively sensitive to application of a SCM practice, that node gets the state of "recommended". The conceptual model of SCI includes both

SCM practices and customer values presented as nodes of the network. This model which is constructed with BN illustrates relations between SCM practices and customer values. The SCI conceptual model can be used to conduct sensitivity analysis and scenario planning through grounding one (or more) nodes and monitoring the influence on the rest of the network.

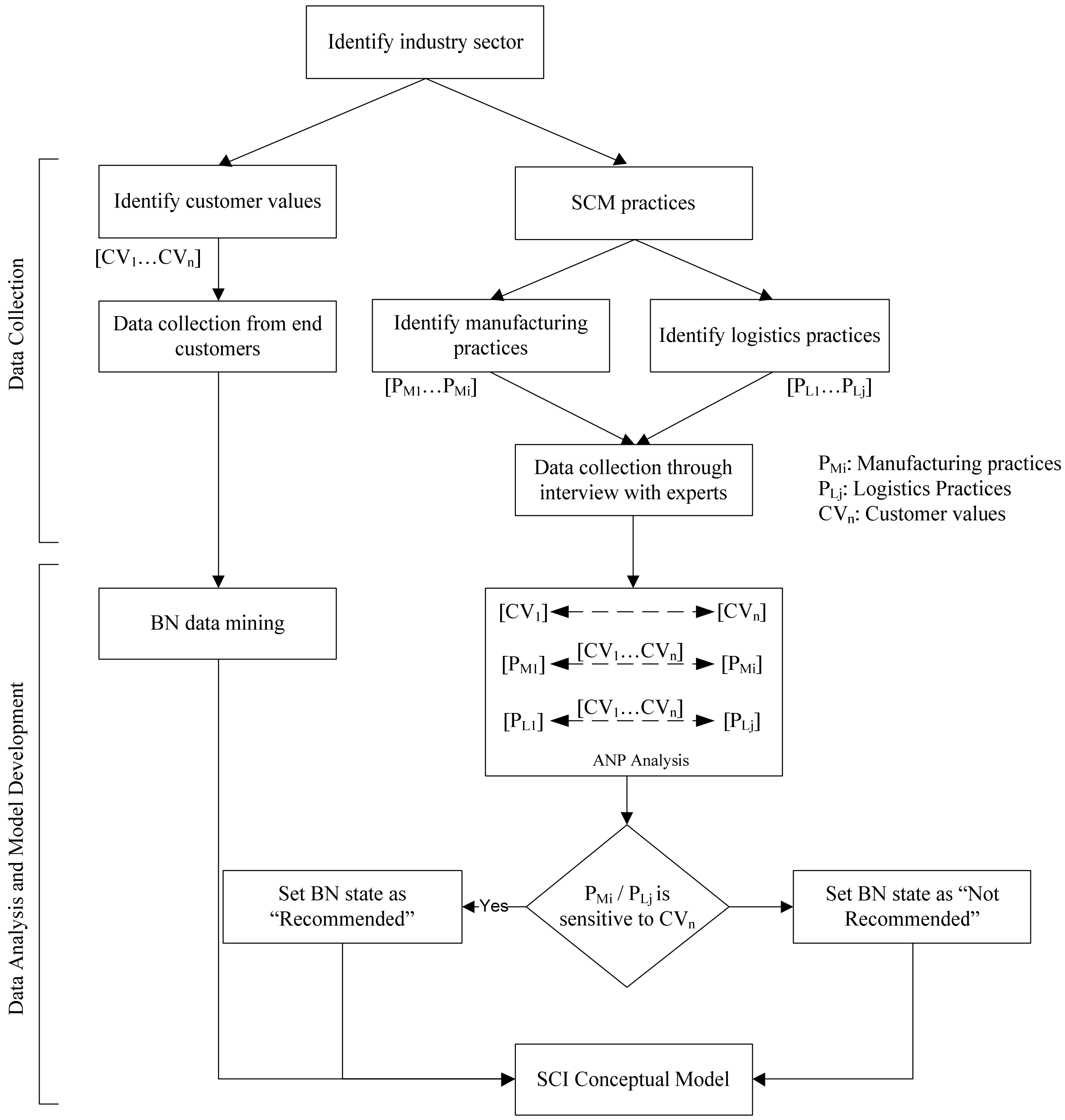


Figure 4.8 The proposed apprach toward supply chain integration

4.4 Survey and Case Studies

Conducting survey and case studies can be comprehended as a particular useful approach for easing real world examples. This approach allows direct observation input in research. Application of case studies is pretty dominant in SCM context in order to present results of field study or examples of the implementations of ideas.

One survey and two case studies are covered in this research. The survey is related to phase one and the two case studies cover all three phases.

4.4.1 Survey: Correlations among customer values

This survey is planned to analyze correlations among customer values, it will also be the input to the next two case studies. Six customer values are identified from the literature namely: time, cost, quality, customization, know-how, and respect for the environment. Data about these values are collected through pairwise comparisons from end customers in six industries which are automotive, electronics, furniture, food, fashion, and pharmaceutical (figure 4.9). In the data collection phase of the research I tried to collect data about different industrial sectors whereas SCI model of two of them are constructed in the forth coming case studies. Therefore, there is potential to do further research based on this data however the current research limit its scopes into two SCI models. The figure 4.9 presents the types of the collected data. The dataset includes data about the six customer values (illustrated in the center of the figure) in six industries (see the header of the box).

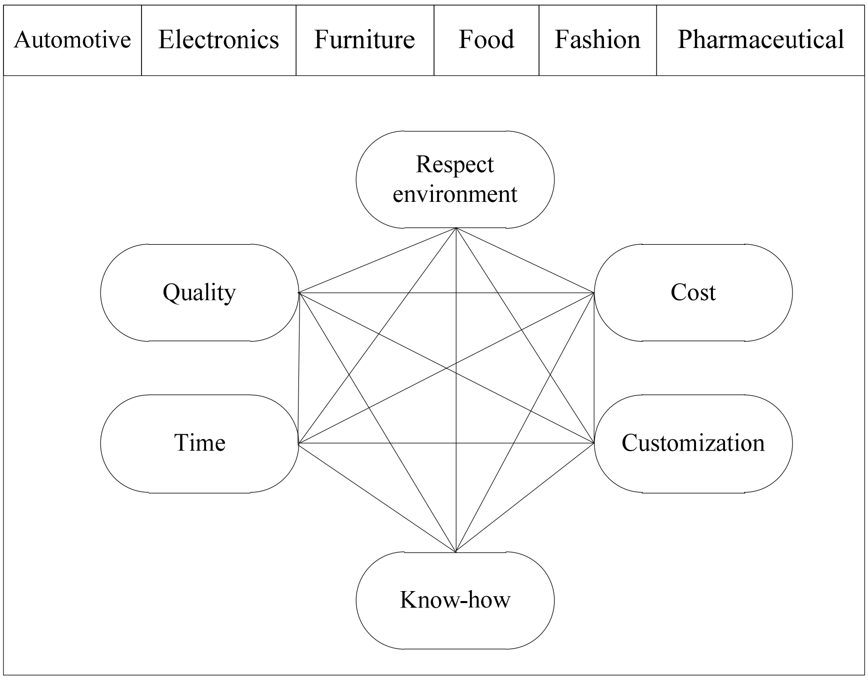


Figure 4.9 Outlines of the survey: customer values in six industries

4.4.2 Case study 1: SCI model in fashion industry

This case study takes analysis of the customer value data on fashion industry in order to identify relations between them and SCM practices. Practices are classified into manufacturing practices and logistics practices. The fashion industry is a diverse field including variety of professional expertise. It is a competitive business with constant change that has led to increase of academic attention to this specific industry (Gerber and Saiki, 2010). The main characteristic of this industry is "fast fashion" which refers to fast fashion from a supplier as well as a consumer's perspective. It means the speed at which clothing can be produced for sale is quite astounding. With fashion trends changing seasonally, as well as the introduction of half, and quarter seasons (seasons within seasons), the time that the entire production process has to be done in is getting ever faster. This indicates a shorter life cycle and higher profit margins from the sale of fast selling merchandise, skipping the mark-down process altogether. In addition, desire to have variety and instant gratification with price mavens is motivating consumers to prefer retailers (Bhardwaj and Fairhurst, 2010).

The interview for this case study is conducted with Eric Hargraves, the supply chain specialist of the Upward Unlimited Inc., USA. Upward supplies sport clothes focused on kids sports. Upward Sports, the world's largest Christian sports league for kids, has become the place to play fun sports for over half a million families in the United States and Canada. By providing a fun sports experience based on healthy competition, Upward Sports Leagues help kids develop skills for the sports arena and values for life. Upward Sports uses the universal language of sports to connect with kids at a critical age and help them discover and build athletic skills, values, self-confidence and a life-long love of the game. Upward Sports partners with around 2600 local churches to provide first-class, organized and welcoming kids basketball, kids soccer, kids flag football and kids cheerleading leagues and camps.

4.4.3 Case study 2: SCI model in food industry

The input data about customer value for this case study also comes from the data analysis of the survey. Thereafter, relations between SCM practices and customer values in the food industry are explored. Food industry is typically considered as low-tech industry based on SMEs. This sector is praised for its ability to deliver consistently positive investment returns. Indeed, over the past 20 years, Food Processing stocks have, on average, delivered high single-digit annual total returns (share-price appreciation and dividends), with much less volatility than the broader market indexes. In this industry– in general, but not always – static capabilities dominate over dynamic capabilities (Muscio, Nardone, and Dottore, 2010). Customer demands in this industry are mostly regarding quality and safety issues. Therefore, in term of the nature of the industry it is in contrast with the first case study. Selection of this specific industry is due to investigate the capability of the proposed model in different contexts.

Interview was conducted with John Chase, the director of Sopplan, New Zealand which is a sales and operations planning company in the food industry. John has been involved in Sales and Operations Planning since the mid 1980’s, even before the name moved into common usage. His early involvement included forecasting sales, planning production, planning inventories and improving manufacturing processes for a fruit cannery, an apparel manufacturer and metal packaging company. Since that time the interviewee has continued his hands-on work in the field as a consultant to companies in the food and dairy, agricultural produce, automotive, steelmaking, petrochemical, mining, consumer goods and telecommunications industries. He has worked with companies in 12 countries around the globe. He has also led Supply Chain Management teams for two major US based consulting firms - Ernst and Young and KPMG Consulting (BearingPoint). John's experience is rounded-out by extensive practical involvement in Lean management and in selecting and managing the implementation of Enterprise Resource Planning (ERP) systems for manufacturing businesses. In short, the interview is a professional consultant in the food and dairy business; some of his customers are Hubbards, Tatua, Westland Mil Products, Fonterra, and Zespri (all in New Zealand).

4.5 Conclusion

This chapter presented the supply chain integration conceptual model. It started with discussing the presence of uncertainty and randomness which is followed by exploring the two methods that are used in the model development. Bayesian network and analytic network process are used as methods to develop the model. The final model benefits from Bayesian network that is proved as a well-established method in handling uncertainty and managing influential relationships. The model development goes through three phases: In the first phase values of the end customer are identified and data about them is collected using a trade-off based questionnaire; the second phases comparatively analyzes experts opinion about supply chain practices; the third phase joins the proceeded phases in a conceptual model which quantitatively presents relations between customer values and supply chain practices. In addition, this chapter introduces one survey and two case studies which will be discussed in detail in the next chapter. The case studies serve as empirical examples of applying the proposed model in fashion and food industries.

5 Survey and Case Studies

This chapter presents a survey and two case studies which were planned in the previous chapter. The survey goes through analysis of customer values. It provides input to the two case studies. The first case study develops supply chain integration model for the fashion industry and the second case study develops the model for the food industry. These two case studies employ the proposed model in the previous chapter. In other words they are providing empirical example of the model in two different industries. Practitioners can benefit from the procedure followed in these case studies as well as the sensitivity analysis and scenario planning which are considerably beneficial in real world decision making procedures.

5.1 Survey: Correlations among customer values

This section presents findings of the survey through analyzing the collected customer value data. A data set of 786 responses (131 for each industry) from end customer is used in this survey. Data is collected through an online questionnaire designed based on pairwise comparison between values (see section 4.4.1). Table 5.1 presents the result of pairwise comparison of customer values. Table 5.2 presents results in six different industries. In Table 5.1 and 5.2 there are two figures in each cell representing the two preferences of respondents as: *significantly more important* and just *more important*. Table 5.3 and 5.4 present Friedman test results for each industry and well as each customer value. Results of the Friedman test in table 5.3 show that the Chi-squared value is significant at 0.01 level ($p<0.01$). This indicates that the mean ranks significantly differed among time, quality, cost, customization, know-how and respect-environment factors. In table 5.4 Chi-squared value is significant at 0.01 level ($p<0.01$) for quality, cost, customization, and know how, it is also significant at 0.05 level ($p<0.05$) for respect environment. However, Chi-squared value in table 4 is not significant ($p>0.05$) for time. Discussions on data presented in Table 5.1-5.4 are categorized in six subsections named after customer values. Thereafter in the seventh subsection customer value coefficient is presented.

Table 5.1 Pairwise comparison of customer values: *significantly more important* and *more important* values (values in %)

	Quality	Cost	Time	Customization	Know-how	Respect Env
Quality		19, 30	1, 4	5, 8	4, 8	8, 15
Cost	19, 30		4, 7	5, 15	6, 13	9, 21
Time	51, 30	33, 36		5, 26	20, 26	25, 27
Customization	26, 37	23, 33	7, 18		11, 23	22, 30
Know-how	24, 34	18, 33	7, 17	7, 34		19, 29
Respect Env	16, 29	12, 29	6, 13	4, 29	5, 14	

Table 5.2 End customer preferences on values in six industries (values in %)

	Quality	Cost	Time	Customizatio n	Know-how	Respect Env
Automotive	21, 37	20, 30	3, 12	7, 16	7, 21	17, 30
Electronics	21, 38	17, 33	4, 14	7, 17	7, 23	13, 29
Furniture	20, 35	30, 21	4, 12	11, 18	6, 17	18, 23
Food	36, 27	28, 16	5, 14	7, 16	9, 14	18, 23
Fashion	22, 34	30, 19	5, 8	11, 18	5, 12	16, 22
Pharmaceuticals	44 , 21	17, 21	11, 8	6, 14	19, 15	16, 19

Table 5.3 The Friedman test results for each customer value

	Customer Value Mean Rank						**Statistics**		
	Quality	Cost	Time	Customization	Know-how	Respect Env	Chi-squared	df	Sig.
Automotive	2.52	5.08	3.64	2.68	3.52	3.57	157.88	5	0.001
Electronics	2.19	4.64	4.32	3.31	2.72	3.83	171.31	5	0.001
Furniture	2.31	5.01	3.89	2.85	3.04	3.9	171.58	5	0.001
Food	2.16	4.55	4.37	3.26	2.81	3.86	162.19	5	0.001
Fashion	2.23	4.79	4.16	2.79	3.18	3.85	160.79	5	0.001
Pharmaceuticals	1.97	4.84	4.31	2.72	3.1	4.06	207.7	5	0.001

Table 5.4 The Friedman test results for each industry

	Customer Value Mean Rank						Statistics		
	Automotive	**Electronics**	**Furniture**	**Food**	**Fashion**	**Pharmaceuticals**	**Chi-squared**	**df**	**Sig.**
Quality	4.36	3.19	3.98	2.97	3.36	3.14	57.61	5	0.001
Cost	2.74	3.69	3.06	4.04	3.6	3.86	47.7	5	0.001
Time	3.64	3.49	3.68	3.43	3.57	3.19	6.19	5	0.288
Customization	2.94	4.01	3.28	3.97	3.46	3.35	33.24	5	0.001
Know-how	4.11	2.85	3.3	3.08	3.92	3.75	307.29	5	0.001
Respect Env	3.05	3.53	3.55	3.56	3.47	3.84	13.47	5	0.019

5.1.1 Quality

Quality gets the highest mean in the six industries (table 5.1-2). In addition, in 30% of the comparisons it is significantly more important than other values. Quality was judged to be significantly less important than another value less frequently than others (fewest zeros in the data base). In the pharmaceutical industry, the emphasis on quality is the strongest with 44% of respondents thinking it significantly more important and 21% more important (table 5.1). After the pharmaceutical industry the next industries regarding the importance of the quality are food, electronics, clothes, automotive and Furniture, respectively.

According to this table 5.1, 51% of respondents are ready to wait longer in order to get a higher quality product, and 30%of respondents said quality is more important than time, which gives an overall total of 81% respondents who attached greater importance to quality. Although quick response to customer demand is stressed in the literature (Hallgren and Olhager, 2009), this findings make it clear that quality should be given higher priority. On the other hand, only 16% of respondents thought quality is significantly more important than respect for the environment and 29% thought quality is just more important.

5.1.2 Cost

Respondents assigned the second greatest importance to cost in most of the six industries, although its level of importance varies from industry to industry. In the case of the furniture industry, cost is considered significantly more important in 21% of the comparisons; giving the furniture industry the highest sensitivity to this factor (table 5.1-2). Cost gets approximately a sum of 50% in all the other industries.

Comparing the importance attached to cost and time, the conclusion is that probably customers are prepared to sacrifice delivery time if there is a cost benefit (like the case of quality). On the other hand, 59% of respondents did not prioritize cost over respect for the environment (table 5.2). Accordingly, supply chains are advised to employ green practices to gain greater conformity to customer perceived values. According to holistic green production, Nissan Annual Report (2008), maintain that over 80 percent of carbon savings are only achieved when designing the supply chain with respect for the environment. To achieve customer value, it is essential to start from the design phase of supply chain.

5.1.3 Time

Friedman test results (table 5.4) show that the Chi-squared value is not significant ($p>0.05$) and the mean ranks are not significantly different between different industries. Time is assigned the lowest level of importance in all industries. In the pharmaceutical industry it is assigned the highest value, but even in this industry it is rated as significantly more important than other values in only 11% of cases. Its importance is least appreciated in the automotive industry where only 3% of respondents found it significantly more important and only 12% found it more important than other customer values (Table 5.1). According to the dataset, time is rated as significantly more important than other customer values by 3% of respondents in the automotive industry, 4% in electronics, 4% in furniture, 5% in food, 5% in fashion, and 11% in the pharmaceutical industry, while it was described as more important than other customer values by 12% in the automotive industry, 14% in electronics, 12% in furniture, 14% in food, 8% in fashion, and 8% in pharmaceutical industries.

Looking into comparisons of time with other customer values reveals the fact that most respondents prefer to sacrifice time to gain other values. Time fared best in comparison with customization, where it was considered significantly more important in 7% of cases and more important in 18%, giving a total of 25% (Table 5.2).

5.1.4 Customization

Customization of products is the option given to customers to modify the product they buy according to their specific preferences. The level of customization significantly influences the type of practices enterprises employ to manufacture products. Customization is considered significantly more important in only 6% of cases in the pharmaceutical industry as well as in 11% of cases in the furniture and fashion industries. It is considered more important in 14% of cases in the pharmaceutical industry, and 18% in the furniture and fashion industries. Its values were the highest in the furniture and fashion industries, and lowest in the pharmaceutical industry. According to the responses to the dataset, customization is considered significantly more important than other customer values by 7% of respondents in the automotive industry, 7% in electronics, 11% in furniture, 7% in food, 11% in fashion, and 6% in the pharmaceutical industry. Moreover, customization is considered more important than other values by 16% in the automotive industry, 17% in electronics, 18% in furniture, 16% in food, 18% in fashion, and 14% in the pharmaceutical industry (table 5.1-2).

Comparing customization with other customer values reveals the fact that this factor is considered significantly more important than other values in a range from 4% (compared with respect for the environment) to 7% (compared to know-how) which is a very low score. It is clear that 93% to 96% of responses customization is not rated as significantly more important than other values. In addition, customization is just more important than other values in 8% of cases (compared to quality) and 34% (compared to know-how) (table 5.2). Although Tu *et al*. (2001) emphasize the importance of customization as a critical customer value; the finding of the current research shows that customization is addressed by customers only after other values are satisfied.

5.1.5 Know-how

Customer know-how is the initial knowledge of customers when buying a product. For instance in the electronics industry, customer know-how refers to the initial knowledge of the customer about the functionality of the product. However, in the fashion and furniture industries it refers to the initial knowledge of customer about the way products are produced. Customer know-how is assigned the highest score in the pharmaceutical industry rating it as significantly more important by 19% and as more important by 15%.Summing up the scores of significantly more important and more important, know-how was given an overall score of 28% in the automotive industry, 30% in electronics, 23% in furniture, 23% in food, 17% in fashion, and 34% in the pharmaceutical industry. With the exception of the pharmaceutical industry, which deals with human health issues, know-how is described as significantly more important by fewer than 10% of respondents in the other industries (table 5.1).

Comparing the importance of know-how to other values, it scores best against time, where it is significantly more important in 20% of cases and more important in 26% (table 5.2). Gruen *et al*. (2006) found that customer know-how has a positive impact on customer loyalty and the overall perceived value of the firm by the customer, whereas the finding of this research develops that understanding of this value by suggesting that know-how is an important customer value after the other customer values have been satisfied.

5.1.6 Respect for the environment

Friedman test results show that the Chi-squared value is significant at 0.05 level ($p<0.05$) which indicates that the mean ranks significantly differed between different industries (table 5.4). According to the results of the current research, respect for environment is significantly more important than other customer values in a range from 13% of cases, in the electronics industry, to 18% of cases, in the furniture and food industries. It is also more important than other values in a range from 19% in the pharmaceutical industry to 30% in the automotive industry. In a survey in automotive industry, González *et al*. (2008) found a positive relation between the possession of certified EMS, specifically ISO 14001 and eco-management and audit scheme, and the environmental demands. The present research adds to that research, which was conducted from the company perspective, to suggest that environmental standards contribute to customer values as well as those of companies. After the automotive industry, the electronics industry receives the highest importance rate by29%.In the comparison between respect for the environment and other customer values, in the electronics industry, 42% of respondents gave overall priority to respect for the environment, while the corresponding figure was 47% in the automotive industry, 41% in furniture, 41% in food, 38% in fashion, and 35% in the pharmaceutical industry (table 5.1).

Comparing respect for the environment with other customer values indicates that 8% rated it as significantly more important than quality, 25% regarded it as more important than time, 15% considered it more important than quality. Adding together the scores for significantly more important and more important, 52% of respondents chose respect for the environment over time and customization. This result supports the argument by Kammerer (2009) who said that green products which besides their public benefits have private environmental benefits for the customer (e.g. energy savings) will generate stronger consumer demand and can thus constitute the firm's motivation. According to the findings of Kammerer (2009) as well as the current research, respect for the environment is of increasing importance to both firms and customers (table 5.2).

5.1.7 Customer value coefficient

In this section, the six customer values and industries are put together to present the overall findings. Since in the data collection phase respondents had two importance levels to compare customer values stated as significantly more important and more important so a coefficient is presented to have one unique number for each of values in each of industries. This coefficient gives double importance if the respondent selects significantly more important. The coefficient counts the number of 4’s in the dataset, makes it double, and adds it to the count of 3’s in the dataset. Thereafter, the average of this value is calculated and finally divided by the sum of other customer values to result in the share of each customer value.

$$CV_i = [2 \times COUNTIF(Range, 4) + COUNTIF(Range, 3) \times \frac{1}{Total}] \div \sum_{i=1}^{6} CV_i$$

Figure 5.1 presents coefficient of the six customer values in the six industries. Quality gets its highest importance in pharmaceutical industry then respectably food, fashion, electronics, automotive, and furniture. Respondents give highest importance to cost in furniture and fashion industries thereafter automotive, electronics, food, and pharmaceuticals. Time is the least important value in the six industries. However, its most importance rate is in pharmaceutical industry and after that come food, electronics, furniture, fashion, and automotive industries. Due to the fact that the difference between the highest and lowest time coefficients is only 0.03, we argue that supply chains should put their effort on improving other values. The next customer value is customization which is most appreciated in furniture and fashion industries with the coefficient of 0.14. Thereafter come automotive, electronics, food, and pharmaceuticals. Know-how receives its highest coefficient in pharmaceutical industry by 0.16 and after it respectably electronics, automotive, food, furniture, and fashion industries. The last customer value coefficient is respect for the environment that receives its highest coefficient in automotive industry by 0.21 and after it come furniture, electronics, food, fashion, and pharmaceutical industry (figure 5.1).

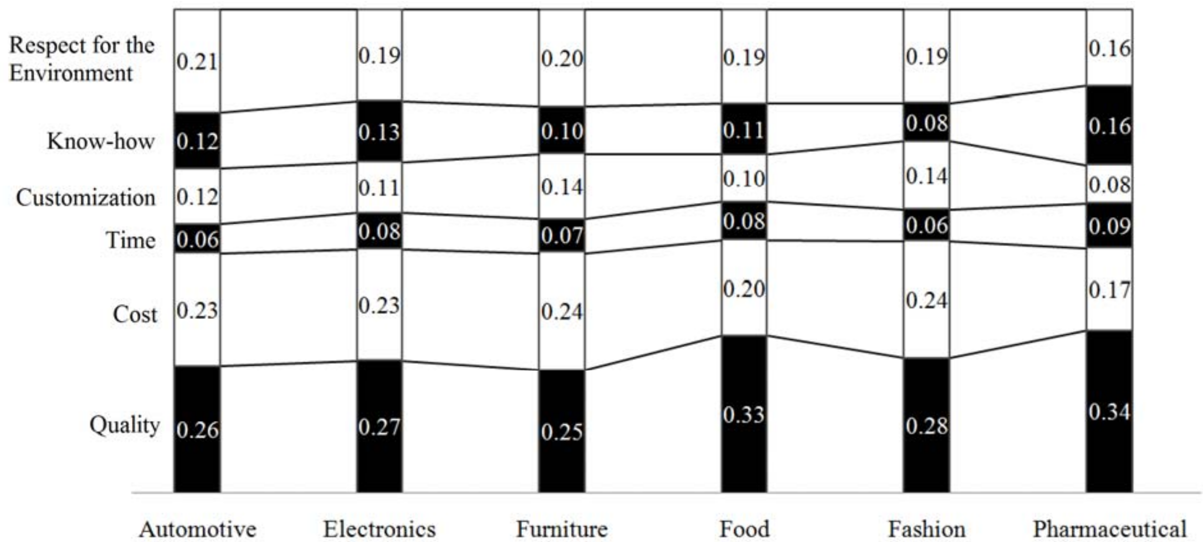


Figure 5.1 Coefficient of customer values in the six industries

Decision makers in these six industries can benefit from the findings of this research in situations where the final result of their decision will lead in contributing to one customer value and harming another. In such cases, they can refer to the current study and find the importance level of competing values in order to make an appropriate decision. Supply chain decision makers should manage the practices that are employed in different sections of the supply chain, from raw materials at the upstream end to market and consumption in the downstream end, in a way as to contribute to customer values. Therefore, all efforts across supply chain will be align with what the end customer expects.

5.2 Case Study 1: SCI Model in Fashion Industry

5.2.1 Data Collection

The case company is a large scale (with more than 250 employees) situated in the USA and works with global partners. Customer value data benefits from 131 respondents from end customers which are collected in a pairwise approach where each pair of customer values is compared. As presented in section 2.2 this research categorizes customer values into six factors as: time, quality, cost, customization, know-how, respect environment. Since the objective is to explore trade-offs among factors, the Friedman test is used to identify the importance order of values from end customer perspectives (table 5.5). Results show that the Chi-squared value was significant at 0.01 level ($p<0.01$). This indicates that the mean ranks significantly differ among time, quality, cost, customization, know-how and respect-environment factors and the highest rank is devoted to quality. The next important factors are cost, respect-environment, customization, know-how and time, respectively. The BN model of customer values presented in figure 5.2 also confirms the outcome of Friedman test. In addition it put forwards more details about correlations among values.

Table 5.5 Friedman test on customer value data in fashion industry

Mean Rank						Statistics		
Time	Quality	Cost	Customization	Know-how	Respect environment	Friedman Chi-squared	df	Sig.
2.19	4.64	4.32	3.31	2.72	3.83	171.31	5	0.001

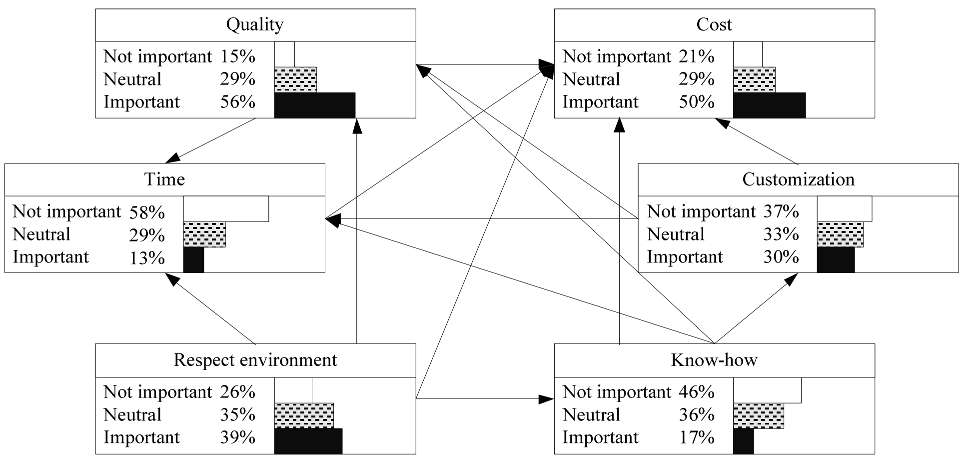


Figure 5.2 Bayesian network of the end customer values in the fashion industry- Generated by GeNIe 2.0

5.2.2 *The ANP Model*

The second part of the model is prioritizing SCM practices with respect to the identified customer values. This phase is managed through an ANP model where SCM expert makes pairwise comparison of practices. The expert for the case company who is involved in this part is supply chain specialist of Upward Unlimited Inc. Figure 5.3 presents the five manufacturing practices and the four logistics practices which are studied in this case study. The interview procedure with expert has three steps. In the first step factors are compared with one another. Notice that the same factors are considered as customer values in order to make connection between BN and ANP. The second step is comparing manufacturing practices with respect to the factors. In the third step logistics practices are pairwisely compared with respect to the factors. Table 5.6 presents the data collected through interview; this data is imported to SuperDecisions 2.2.6 software which is specialized for AHP and ANP analyses. The output of the software is the unweighted super matrix of alternatives with respect to criterion (table 5.7) and the priorities of each cluster (table 5.8). This data makes enables construction of the BN model including both customer values and the two clusters of practices.

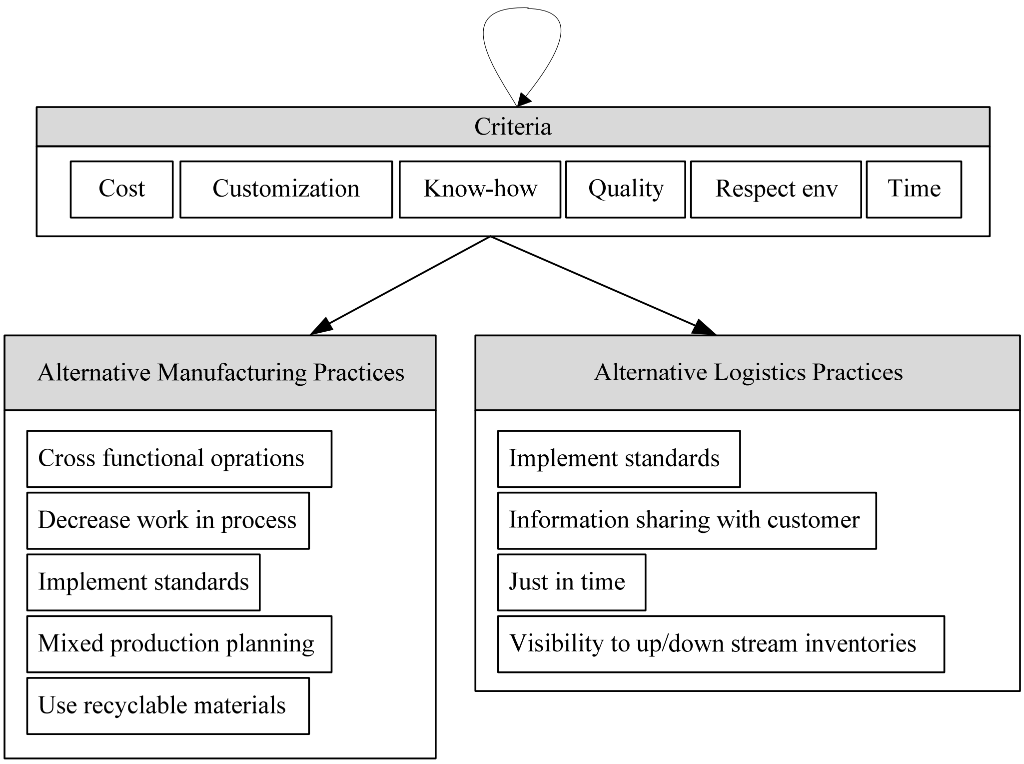


Figure 5.3 Criteria and alternatives of the analytic network process model

Table 5.6 ANP inputs in the fashion industry collected from interview with expert

1. Pairwise comparison of customer values
2. Pairwise comparison of manufacturing practices
3. Pairwise comparison of logistics practices

1) Pairwise comparison of customer values

	Customization	Know-how	Quality	Respect env.	Time
Cost	← 6	← 6	← 2	← 2	← 1
Customization		← 2	← 1	← 4	↑ 7
Know-how			↑ 5	← 1	↑ 2
Quality				← 1	← 1
Respect env.					↑ 6

2) Pairwise comparison of manufacturing practices with respect to customer values

Comparisons with respect to "Cost"

	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	↑ 7	← 1	↑ 2	← 2
Decrease work in process		← 1	← 1	← 7
Implement standards			← 1	← 1
Mixed production planning				← 5

Comparisons with respect to "Customization"

	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	← 7	← 7	← 7	← 7
Decrease work in process		← 1	↑ 5	← 5
Implement standards			← 1	← 1
Mixed production planning				← 1

Comparisons with respect to "Know-how"

	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	← 7	← 1	← 1	← 1
Decrease work in process		↑ 5	← 1	← 1
Implement standards			← 5	← 1
Mixed production planning				← 2

Comparisons with respect to "Quality"

	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	↑ 5	↑ 7	← 5	← 5
Decrease work in process		← 5	← 5	← 6
Implement standards			← 1	← 7
Mixed production planning				← 4

Comparisons with respect to "Respect environment"

	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	↑ 7	↑ 7	← 1	↑ 7
Decrease work in process		↑ 7	← 5	↑ 7
Implement standards			← 7	← 2
Mixed production planning				↑ 7

Comparisons with respect to "Time"				
	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	← 1	← 1	↑ 3	← 7
Decrease work in process		← 1	← 1	← 7
Implement standards			← 1	← 7
Mixed production planning				← 7

3) Pairwise comparison of logistics practices with respect to customer values

Comparisons with respect to "Cost"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	↑ 7	↑ 7	↑ 7
Information sharing with customer		← 1	↑ 2
Just in time			← 1

Comparisons with respect to "Customization"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	↑ 7	← 1	← 1
Information sharing with customer		← 7	← 5
Just in time			← 1

Comparisons with respect to "Know-how"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	↑ 7	← 1	← 1
Information sharing with customer		← 7	← 7
Just in time			← 1

Comparisons with respect to "Quality"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	← 4	← 4	← 4
Information sharing with customer		← 6	← 6
Just in time			← 2

Comparisons with respect to "Respect environment"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	↑ 7	← 2	← 2
Information sharing with customer		← 7	← 7
Just in time			← 1

Comparisons with respect to "Time"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	↑ 2	↑ 7	↑ 7
Information sharing with customer		↑ 4	↑ 3
Just in time			← 1

Table 5.7 Unweighted super matrix in the fashion industry – Calculated by SuperDecisions 2.2.6

		Cost	Customization	Know-how	Quality	Respect env.	Time
Logistics Practices	Implement standards	0.03	0.02	0.10	0.03	0.00	0.03
	Information sharing with customer	0.14	0.06	0.40	0.01	0.00	0.05
	Just in time	0.16	0.01	0.06	0.00	0.00	0.18
	Visibility of up/down stream inventories	0.19	0.01	0.06	0.00	0.00	0.17
Manufacturing Practices	Cross functional operations	0.05	0.53	0.10	0.13	0.04	0.11
	Decrease work in process	0.23	0.10	0.03	0.46	0.12	0.13
	Implementation of standards	0.05	0.08	0.13	0.24	0.45	0.13
	Mixed Production planning	0.12	0.14	0.06	0.09	0.04	0.18
	Use recyclable materials	0.03	0.06	0.06	0.03	0.35	0.02

Table 5.8 Priorities in clusters in the fashion industry – Calculated by SuperDecisions 2.2.6

Clusters		Normalized values	Limiting
Logistics Practices	Implementing logistics standards	0.02967	0.014834
	Information Sharing with Customer	0.08936	0.044682
	Just in Time	0.10689	0.053447
	Visibility to upstream / downstream inventories	0.11280	0.056398
Manufacturing Practices	Cross functional operations	0.13574	0.067868
	Decrease work in process	0.20365	0.101826
	Implement standards	0.14368	0.071839
	Mixed production planning	0.12482	0.062409
	Use recyclable materials	0.05340	0.026698
Comparison criterion	Cost	0.29853	0.149266
	Customization	0.11108	0.055539
	Know-how	0.06020	0.030099
	Quality	0.15617	0.078084
	Respect Environment	0.07403	0.037015
	Time	0.30000	0.149998

Notice the importance of factors differs between experts and end customers. Surprisingly, time is the most important factor from expert's perspective whereas it's the least important one from the eye of customers. This phenomenon is due to the fact that from experts perspectives long time means wasteful procedures. Therefore, experts closely watch this factor to ensure internal procedures are running according to standards and plans. However, customers perceive time as delivery time which is not considered as important in comparison with other values. In addition, as it is discussed in the section 4.4.1 the fashion industry is very sensitive to the time and time to market is a winning factor for enterprises in this industry sector.

5.2.3 The Integration Model

In the last phase – in order to put together experts knowledge and customer preferences- synthesized values from ANP model are used to identify prior probabilities of practices and construct the BN model including both practices and customer values. In the SCI model presented in the figure 5.4 customer values have three different states as: not important, neutral, and important whereas SCM practices has two states as: not recommended and recommended. This model operates in both directions from child nodes to parent nodes and vice versa. Therefore, in case of grounding one of the practices, the status of other nodes will be dynamically changed according to it. In addition, if a root node is grounded in one of its states, the rest of the network will be changes accordingly. It worth noticing that the status of customer value nodes are calculated based on the customer data which was collected and analyzed in the survey. Since the market conditions are dynamic and variety of factors may influence customer preferences, therefore practitioners are suggested to keep this data updated. On the other side, SCM practices nodes are calculated based on expert's comparative analysis with respect to customer values. Since these are technical practices, this analysis can be used for longer time and doesn't require frequent update however practitioners are recommended to double check them and adjust the network in case amendments are required.

The importance order of customer values when none of nodes are grounded is respectively quality, cost, respect environment, customization, know-how and time. According to figure 5.4 the most recommended manufacturing practice to increase quality is decrease work in process. The most recommended logistic practice for this customer value is visibility to upstream/ downstream inventories. Details of the importance level of customer values and SCM practices in fashion industry are presented in the figure 5.4. In order to efficiently read SCI model presented in this figure, initials are given in the table 5.9. For instance node Cu 8 refers to "just in time" as a practice with respect to "customization".

Table 5.9 Supply chain practices and customer values initials used in the integration model: Manual of figure 5.4

	Node names (Supply Chain practices and customer values)	Initial
Manufacturing practices	Cross functional operations	1
	Decrease work in process	2
	Implement standards	3
	Mixed production planning	4
	Use recyclable materials	5
Logistics practices	Implementing logistics standards	6
	Information Sharing with Customer	7
	Just in Time	8
	Visibility to upstream / downstream inventories	9
Customer values	Cost	C
	Customization	Cu
	Know-how	K
	Quality	Q
	Respect Environment	R
	Time	T

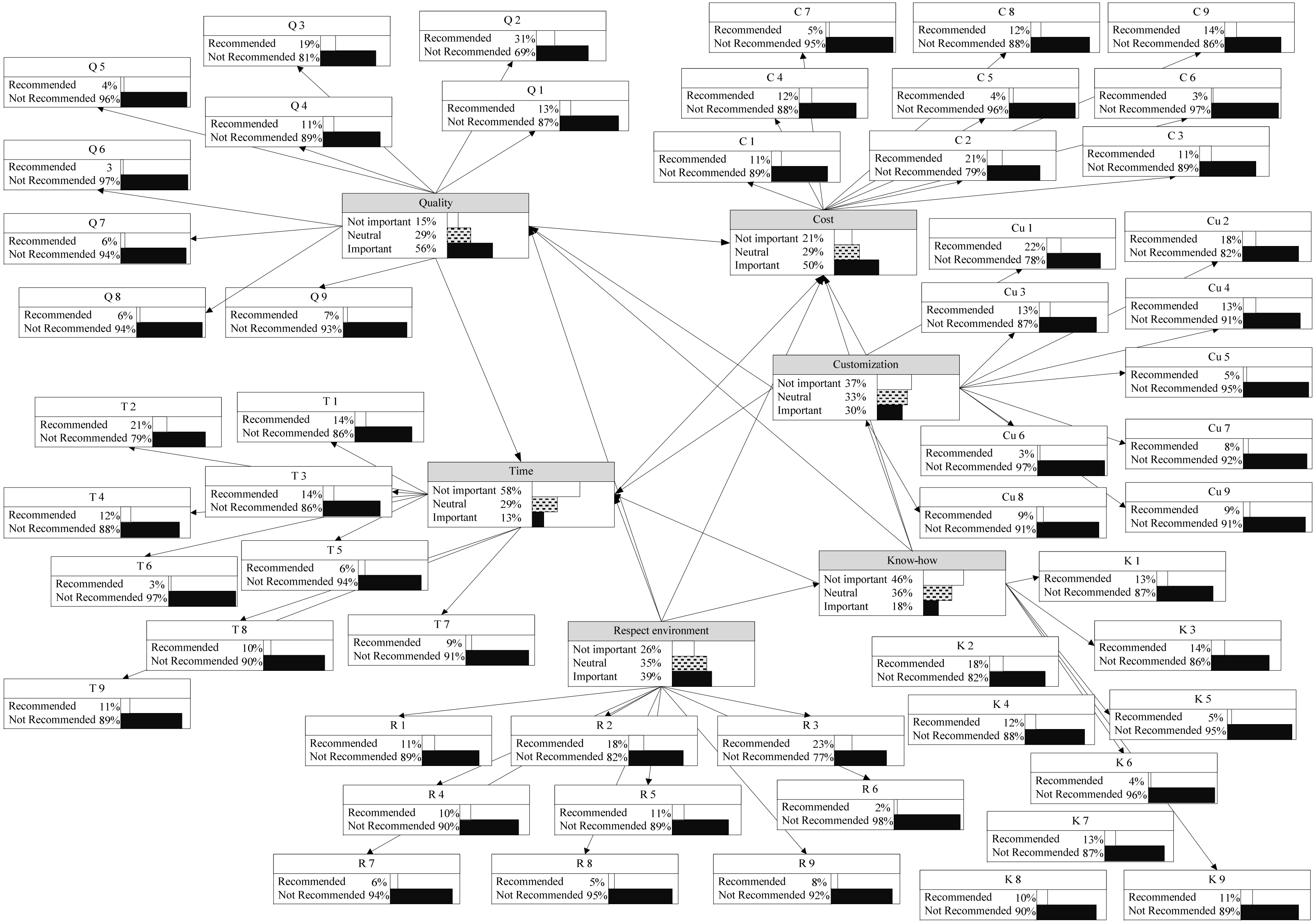


Figure 5.4 Integration of supply chain practices with customer values in the fashion industry – Generated by GeNIe 2.0

5.2.4 *Sensitivity analysis and scenario planning: Cost*

Sensitivity analysis explores the status of the network with respect to changes in one specific node. Scenario planning (also known as scenario thinking) is a strategic planning method that considers a plausible, but unexpectedly important situation and strives to finds effective approach to deal with it. In this case study, the second important value from customer perspective (see table 5.5 and figure 5.2) as well as from expert perspective (see table 5.8) in fashion industry is cost.

In this section, sensitivity of the supply chain practices with respect to cost is explored in the case company. This can be seen as a scenario in which (for instance due to the hit of financial crisis) customers demand for lower price and supply chain requires to implement effective practices to reduce costs. The status of the network in the situation where cost is grounded as "important" is illustrated in the figure 5.5. Comparing figure 5.5 and customer value section of figure 5.4 shows the difference in the state of other customer value nodes in the situation where cost node is grounded as important. In order to contribute to cost, decrease work in process (as manufacturing practice) and visibility to upstream / downstream inventories (as logistics practice) are recommended (figure 5.6 and table 5.10). As it is shown, other practices either don't contribute to reduction of cost (like implementation logistics standards and mixed production planning); or they lead to increase of cost which is not favorable.

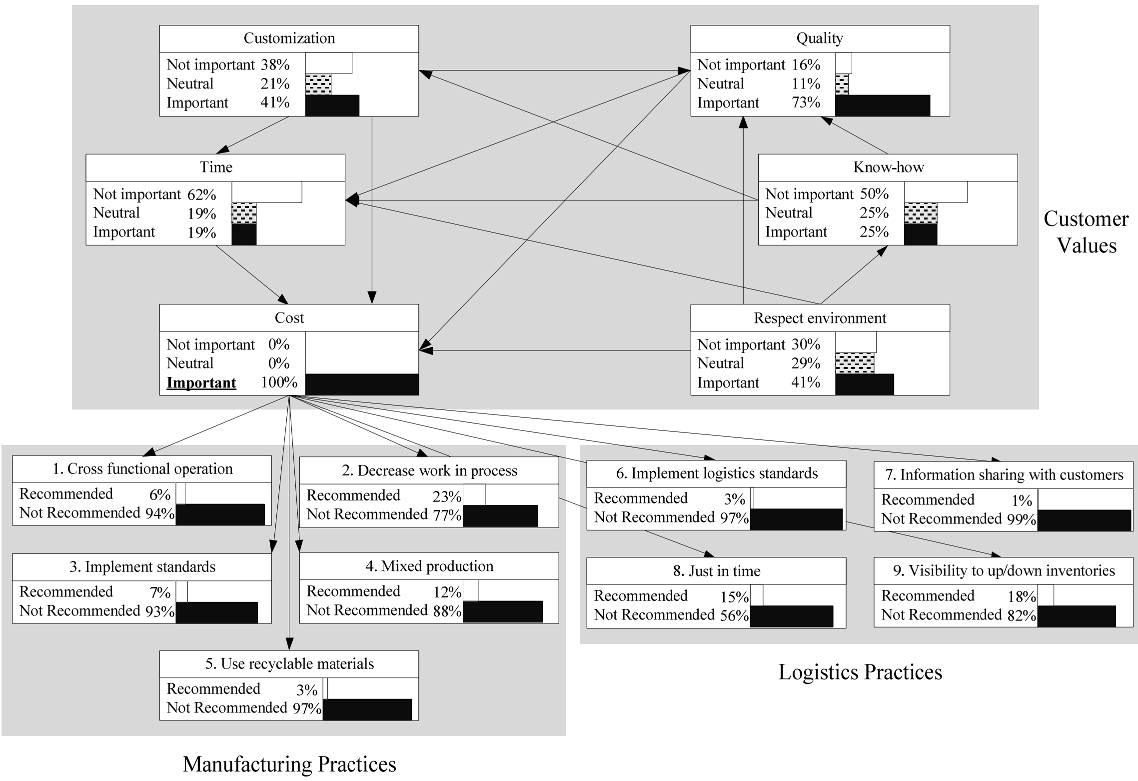


Figure 5.5 State of the network in the fashion industry when "Cost" is grounded as important – Generated by GeNIe 2.0

Table 5.10 Importance of practices: normal state vs. “cost” is grounded as *important*

	Practices	Normal state	If “cost” is important	Difference
Logistics Practices	Implementing logistics standards	3%	3%	0%
	Information Sharing with Customer	5%	1%	-4%
	Just in Time	12%	15%	+3%
	Visibility to upstream / downstream inventories	14%	18%	+4%
Manufacturing Practices	Cross functional operations	11%	6%	-5%
	Decrease work in process	21%	23%	+2%
	Implement standards	11%	7%	-4%
	Mixed production planning	12%	12%	0%
	Use recyclable materials	4%	3%	-1%

5.3 Case Study 2: SCI Model in Food Industry

5.3.1 Data collection

The case company is a small scale (with about 10 employees) situated in New Zealand. Customer value data benefits from 131 respondents collected in a pairwise approach where each pair of customer values is compared. As presented in section 2.2.1.3 this research categorizes customer values into six factors as: time, quality, cost, customization, know-how, respect environment. Since the objective is to explore trade-offs among factors, the Friedman test is used to identify the importance order of values from end customer perspectives (table 5.11). Results show that the Chi-squared value was significant at 0.01 level ($p<0.01$). This indicates that the mean ranks significantly differ among time, quality, cost, customization, know-how and respect-environment factors and the highest rank is devoted to quality. The next important factors are respect-environment, cost, know-how, customization and time, respectively. The BN model of customer values presented in figure 5.6 also confirms the outcome of Friedman test. In addition it put forwards more details about correlations among values.

Table 5.11 Friedman test on customer value data in food industry

Mean Rank						**Statistics**		
Time	Quality	Cost	Customization	Know-how	Respect environment	Friedman Chi-squared	df	Sig.
2.31	5.01	3.89	2.85	3.04	3.90	171.58	5	0.001

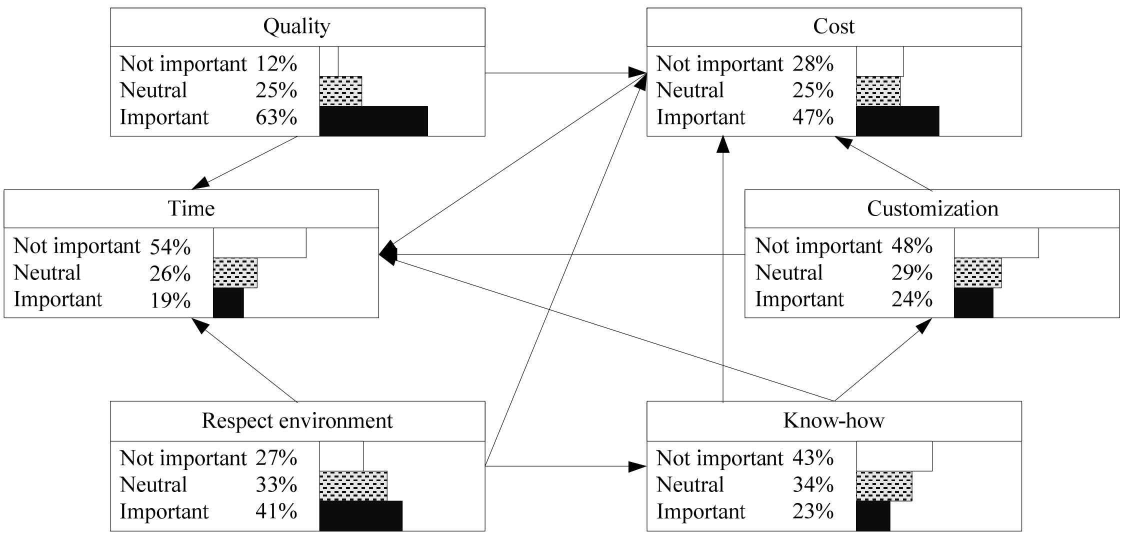


Figure 5.6 Bayesian network of the end customer values in the food industry– Generated by GeNIe 2.0

5.3.2 The ANP Model

The ANP inputs are prepared through interview with director of the case company. As discussed in the section 4.4.2 since food industry is mostly influenced by local neighborhoods, a small scale case company is selected which is located in New Zealand. The Interviewee is the director of the Sopplan, he is also consultant of some other companies in the food industry. Due to his expertise in this specific industry sector, the interview is conducted with him. The expert is asked to make pairwise comparison of practices with respect to customer values. There are five production practices and four logistics practices which go through comparison procedure (figure 5.7). According to the methodology presented in the section 4.2 there are three types of comparison: firstly, customer values are compared to one another, secondly production practices are compared with respect to customer values, and in the third step logistics practices are compared with those values. The data presented in the table 5.12 is the collected data through interview to develop the ANP part of the model. This data was imported to SuperDecisions 2.2.6 software which is specialized software for AHP and ANP analyses. The outputs of this software are unweighted super matrix and priorities which are presented respectively in table 5.13 and 5.14.

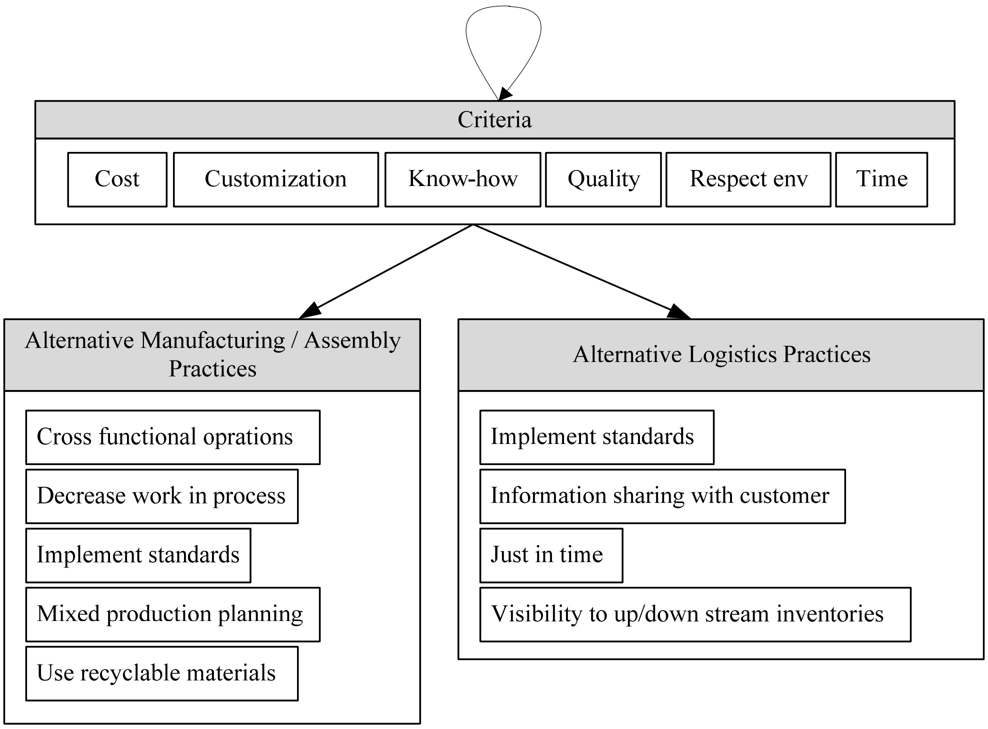


Figure 5.7 Criteria and alternatives of the analytic network process model: Food industry

Table 5.12 ANP inputs in the food industry collected from interview with expert

1. Pairwise comparison of customer values
2. Pairwise comparison of manufacturing practices
3. Pairwise comparison of logistics practices

1) Pairwise comparison of customer values

	Customization	Know-how	Quality	Respect env.	Time
Cost	← 6	← 9	↑ 7	← 9	← 4
Customization		↑ 7	↑ 9	← 9	← 2
Know-how			↑ 8	← 9	← 2
Quality				← 9	← 4
Respect env.					↑ 9

2) Pairwise comparison of manufacturing practices with respect to factors

Comparisons with respect to "Cost"				
	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	← 8	← 4	← 4	← 9
Decrease work in process		↑ 6	← 1	← 4
Implement standards			← 6	← 9
Mixed production planning				← 9
Comparisons with respect to "Customization"				
	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	← 5	← 8	← 9	← 9
Decrease work in process		← 7	← 3	← 9
Implement standards			↑ 3	← 7
Mixed production planning				← 9
Comparisons with respect to "Know-how"				
	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	← 8	↑ 8	← 4	← 9
Decrease work in process		↑ 6	↑ 6	← 9
Implement standards			↑ 2	← 9
Mixed production planning				← 9
Comparisons with respect to "Quality"				
	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	↑ 6	↑ 7	← 5	← 5
Decrease work in process		↑ 7	← 1	← 8
Implement standards			← 9	← 9
Mixed production planning				← 5
Comparisons with respect to "Respect environment"				
	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	← 8	↑ 3	↑ 4	↑ 9
Decrease work in process		↑ 4	↑ 2	↑ 8
Implement standards			← 2	↑ 9
Mixed production planning				↑ 9

Comparisons with respect to "Time"				
	Decrease work in process	Implement standards	Mixed production planning	Use recyclable materials
Cross functional operations	↑ 8	↑ 5	← 1	← 9
Decrease work in process		← 1	← 5	← 9
Implement standards			← 3	← 9

3) Pairwise comparison of logistics practices with respect to factors

Comparisons with respect to "Cost"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	↑ 3	↑ 3	↑ 4
Information sharing with customer		← 3	← 1
Just in time			← 2

Comparisons with respect to "Customization"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	↑ 7	↑ 8	← 1
Information sharing with customer		← 5	← 7
Just in time			↑ 3

Comparisons with respect to "Know-how"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	↑ 8	← 7	← 5
Information sharing with customer		← 5	← 5
Just in time			← 1

Comparisons with respect to "Quality"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	↑ 3	↑ 3	↑ 4
Information sharing with customer		← 3	← 1
Just in time			← 2

Comparisons with respect to "Respect environment"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	↑ 3	↑ 3	↑ 4
Information sharing with customer		← 3	← 1
Just in time			← 2

Comparisons with respect to "Time"			
	Information sharing with customer	Just in time	Visibility to up / down stream inventories
Implementation of standards	↑ 3	↑ 3	↑ 4
Information sharing with customer		← 3	← 1
Just in time			← 2

Table 5.13 Unweighted super matrix in the food industry – Calcuated by SuperDecisions 2.2.6

		Cost	Customization	Know-how	Quality	Respect env.	Time
Log Practices	Implement standards	0.01	0.02	0.00	0.01	0.08	0.01
	Information sharing with customer	0.04	0.24	0.01	0.01	0.22	0.06
	Just in time	0.03	0.07	0.00	0.01	0.16	0.04
	Visibility of up/down stream inventories	0.03	0.07	0.00	0.01	0.16	0.04
Man Practices	Cross functional operations	0.45	0.35	0.25	0.11	0.03	0.08
	Decrease work in process	0.06	0.14	0.05	0.19	0.01	0.36
	Implementation of standards	0.26	0.04	0.44	0.57	0.05	0.28
	Mixed Production planning	0.09	0.07	0.23	0.07	0.04	0.10
	Use recyclable materials	0.02	0.02	0.02	0.02	0.23	0.02

Table 5.14 Priorities in clusters in the food industry- Calculated by SuperDecisions 2.2.6

Clusters		Normalized values	Limiting
Logistics Practices	Implementing logistics standards	0.00998	0.004991
	Information Sharing with Customer	0.03975	0.019873
	Just in Time	0.02193	0.010965
	Visibility to upstream / downstream inventories	0.02148	0.01074
Manufacturing Practices	Cross functional operations	0.22312	0.111558
	Decrease work in process	0.14602	0.073009
	Implement standards	0.42021	0.210105
	Mixed production planning	0.09427	0.047137
	Use recyclable materials	0.02324	0.011621
Comparison criterion	Cost	0.25353	0.126766
	Customization	0.05471	0.027354
	Know-how	0.10703	0.053517
	Quality	0.50876	0.254381
	Respect Environment	0.01587	0.007933
	Time	0.06010	0.03005

According to the priorities give to the values the order of values from the highest importance is: quality, cost, know-how, time, customization, and respect environment (table 5.14). However, the importance of those value from end customers' perspective is quality, respect environment, cost, know-how, customization, and time. It worth reminding that these values are gathered through pairwise comparisons where trade-offs between each two values are considered. In other words, respondent may sacrifice one to get higher level of another whereas all values are important and apparently the optimum situation is having all fulfilled. The importance of such analysis is more tangible in decision making procedures when contributing to one value may result in decrease of another.

5.3.3 The Integration Model

In the last phase – in order to put together experts knowledge and customer preferences- synthesized values from ANP model are used to identify prior probabilities of practices and construct the BN model including both practices and customer values. In the SCI model presented in the figure 5.8 customer values have three different states as: not important, neutral, and important whereas SCM practices has two states as: not recommended and recommended. This model operates in both directions from child nodes to parent nodes and vice versa. Therefore, in case of grounding one of the practices, the status of other nodes will be dynamically changed according to it. In addition, if a root node is grounded in one of its states, the rest of the network will be changes accordingly. It worth noticing that the status of customer value nodes are calculated based on the customer data which was collected and analyzed in the survey. Since the market conditions are dynamic and variety of factors may influence customer preferences, therefore practitioners are suggested to keep this data updated. On the other side, SCM practices nodes are calculated based on expert's comparative analysis with respect to customer values. Since these are technical practices, this analysis can be used for longer time and doesn't require frequent update however practitioners are recommended to double check them and adjust the network in case amendments are required.

The importance order of customer values when none of nodes are grounded is respectively quality, cost, respect environment, know-how, customization, and time. According to figure 5.8 the most recommended manufacturing practice to increase quality is implementation of standards. The most recommended logistic practice for this customer value is information sharing with customer. Details of the importance level of customer values and SCM practices in fashion industry are presented in the figure 5.8. In order to efficiently read SCI model presented in this figure, initials are given in the table 5.15. For instance node K 1 refers to "cross functional operations" as a practice with respect to "know-how".

Table 5.15 Supply chain practices and customer values initials used in the integration model: Manual of figure 5.9

Node names (Supply chain practices and customer values)		Initial
Manufacturing practices	Cross functional operations	1
	Decrease work in process	2
	Implement standards	3
	Mixed production planning	4
	Use recyclable materials	5
Logistics practices	Implementing logistics standards	6
	Information Sharing with Customer	7
	Just in Time	8
	Visibility to upstream / downstream inventories	9
Customer values	Cost	C
	Customization	Cu
	Know-how	K
	Quality	Q
	Respect Environment	R
	Time	T

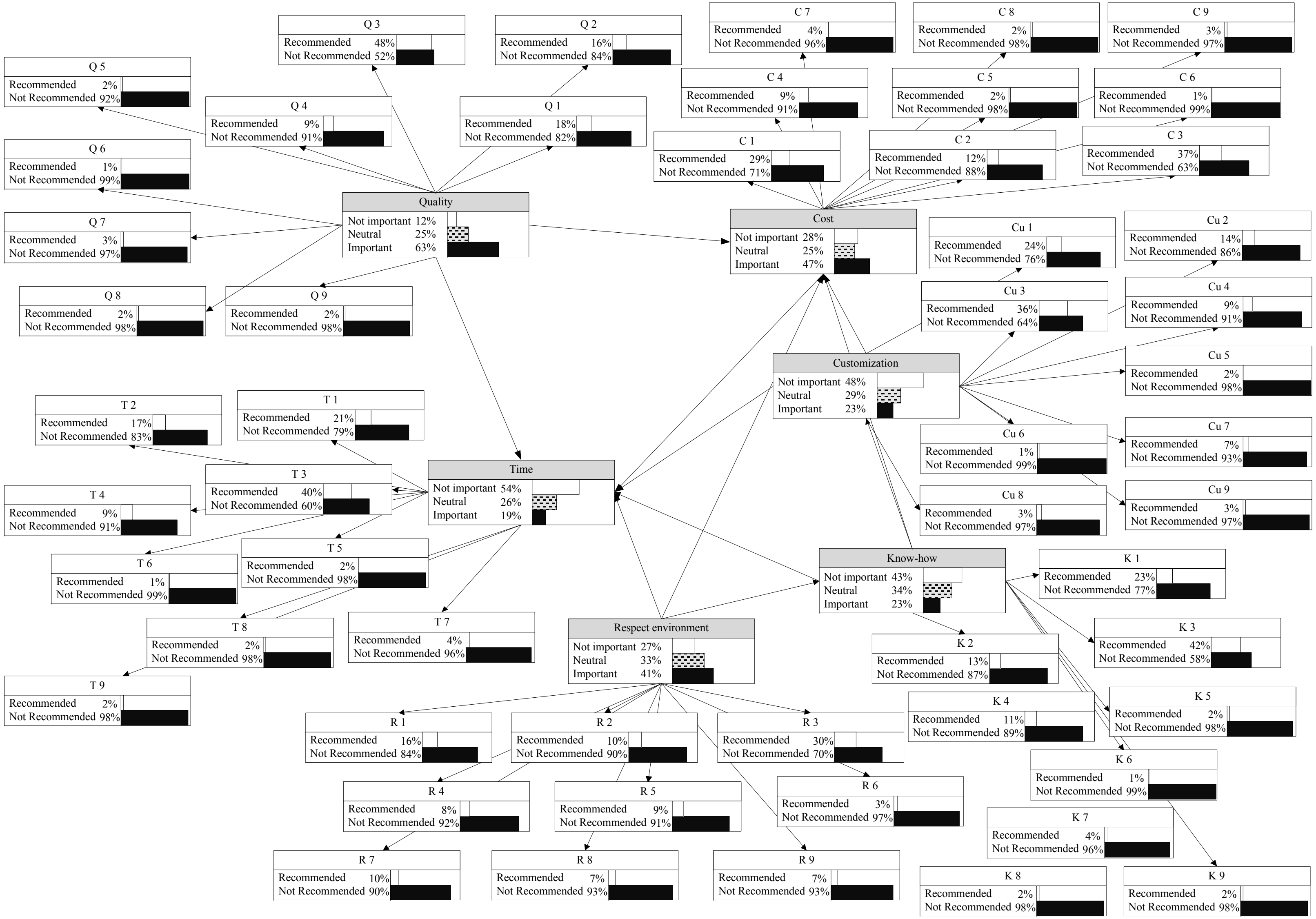


Figure 5.8 Integration of supply chain practices with customer values in the food industry – Generated by GeNIe 2.0

5.3.4 *Sensitivity analysis and scenario planning: respect for the environment*

Sensitivity analysis and scenario planning are used to monitor behavior of the network with respect to specific changes. Sensitivity analysis explores the network response regarding changes in a particular node. Scenario planning considers an important probable situation and strives to find a way to confront it. Regarding the current case company in the food industry, respect environment is the second most important value from end customer perspective (see table 5.11) whereas it is the least important value from the expert perspective (see table 5.14). Therefore, sensitivity of supply chain practices is explored regarding this value. This analysis seeks to identify the state of the network when respect environment is on the "important" state (figure 5.9). Comparing figure 5.9 and customer value section of figure 5.8 shows the difference in the state of other customer value nodes in the situation where time node is grounded as important. In addition, according to this BN, in order to contribute to respect environment, using recyclable materials (as manufacturing practice) and information sharing with customer (as logistics practice) are recommended (figure 5.9, table 5.16).

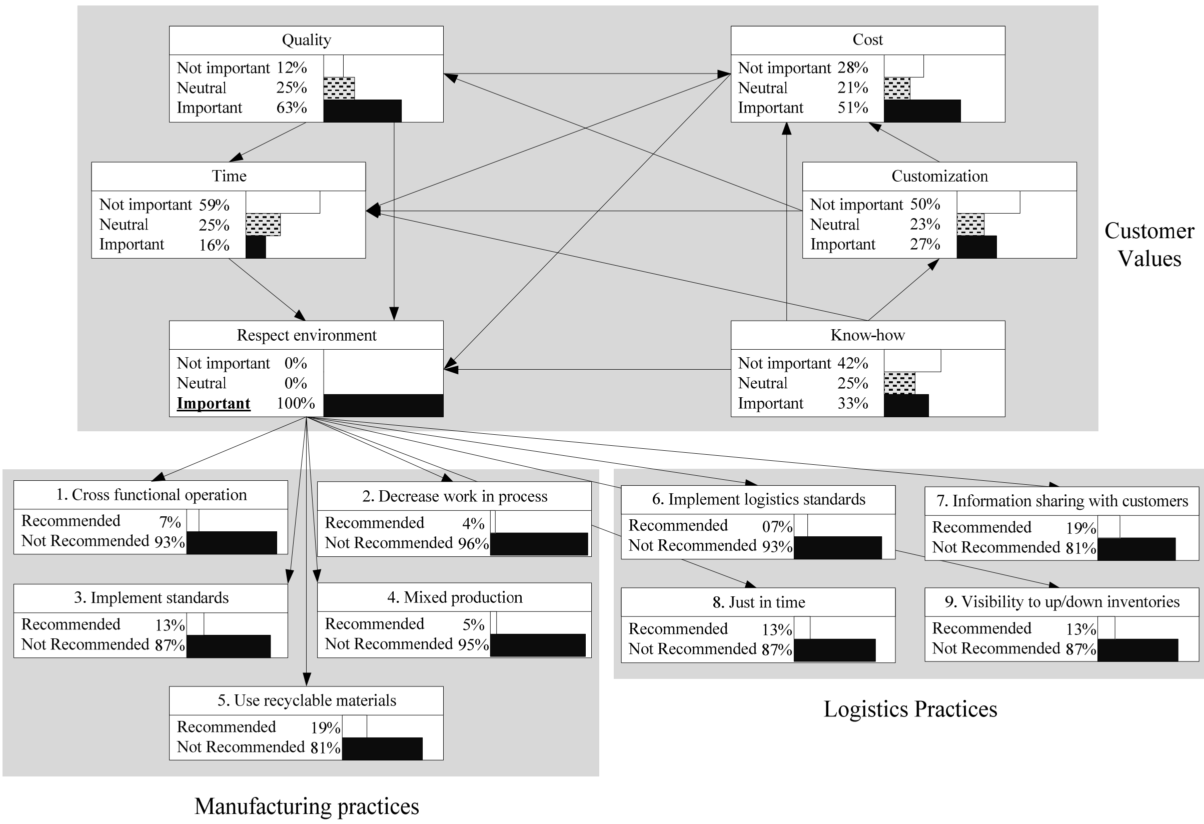


Figure 5.9 State of the network in the food industry: "respect environment" is set as important – Generated by GeNIe 2.0

Table 5.16 Importance of practices: normal state vs. "respect environment" is set as *important*

	Practices	Normal state	When "respect environment" is important	Difference
Logistics Practices	Implementing logistics standards	3%	7%	+4%
	Information Sharing with Customer	10%	19%	+9%
	Just in Time	7%	13%	+6%
	Visibility to upstream / downstream inventories	7%	13%	+6%
Manufacturing Practices	Cross functional operations	16%	7%	-9%
	Decrease work in process	10%	4%	-6%
	Implement standards	30%	13%	-17%
	Mixed production planning	8%	5%	-3%
	Use recyclable materials	9%	19%	+10%

5.4 Conclusion

This chapter was dedicated to presentation of a survey and two case studies which were introduced in the section 4. The survey collected and analyzed data about six customer values as quality, cost, time, customization, know-how, respect for the environment. Data about customer values was collected in six industries namely automotive, electronics, fashion, food, furniture, and pharmaceutical. As a result of data analysis, customer value coefficient was developed for the six studies industries. In addition, this chapter presents two case studies in which supply chain integration model for the fashion and food industry was developed. Selection of these two industries was due to their difference in characteristics as well as customer expectations. Fashion industry is a rapidly changing industry with global customers. In contrast, food industry has slow change rate which is concentrated for the regional demands. Development of the integration model of these two industries followed the same procedure in which five manufacturing practices and four logistics practices were investigates. These two case studies showed the applicability of the proposed integration model in these two different industry sectors.

6 Conclusions

This chapter serves as conclusion to this dissertation. It starts with the thesis overview followed by presentation of main results. Thereafter, theoretical and managerial implications are discussed and case study findings are presented. Last but not the least, recommendations for future research works are provided.

6.1 Thesis overview

The current dissertation locates itself in the Supply Chain Integration (SCI) context. It develops a conceptual integration model which quantitatively addresses relations between Supply Chain Management (SCM) practices and customer values. Development of the model benefits from two methods: Analytic Network Process (ANP) and Bayesian Network (BN) in three phases. In the first phase, customer value data is analyzed using BN to identify trade-offs between them; the second phase goes through interview with experts to identify priorities and synergies between practices using ANP; these two phases join in the third phase to form the integration model which is managed by BN. The proposed integration model is used in two case studies in chapter 5 to clarify application of the model. The case studies revealed the capability of the proposed model in achieving research objectives.

Satisfying all customer values in a supply chain is far too optimistic. In the real cases, decision makers face the situation in which they have to decide which value they want to improve, and often such decision may result in losing another customer value. Therefore, it is critical in such cases to contribute to the customer value which is more preferred by the end customer. This scenario may also happen in contingency plans where improving one customer value may result in sacrificing others. The pairwise analysis and findings of the current research come to assist decision makers in such cases. Using the proposed model, they will be able to lead their supply chain in the direction of fulfilling expectations of their customers.

In presentation of the model (chapter 4), practices and customer values are kept as parameters to enable generalization of the model. However, they are identified from the literature (see table 2.4 for practices and table 4.3 for customer values). More specifically six customer values are identified namely: quality, cost, time, customization, know-how, and respect for the environment. It employs a questionnaire in the data collection phase. The analysis phase uses a pairwise analysis to compare customer values across industries as well as comparisons among customer values themselves. In addition, the customer value coefficient is developed based on the dataset which dedicates a coefficient to each customer value in the automotive, electronics, furniture, fashion, food, and pharmaceutical industry sectors. The customer value coefficient gives a quantitative measure based on end customer comparative data about trade-offs. This coefficient facilitates decision making procedure in accordance with customer preferences. The result of customer value analysis is combined with expert interview in the fashion and food industries to construct their integration model.

The proposed model revealed to have the capability to be used in different industry sectors. Nevertheless, amendments might be required to adjust the outcome of the model with the real world cases. This can involve introducing a weight system to customer values in order to give additional importance to some of them or adding additional cluster of relevant practices according to the industry sector. The model output is dependent on input data; therefore its validity is tightly connected to the validity of inputs. Practitioners are recommended to keep their inputs updated to ensure the validity of outputs. A practical suggestion is to be careful about adding extra factors (extra customer value or practices) because, as the number of factors increases, the amount of required input data increases (which is not always feasible to have).

The novelty of the current research is in its perspective toward SCI as well as the methodology it employs. SCI is extensively discussed in the literature; however the diversity of SCM context has directed researchers toward qualitative approaches which are beneficial in their own way, but there is a lack of work on quantitative methods. ANP and BN methods have the capability to combine both qualitative and quantitative inputs through pairwise comparisons and provide quantitative outputs. Presence of quantitative outputs makes the foundation to integrate this approach to other perspectives of SCI.

6.2 Main results

This research follows a theory building approach through case studies. It identified gaps in the SCI literature and addressed those gaps using well established quantitative methods (BN and ANP). In doing so, it proposed a conceptual model which was then used in two case companies. In development of SCI model the following points were considered:

- Internal activities in the chain should be aligned with customer preferences to ensure those activities are contributing to the end customer.
- Relations between SCM practices and customer values should be quantitatively identified
- Influential relations should be possible to monitor
- Sensitivity analysis and scenario planning should be available in the model to enable decision makers to monitor their chain regarding the influence of each factor and avoid trial and errors in the decision making procedure.

The presented integration model proved its capability to quantitatively present relations between supply chain practices and customer values (see figure 5.4 in the fashion industry case study and figure 5.8 in the food industry case study). The SCI model introduced in the chapter 4 was applied in fashion and food industries which were presented as case study one and two respectively (sections 5.2 and 5.3). The survey is dedicated to analysis of customer values which is then used as input in the next two case studies. This model considers practices and customer values as nodes of a network in which customer values are connected to practices and the network explores their relations. The proposed model takes two kinds of inputs: customer value data from end customer; and supply chain practices data from supply chain expert. Both kinds of data are collected through a comparative approach. The proposed model is capable of handling sensitivity analysis and scenario planning by grounding one node in a particular state of monitoring its influence on the rest of the network (see figure 5.5 in the fashion industry case study and figure 5.9 in the food industry case study). The case studies show that the proposed SCI model is capable of:

- Identify relations between SCM practices and customer values through: data mining of customer values by BN, comparative analysis of SCM practices by ANP, and developing a BN model to present casual relations among factors.
- Quantitatively present relations between nodes through different states of each node.
- Sensitivity analysis and scenario planning can be managed through grounding one node and following its influences on the state of other nodes
- Facilitate adjustment of internal activities with respect to changes in customer values

The successful application of the proposed model in the two case studies supports that research questions were answered and research objectives were accomplished. The presented experiences in the fashion and food industry (in the format of case studies in chapter 5) proved that the proposed model is a well established approach to develop supply chain integration model.

6.3 Theoretical and managerial implications

The proposed SCI model can be looked from theoretical, managerial, and practical perspectives. Theoretical perspectives was concerned with theory building to address gaps in SCI which can be considered as one step forward in solving obstacles in this context. Development of SCI has been concern of extensive literature which has shed light to its different aspects. Researchers have also pointed out the fact that comprehensive SCI model which covers all aspects such as financial, technical, managerial, social, and political is not feasible at the current state; however, it is possible to take different perspectives and explore its wide area. The current research takes a novel perspective and seeks to develop a model to identify relations between SCM practices with customer values. Through this approach internal activities in the whole chain were integratively monitored and their coherence with end customers' expectations were identified. In development of the SCI model, this thesis proposes combining ANP and BN methods to achieve objectives. ANP is a powerful tool in identifying priorities and synergies between clusters. Therefore, ANP is used to generate quantitative output from comparative analyses of SCM practices. The input data for ANP is collected though interview with experts. BN is a well established statistical method in identifying casual relationship and interdependencies between nodes of a system. BN is used initially to indentify correlation among customer values; thereafter, ANP outputs were imported to BN to generate the SCI model. The proposed SCI model is handled by BN in which nodes of the network are customer values and SCM practices.

Managerial perspective is concerned with applicability of the proposed model in decision making procedures. Managers can benefit from these findings in the design, analysis, and improvement of their supply chain in order to have an integrated supply chain which contributes to end customer values. Through applying the proposed approach, they can avoid mismatching between their applied practices and expected outcomes. Although it is theoretically possible, a practical recommendation is not to combine technical and strategic entities in one network. It is due to the fact that it increases the complexity of the network resulting in an unrealistic inference. In both cases the proposed approach and the presented case study provide foundation to develop strategic and technical networks.

The perspective of this research toward SCI provides experts with deeper knowledge of their supply chain. Keeping focus on what is expected from supply chains (or customer values) and what is actually happening inside supply chain (or practices) provide managers and decision makers with a neat explanation of their corresponding system without hinder of too much details. In addition, the proposed model is capable of handling sensitivity analysis and scenario planning which can result in saving considerable amount of resources by aligning internal activities with expected outputs. The proposed model gives managers an overall picture of the current state of their system as well as future state of the system in the case of one or more nodes are grounded in a specific state.

The proposed model is rooted in the historical data on system nodes and generated outputs are probabilistic value of each node state. Therefore, outputs are valid for the introduced data. Thus, practitioners are recommended to keep their model updated with the changes in the market and internal practices to ensure generated results resemble real world situations.

6.4 Findings of the survey and case studies

The survey collects and analyzes data about six customer values namely quality, cost, time, customization, know-how, and respect for the environment in six industrial sectors as automotive, electronics, furniture, food, fashion, and pharmaceutical (see section 5.1). This survey benefits from a dataset of 131 responses from end customers. According to confidence intervals the minimum sample size for such analysis is 124 therefore the volume of used database was sufficient to draw conclusions. Friedman test was used to comparatively analyze data. According to the results, the importance of customer values in automotive, electronics, and pharmaceutical industries was: quality, cost, respect for the environment, know-how, customization, time; in the electronic industry: quality, cost, respect for the environment, know-how, customization, time; whereas in the furniture, food, and fashion industries the order is: quality, cost, respect environment, customization, know-how, time (see table 5.2 for more details). At the end of this survey, customer value coefficient for the six studies industries was introduced. Therefore, other researchers can directly use this coefficient instead of using the whole dataset.

The first case study develops SCI model for the fashion industry (see section 5.2). It starts with building BN model of customer values in this industry. Thereafter, supply chain practices (categorized into manufacturing and logistics) are pairwisely compared with respect to those values by supply chain expert (supply chain specialist of Upward Unlimited Company, USA). In general state the order of studies manufacturing practices was: decrease work in process, implement standards, cross functional operations, mixed production planning, and use recyclable materials. The priority in logistics practices was visibility in upstream / downstream inventories, just in time, information sharing with customer, and implementing logistics standards (see table 5.8). The SCI model of fashion industry was presented as a BN model in figure 5.4. Thereafter, sensitivity analysis of this industry with respect to cost was presented, as well as a scenario in which cost is grounded as important in the model.

The second case study develops SCI model for the food industry (see section 5.3). It follows the same procedure the previous case study. These two case studies provide experiences of using the proposed model in two different industrial sectors. The fashion industry has international range of customers with rapid changes on customer preferences, in contract food industry focuses on regional customer with low fluctuations in the preferences of the end customers. Case study of the food industry is conducted with the director of Sopplan Company, New Zealand who made pairwise comparisons between practices. According to the developed integration model (figure 5.9), the order of practices in normal state was: implement standards, cross functional operations, decrease work in process, mixed production planning, and use recyclable materials. The priority in logistics practices was: information sharing with customer, just in time, visibility is upstream / downstream inventories, and implementing logistics standards (see table 5.14). Thereafter, sensitivity analysis of this industry regarding respect environment is presented, as well as a scenario in which respect environment is grounded as important in the model.

6.5 Recommendation for future research

The context of SCI addresses several topics which require detail research. Further research may be pursued in two main streams. On one stream, aspects of SCI such as financial, cultural, and organizational integrations can be investigated. On the second stream, tools such as Petri net and Fuzzy logic may be deeply investigated for their potential to tackle SCI issues.

Further research may expand the scope of the current research to include other SCI topics in the model. The current research builds a theoretically rich and practically flexible platform to address a specific aspect of SCI. Further research may introduce financial, cultural, environmental, political, and organizational issues to the proposed model. Apparently, introduction of any of these fields require relevant selection of nodes, typology of the model, and identification of node states which should be done by experts of the fields. Researchers may also try to customize the proposed model through including special characteristics of different industries. Moving into this direction may shrink the scope meanwhile increase the accuracy. In addition, such customization will open the possibility of conducting cross industrial studies to identify the similarities and differences between industries in both theoretical and practical ways.

SCI model can be developed by employing other tools such as Perti net or Fuzzy logic. The current research used BN and ANP due to its scope on addressing supply chain practices and customer values. However, further research may employ other tools in order to dig into other fields in integration. There is few and limited research on application of such tools in SCI which makes the potential for researchers to investigate the strength of them in dealing with SCI obstacles and issues.

Finally, further research can replicate the approach of this thesis in different industrial sectors as well as different cultural backgrounds. I tried to include in the body of the thesis the data and analysis of the data which were collected for the case studies; this data can be used in further researches to undergo data mining procedures and comparisons. In the presence of data about other fields, new scenarios can be planned to reach new results.

There are two appendixes after the references sections. The appendix A provides collected data about customer values in six industries. The dataset of each industry includes 131 responses from end customers which are gathered via a comparative design questionnaire. The analysis of this appendix is used in the customer value survey presented in the section 5.1. The appendix B presents the questions which were used in the interview with experts concerning comparative analysis of practices. The collected data through interviews was used in the ANP model to identify priorities and synergies of practices.

References

Abad-Grau, M. M., and Arias-Aranda, D. (2006). Operations strategy and flexibility: modeling with Bayesian classifiers. *Industrial Management and Data Systems*, *106*(4), 460–484. doi:10.1108/02635570610661570

Abd El-Aal, M. A. M., El-Sharief, M. A., Ezz El-Deen, A., and Nassr, A. B. (2011). Supply chain performance evaluation: a comprehensive evaluation system. *International Journal of Business Performance and Supply Chain Modelling*, *3*(2), 141–166. doi:10.1504/IJBPSCM.2011.041376

Agarwal, A., and Shankar, R. (2002). Analyzing alternatives for improvement in supply chain performance. *Work Study*, *51*(1), 32–37. doi:10.1108/00438020210415497

Agarwal, A., Shankar, R., and Tiwari, M. K. (2006). Modeling the metrics of lean, agile and leagile supply chain: An ANP-based approach. *European Journal of Operational Research*, *173*(1), 211–225. doi:10.1016/j.ejor.2004.12.005

Aktar Demirtas, E., and Ustun, O. (2009). Analytic network process and multi-period goal programming integration in purchasing decisions. *Computers and Industrial Engineering*, *56*(2), 677–690. doi:10.1016/j.cie.2006.12.006

Alam, I. (2006). Process of customer interaction in new service development. *Involving customers in new service development*, 15–32.

Algarni, A., Jamal, A., Ahmad, A., Algarni, A. M., and Tozan, M. (2006). Neural network-based failure rate prediction for De Havilland Dash-8 tires. *Engineering Applications of Artificial Intelligence*, *19*(6), 681–691. doi:10.1016/j.engappai.2006.01.005

Almukkahal, R., DeLancey, D., Lawsky, E., Meery, B., and Ottman, L. (2011). *CK-12 Advanced Probability and Statistics* (2nd ed.). CK-12 Foundation.

Aloini, D. (2012). Supply chain management: a review of implementation risks in the construction industry. *Business Process Management Journal*, *18*(5), 735–761. doi:10.1108/14637151211270135

Ambroggi, M., and Trucco, P. (2011). Modelling and assessment of dependent performance shaping factors through Analytic Network Process. *Reliability Engineering and System Safety*, *96*(7), 849–860. doi:10.1016/j.ress.2011.03.004

Amini, M., Wakolbinger, T., Racer, M., and Nejad, M. G. (2012). Alternative supply chain production–sales policies for new product diffusion: An agent-based modeling and simulation approach. *European Journal of Operational Research*, *216*(2), 301–311. doi:10.1016/j.ejor.2011.07.040

Ancarani, A. (2009). Supplier evaluation in local public services: Application of a model of value for customer. *Journal of Purchasing and Supply Management*, *15*(1), 33–42. doi:10.1016/j.pursup.2008.09.003

Angeles, R. (2009). Anticipated IT infrastructure and supply chain integration capabilities for RFID and their associated deployment outcomes. *International Journal of Information Management*, *29*(3), 219–231. doi:10.1016/j.ijinfomgt.2008.09.001

Angerhofer, B., and Angelides, M. (2006). A model and a performance measurement system for collaborative supply chains. *Decision Support Systems*, *42*(1), 283–301. doi:10.1016/j.dss.2004.12.005

Aryee, G., Naim, M. M., and Lalwani, C. (2008). Supply chain integration using a maturity scale. *Journal of Manufacturing Technology Management*, *19*(5), 559–575. doi:10.1108/17410380810877258

Asif, M., Fisscher, O. a. M., Bruijn, E. J., and Pagell, M. (2010). Integration of management systems: A methodology for operational excellence and strategic flexibility. *Operations Management Research*, *3*(3-4), 146–160. doi:10.1007/s12063-010-0037-z

Askariazad, M., and Wanous, M. (2009). A proposed value model for prioritising supply chain performance measures. *International Journal of Business Performance and Supply Chain Modelling*, *1*(2/3), 115–128. doi:10.1504/IJBPSCM.2009.030637

Autry, C. W., Zacharia, Z. G., and Lamb, C. W. (2008). A Logistics Strategy Taxonomy. *Journal of Business Logistics*, *29*(2), 27–51. doi:10.1002/j.2158-1592.2008.tb00086.x

Ayag, Z., Samanlioglu, F., and Buyukozkan, G. (2012). A fuzzy QFD approach to determine supply chain management strategies in the dairy industry. *Journal of Intelligent Manufacturing*. doi:10.1007/s10845-012-0639-4

Azevedo, S. G., Carvalho, H., and Cruz-Machado, V. (2011). A proposal of LARG Supply Chain Management Practices and a Performance Measurement System. *International Journal of e-Education, e-Business, e-Management and e-Learning*, *1*(1), 7–14.

Baesens, B., Verstraeten, G., Poel, D. Van den, Egmont-Petersen, M., Kenhove, P. Van, and Vanthienen, J. (2004). Bayesian network classifiers for identifying the slope of the customer lifecycle of long-life customers. *European Journal of Operational Research*, *156*(2), 508–523. doi:10.1016/S0377-2217(03)00043-2

Bagchi, P. K., Ha, B. C., Skjoett-Larsen, T., and Soerensen, L. B. (2005). Supply chain integration: a European survey. *International Journal of Logistics Management*, *16*(2), 275–294. doi:10.1108/09574090510634557

Baharanchi, S. R. H. (2011). Investigating relationship between product features and supply chain integration. *World Academy of Science, Engineering and Technology*, *81*, 530–534.

Baharanchi, S. R. H. (2009). Investigation of the Impact of Supply Chain Integration on Product Innovation and Quality. *Scientia Iranica: Transaction E - Industrial Engineering*, *16*(1), 81–89.

Barnes, B. R., Naudé, P., and Michell, P. (2007). Perceptual gaps and similarities in buyer–seller dyadic relationships. *Industrial Marketing Management*, *36*(5), 662–675. doi:10.1016/j.indmarman.2006.04.004

Bask, A., Lipponen, M., Rajahonka, M., and Tinnila, M. (2011). Framework for modularity and customization: service perspective. *Journal of Business and Industrial Marketing*, *26*(5), 306–319. doi:10.1108/08858621111144370

Bayes, T., and Price, R. (1763). An Essay towards Solving a Problem in the Doctrine of Chances. By the Late Rev. Mr. Bayes, F. R. S. Communicated by Mr. Price, in a Letter to John Canton, A. M.

F. R. S. *Philosophical Transactions of the Royal Society of London*, *53*, 370–418. doi:10.1098/rstl.1763.0053

Bhagwat, R., and Sharma, M. K. (2007). Performance measurement of supply chain management: A balanced scorecard approach. *Computers and Industrial Engineering*, *53*(1), 43–62. doi:10.1016/j.cie.2007.04.001

Bhardwaj, V., and Fairhurst, A. (2010). Fast fashion: response to changes in the fashion industry. *The International Review of Retail, Distribution and Consumer Research*, *20*(1), 165–173. doi:10.1080/09593960903498300

Bhatti, R. S., Kumar, P., and Kumar, D. (2010). A loss function based decision support model for 3PL selection by 4PLs. *International Journal of Integrated Supply Management*, *5*(4), 365–375. doi:10.1504/IJISM.2010.035643

Bie, R., Fu, Z., Sun, Q., and Chen, C. (2010). A Comparison Study of Bayesian Classifiers on Web Pages Classification. *New Generation Computing*, *28*(2), 161–168. doi:10.1007/s00354-008-0083-3

Blocker, C. P. (2011). Modeling customer value perceptions in cross-cultural business markets. *Journal of Business Research*, *64*(5), 533–540. doi:10.1016/j.jbusres.2010.05.001

Blocker, C. P., Flint, D. J., Myers, M. B., and Slater, S. F. (2010). Proactive customer orientation and its role for creating customer value in global markets. *Journal of the Academy of Marketing Science*, *39*(2), 216–233. doi:10.1007/s11747-010-0202-9

Boudali, H., and Dugan, J. (2005). A discrete-time Bayesian network reliability modeling and analysis framework. *Reliability Engineering and System Safety*, *87*(3), 337–349. doi:10.1016/j.ress.2004.06.004

Bozarth, C., Warsing, D., Flynn, B., and Flynn, E. (2009). The impact of supply chain complexity on manufacturing plant performance. *Journal of Operations Management*, *27*(1), 78–93. doi:10.1016/j.jom.2008.07.003

Braunscheidel, M. J., Suresh, N. C., and Boisner, A. D. (2010). Investigating the impact of organizational culture on supply chain integration. *Human Resource Management*, *49*(5), 883–911. doi:10.1002/hrm.20381

Bravo Vergel, Y., and Sculpher, M. (2006). Making decisions under uncertainty--the role of probabilistic decision modelling. *Family practice*, *23*(4), 391–2. doi:10.1093/fampra/cml037

Briscoe, G., and Dainty, A. (2005). Construction supply chain integration: an elusive goal? *Supply Chain Management: An International Journal*, *10*(4), 319–326. doi:10.1108/13598540510612794

Bullinger, H., Kühner, M., and Van Hoof, A. (2002). Analysing supply chain performance using a balanced measurement method. *International Journal of Production Research*, *40*(15), 3533–3543. doi:10.1080/00207540210161669

Businessweek, "Motorola's Fuzzy Camera-Phone Picture", December 11, 2003, Retrieved from http://www.businessweek.com/stories/2003-12-11/motorolas-fuzzy-camera-phone-picture [Accessed: April 11, 2013]

Cachon, G., Fisher, M. (2000). Supply chain inventory management and the value of shared information. *Management Science*, 46(8), 1032-1048.

Cagliano, R., Caniato, F., and Spina, G. (2006). The linkage between supply chain integration and manufacturing improvement programmes. *International Journal of Operations and Production Management*, *26*(3), 282–299. doi:10.1108/01443570610646201

Cai, J., Liu, X., Xiao, Z., and Liu, J. (2009). Improving supply chain performance management: A systematic approach to analyzing iterative KPI accomplishment. *Decision Support Systems*, *46*(2), 512–521. doi:10.1016/j.dss.2008.09.004

Cai, Z., Sun, S., Si, S., and Yannou, B. (2011). Identifying product failure rate based on a conditional Bayesian network classifier. *Expert Systems with Applications*, *38*(5), 5036–5043. doi:10.1016/j.eswa.2010.09.146

Cambra-Fierro, J., and Ruiz-Benitez, R. (2009). Advantages of intermodal logistics platforms: insights from a Spanish platform. *Supply Chain Management: An International Journal*, *14*(6), 418–421. doi:10.1108/13598540910995183

Cao, W., and Zhu, H. (2011). Computer and Computing Technologies in Agriculture IV. (D. Li, Y. Liu, and Y. Chen, Eds.)*IFIP Advances in Information and Communication Technology*, *346*, 14–19. doi:10.1007/978-3-642-18354-6

Carter, P. L., Monczka, R. M., Ragatz, G. L., and Jennings, P. L. (2009). *Supply Chain Integration : Challenges and Good Practices*. Institute for Supply Management^{TM} and W. P. Carey School of Business at Arizona State University.

Carvalho, H., and Cruz-Machado, V. (2009). Lean , agile , resilient and green supply chain : a review. In J. Xu, Y. Jiang, and V. Kachitvichyanukul (Eds.), *Proceedings of the Third International Conference on Management Science and Engineering Management* (pp. 3–14). World Academic Press, World Academic Union.

Carvalho, H., Maleki, M., and Cruz-Machado, V. (2012). The links between supply chain disturbances and resilience strategies. *International Journal of Agile Systems and Management*, *5*(3), 203–234. doi:10.1504/12.47653

Cavusoglu, H., Cavusoglu, H., and Raghunathan, S. (2012). Value of and Interaction between Production Postponement and Information Sharing Strategies for Supply Chain Firms. *Production and Operations Management*, *21*(3), 470–488. doi:10.1111/j.1937-5956.2011.01286.x

Chan, F. T. S., Yee-Loong Chong, A., and Zhou, L. (2012). An empirical investigation of factors affecting e-collaboration diffusion in SMEs. *International Journal of Production Economics*, *138*(2), 329–344. doi:10.1016/j.ijpe.2012.04.004

Chan, H. K., and Chan, F. T. S. (2010). A review of coordination studies in the context of supply chain dynamics. *International Journal of Production Research*, *48*(10), 2793–2819. doi:10.1080/00207540902791843

Chatfield, D. C., Harrison, T. P., and Hayya, J. C. (2006). SISCO: An object-oriented supply chain simulation system. *Decision Support Systems*, *42*(1), 422–434. doi:10.1016/j.dss.2005.02.002

Chen, D., Doumeingts, G., and Vernadat, F. (2008). Architectures for enterprise integration and interoperability: Past, present and future. *Computers in Industry*, *59*(7), 647–659. doi:10.1016/j.compind.2007.12.016

Chen, H., Daugherty, P. J., and Roath, A. S. (2009). Defining and Operationalizing Supply Chain Process Integration. *Journal of Business Logistics*, *30*(1), 63–84. doi:10.1002/j.2158-1592.2009.tb00099.x

Chen, I. J., and Paulraj, A. (2004). Understanding supply chain management: critical research and a theoretical framework. *International Journal of Production Research*, *42*(1), 131–163. doi:10.1080/00207540310001602865

Chen, I. J., and Paulraj, A. (2004). Towards a theory of supply chain management: the constructs and measurements. *Journal of Operations Management*, *22*(2), 119–150. doi:10.1016/j.jom.2003.12.007

Chen, I. J., Paulraj, A., and Lado, A. A. (2004). Strategic purchasing, supply management, and firm performance. *Journal of Operations Management*, *22*(5), 505–523. doi:10.1016/j.jom.2004.06.002

Chen, W. C., Tseng, S. S., and Wang, C. Y. (2005). A novel manufacturing defect detection method using association rule mining techniques. *Expert Systems with Applications*, *29*(4), 807–815. doi:10.1016/j.eswa.2005.06.004

Cheng, J. C. P., Law, K. H., Bjornsson, H., Jones, A., and Sriram, R. (2010). A service oriented framework for construction supply chain integration. *Automation in Construction*, *19*(2), 245–260. doi:10.1016/j.autcon.2009.10.003

Cheung, C. F., Cheung, C. M., and Kwok, S. K. (2012). A Knowledge-based Customization System for Supply Chain Integration. *Expert Systems with Applications*, *39*(4), 3906–3924. doi:10.1016/j.eswa.2011.08.096

Childerhouse, P., Deakins, E., Böhme, T., Towill, D. R., Disney, S. M., and Banomyong, R. (2011). Supply chain integration: an international comparison of maturity. *Asia Pacific Journal of Marketing and Logistics*, *23*(4), 531–552. doi:10.1108/13555851111165075

Chin, K. S., Tang, D.-W., Yang, J. B., Wong, S. Y., and Wang, H. (2009). Assessing new product development project risk by Bayesian network with a systematic probability generation methodology. *Expert Systems with Applications*, *36*(6), 9879–9890. doi:10.1016/j.eswa.2009.02.019

Chiu, M. C., and Okudan, G. (2011). An Integrative Methodology for Product and Supply Chain Design Decisions at the Product Design Stage. *Journal of Mechanical Design*, *133*(2), 021008–1–15. doi:10.1115/1.4003289

Cho, G., and Soh, S. (2010). Optimal decision-making for supplier-buyer ' s maximum profit in a two echelon supply chain. *Journal of Business Management*, *4*(5), 687–694.

Christopher, M. (2000). The Agile Supply Chain. *Industrial Marketing Management*, *29*(1), 37–44. doi:10.1016/S0019-8501(99)00110-8

Chung, S. H., Lee, A. H. I., and Pearn, W. L. (2005). Analytic network process (ANP) approach for product mix planning in semiconductor fabricator. *International Journal of Production Economics*, *96*(1), 15–36. doi:10.1016/j.ijpe.2004.02.006

Cinar, D., and Kayakutlu, G. (2010). Scenario analysis using Bayesian networks: A case study in energy sector. *Knowledge-Based Systems*, *23*(3), 267–276. doi:10.1016/j.knosys.2010.01.009

Cook, L. S., Heiser, D. R., and Sengupta, K. (2011a). The moderating effect of supply chain role on the relationship between supply chain practices and performance: An empirical analysis. *International Journal of Physical Distribution and Logistics Management*, *41*(2), 104–134. doi:10.1108/09600031111118521

Cook, L. S., Heiser, D. R., and Sengupta, K. (2011b). The moderating effect of supply chain role on the relationship between supply chain practices and performance: An empirical analysis. *International Journal of Physical Distribution and Logistics Management*, *41*(2), 104–134. doi:10.1108/09600031111118521

Cooper, M. C., Lambert, D. M., and Pagh, J. D. (1997). Supply chain management: more than a new name for logistics. *International Journal of Logistics Management*, *8*(1), 1 – 14.

Council of Supply Chain Management Professionals (CSCMP). (2010). Supply Chain Management Terms and Glossary. Retrieved April 03, 2013, from http://cscmp.org/sites/default/files/user_uploads/resources/downloads/glossary.pdf

Croson, R., and Donohue, K. (2006). Behavioral Causes of the Bullwhip Effect and the Observed Value of Inventory Information. *Management Science*, *52*(3), 323–336. doi:10.1287/mnsc.1050.0436

Dabhilkar, M. (2011). Trade-offs in make-buy decisions. *Journal of Purchasing and Supply Management*, *17*(3), 158–166. doi:10.1016/j.pursup.2011.04.002

Dabhilkar, M., Bengtsson, L., Von Haartman, R., and Åhlström, P. (2009). Supplier selection or collaboration? Determining factors of performance improvement when outsourcing manufacturing. *Journal of Purchasing and Supply Management*, *15*(3), 143–153. doi:10.1016/j.pursup.2009.05.005

Dada, M., Petruzzi, N. C., and Schwarz, L. B. (2003). *A Newsvendor Model with Unreliable Suppliers*. *Business*. University of Illinois at Urbana-Champaign.

Danese, P., and Romano, P. (2011). Supply chain integration and efficiency performance: a study on the interactions between customer and supplier integration. *Supply Chain Management: An International Journal*, *16*(4), 220–230. doi:10.1108/13598541111139044

Danese, P., and Romano, P. (2012). Relationship between downstream integration, performance measurement systems and supply network efficiency. *International Journal of Production Research*, *50*(7), 2002–2013. doi:10.1080/00207543.2011.575894

Das, A., Narasimhan, R., and Talluri, S. (2006). Supplier integration—Finding an optimal configuration. *Journal of Operations Management*, *24*(5), 563–582. doi:10.1016/j.jom.2005.09.003

Dawes, S. S., Cresswell, A. M., and Pardo, T. A. (2009). From “Need to Know” to “Need to Share”: Tangled Problems, Information Boundaries, and the Building of Public Sector Knowledge

Networks. *Public Administration Review*, *69*(3), 392–402. doi:10.1111/j.1540-6210.2009.01987_2.x

Dibrell, C., Craig, J. B., and Hansen, E. N. (2011). How managerial attitudes toward the natural environment affect market orientation and innovation. *Journal of Business Research*, *64*(4), 401–407. doi:10.1016/j.jbusres.2010.09.013

Dooley, L. M. (2002). Case Study Research and Theory Building. *Advances in Developing Human Resources*, *4*(3), 335–354. doi:10.1177/1523422302043007

Doran, D., and Giannakis, M. (2011a). An examination of a modular supply chain: a construction sector perspective. *Supply Chain Management: An International Journal*, *16*(4), 260–270. doi:10.1108/13598541111139071

Doran, D., and Giannakis, M. (2011b). An examination of a modular supply chain: a construction sector perspective. *Supply Chain Management: An International Journal*, *16*(4), 260–270. doi:10.1108/13598541111139071

Droge, C., Jayaram, J., and Vickery, S. K. (2004). The effects of internal versus external integration practices on time-based performance and overall firm performance. *Journal of Operations Management*, *22*(6), 557–573. doi:10.1016/j.jom.2004.08.001

Droge, C., Vickery, S. K., and Jacobs, M. A. (2012). Does Supply Chain Integration Mediate the Relationships Between Product/Process Strategy and Service Performance? An Empirical Study. *International Journal of Production Economics*, *137*(2), 250–262. doi:10.1016/j.ijpe.2012.02.005

Druzdzel, M. J. (1999). SMILE: Structural Modeling, Inference, and Learning Engine and GeNIe: A development environment for graphical decision-theoretic models. *Sixteenth National Conference on Artificial Intelligence (AAAI-99)* (pp. 902–903). Menlo Park, CA: AAAI Press/The MIT Press.

Du, L. (2007). Acquiring competitive advantage in industry through supply chain integration: a case study of Yue Yuen Industrial Holdings Ltd. Journal of Enterprise Information Management, 20(5), 527–543. doi:10.1108/17410390710823680

Dudley, R. (2013) "Customers Flee Wal-Mart Empty Shelves for Target, Costco", *Bloomberg*, March 26, 2013. Retrieved from http://www.bloomberg.com/news/2013-03-26/customers-flee-wal-mart-empty-shelves-for-target-costco.html [Accessed: April 11, 2013]

Dumrongsiri, A., Fan, M., Jain, A., and Moinzadeh, K. (2008). A supply chain model with direct and retail channels. European Journal of Operational Research, 187(3), 691–718. doi:10.1016/j.ejor.2006.05.044

Efendigil, T., and Önüt, S. (2012). An integration methodology based on fuzzy inference systems and neural approaches for multi-stage supply-chains. *Computers and Industrial Engineering*, *62*(2), 554–569. doi:10.1016/j.cie.2011.11.004

Eisenhardt, K. M., and Graebner, M. E. (2007). Theory Building From Cases: Opportunities and Challenges. *Academy of Management Journal*, *50*(1), 25–32. doi:10.5465/AMJ.2007.24160888

Elia, J. A., Baliban, R. C., and Floudas, C. A. (2012). Nationwide Energy Supply Chain Analysis for Hybrid Feedstock Processes with Significant CO 2 Emissions Reduction. *AIChE Journal*, *58*(7). doi:10.1002/aic

Ellegaard, C., and Koch, C. (2012). The effects of low internal integration between purchasing and operations on suppliers' resource mobilization. *Journal of Purchasing and Supply Management*, *18*(3), 148–158. doi:10.1016/j.pursup.2012.06.001

Eltantawy, R. a., Giunipero, L., and Fox, G. L. (2009). A strategic skill based model of supplier integration and its effect on supply management performance. *Industrial Marketing Management*, *38*(8), 925–936. doi:10.1016/j.indmarman.2008.12.022

Eng, T. (2005). The Influence of a Firm's Cross-Functional Orientation on Supply Chain Performance. *Journal of Supply Chain Management*, *41*(4), 4–16. doi:10.1111/j.1745-493X.2005.04104002.x

Esmaeili, M., Aryanezhad, M. B., and Zeephongsekul, P. (2009). A game theory approach in seller–buyer supply chain. *European Journal of Operational Research*, *195*(2), 442–448. doi:10.1016/j.ejor.2008.02.026

Fabbe-Costes, N., and Jahre, M. (2007). Supply chain integration improves performance: the Emperor's new suit? *International Journal of Physical Distribution and Logistics Management*, *37*(10), 835–855. doi:10.1108/09600030710848941

Fawcett, S. E., and Magnan, G. M. (2002a). The rhetoric and reality of supply chain integration. *International Journal of Physical Distribution and Logistics Management*, *32*(5), 339–361. doi:10.1108/09600030210436222

Fisher, M. L. (1997). What is the Right Supply Chain for Your Product ? *Harvard Business Review*, 105–116.

Fisher, M. L., Raman, A., and McClelland, A. S. (1994). Rocket science retailing is almost here: Are you ready? *Harvard Business Review*, *72*(3), 83–93.

Flint, D. J., Blocker, C. P., and Boutin Jr., P. J. (2011). Customer value anticipation, customer satisfaction and loyalty: An empirical examination. *Industrial Marketing Management*, *40*(2), 219–230. doi:10.1016/j.indmarman.2010.06.034

Flynn, B. B., Huo, B., and Zhao, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of Operations Management*, *28*(1), 58–71. doi:10.1016/j.jom.2009.06.001

Forrester, J. (1961). *Industrial Dynamics*. New York, NY: Wiley.

Forslund, H., and Jonsson, P. (2007). Dyadic integration of the performance management process: A delivery service case study. *International Journal of Physical Distribution and Logistics Management*, *37*(7), 546–567. doi:10.1108/09600030710776473

Forslund, H., and Jonsson, P. (2009). Obstacles to supply chain integration of the performance management process in buyer-supplier dyads: The buyers' perspective. *International Journal of Operations and Production Management*, *29*(1), 77–95. doi:10.1108/01443570910925370

Franca, R. B., Jones, E. C., Richards, C. N., and Carlson, J. P. (2010). Multi-objective stochastic supply chain modeling to evaluate tradeoffs between profit and quality. *International Journal of Production Economics*, *127*(2), 292–299. doi:10.1016/j.ijpe.2009.09.005

Frohlich, M. T., and Westbrook, R. (2001). Arcs of integration: an international study of supply chain strategies. *Journal of Operations Management*, *19*(2), 185–200. doi:10.1016/S0272-6963(00)00055-3

Gallarza, M. G., Gil-Saura, I., and Holbrook, M. B. (2011). The value of value: Further excursions on the meaning and role of customer value. *Journal of Consumer Behaviour*, *10*(4), 179–191. doi:10.1002/cb.328

Gambelli, D., and Bruschi, V. (2010). A Bayesian network to predict the probability of organic farms' exit from the sector: A case study from Marche, Italy. *Computers and Electronics in Agriculture*, *71*(1), 22–31. doi:10.1016/j.compag.2009.11.004

Ganesan, E. (2011). Composite Enterprise Process Modeling (CEProM) Framework - Setting Up a Process Modeling Center of Excellence Using CEProM Framework. *13th International Conference on Enterprise Information Systems (ICEIS)*.

Gerber, T., and Saiki, D. (2010). Success According to Professionals in the Fashion Industry. *The Career Development Quarterly*, *58*(3), 219–229. doi:10.1002/j.2161-0045.2010.tb00188.x

Giannakis, M., and Louis, M. (2011). A multi-agent based framework for supply chain risk management. *Journal of Purchasing and Supply Management*, *17*(1), 23–31. doi:10.1016/j.pursup.2010.05.001

Gimenez, C., Van der Vaart, T., and Van Donk, D. P. (2012). Supply chain integration and performance: the moderating effect of supply complexity. *International Journal of Operations and Production Management*, *32*(5), 583–610. doi:10.1108/01443571211226506

Giunipero, L. C., Hooker, R. E., Matthews, S. C., and Yoon, T.E. and Brudvig, S. (2008). A decade of SCM literature: past, present and future implications. *Journal of Supply Chain Management*, *44*(4), 66–86. doi:10.1111/j.1745-493X.2008.00073.x

Gligor, D. M., and Holcomb, M. C. (2012). Understanding the role of logistics capabilities in achieving supply chain agility: a systematic literature review. *Supply Chain Management: An International Journal*, *17*(4), 438–453. doi:10.1108/13598541211246594

Gonzalez, P., Sarkis, J., Adenso-Diaz, B. (2008) Environmental management system certification and its influence on corporate practices: Evidence from the automotive industry. *International Journal of Operations & Production Management*, 28(11), 1021-1041. doi: 10.1108/01443570810910179

Gopnik, A., and Tenenbaum, J. B. (2007). Bayesian networks, Bayesian learning and cognitive development. *Developmental science*, *10*(3), 281–7. doi:10.1111/j.1467-7687.2007.00584.x

Graf, A., and Maas, P. (2008). Customer value from a customer perspective: a comprehensive review. *Journal für Betriebswirtschaft*, *58*(1), 1–20. doi:10.1007/s11301-008-0032-8

Gregoriades, A., and Mouskos, K. C. (2013). Black spots identification through a Bayesian Networks quantification of accident risk index. *Transportation Research Part C: Emerging Technologies*, *28*, 28–43. doi:10.1016/j.trc.2012.12.008

Guan, W., and Rehme, J. (2012). Vertical integration in supply chains: driving forces and consequences for a manufacturer's downstream integration. *Supply Chain Management: An International Journal*, *17*(2), 187–201. doi:10.1108/13598541211212915

Gunasekaran, A, Lai, K., and Edwincheng, T. (2008). Responsive supply chain: A competitive strategy in a networked economy. *Omega*, *36*(4), 549–564. doi:10.1016/j.omega.2006.12.002

Gunasekaran, A., Patel, C., and McGauRoland E. (2004). A framework for supply chain performance measurement. *International Journal of Production Economics*, *87*(3), 333–347. doi:10.1016/j.ijpe.2003.08.003

Gunasekaran, A., Patel, C., and Tirtiroglu, E. (2001). Performance measures and metrics in a supply chain environment. *International Journal of Operations and Production Management*, *21*(1/2), 71–87. doi:10.1108/01443570110358468

Hadaya, P., and Cassivi, L. (2007). The role of joint collaboration planning actions in a demand-driven supply chain. *Industrial Management and Data Systems*, *107*(7), 954–978. doi:10.1108/02635570710816694

Handfield, R. (1998). The scientific theory-building process: a primer using the case of TQM. *Journal of Operations Management*, *16*(4), 321–339. doi:10.1016/S0272-6963(98)00017-5

Handfield, R., and Nichols, E. L. (1999). *Introduction to supply chain management* (p. 183). Upper Saddle River, N.J.: Prentice Hall.

Harland, C. M. (1996). Supply Chain Management, Purchasing and Supply Management, Logistics, Vertical Integration, Materials Management and Supply Chain Dynamics. In N. Slack (Ed.), *Blackwell Encyclopedic Dictionary of Operations Management*. Blackwell, UK.

Hartmann, E., Kerkfeld, D., and Henke, M. (2012). Top and bottom line relevance of purchasing and supply management. *Journal of Purchasing and Supply Management*, *18*(1), 22–34. doi:10.1016/j.pursup.2011.12.001

He, Y., and Lai, K. K. (2012). Supply chain integration and service oriented transformation: Evidence from Chinese equipment manufacturers. *International Journal of Production Economics*, *135*(2), 791–799. doi:10.1016/j.ijpe.2011.10.013

Hendricks, K. B., Singhal, V. R., and Zhang, R. (2009). The effect of operational slack, diversification, and vertical relatedness on the stock market reaction to supply chain disruptions. *Journal of Operations Management*, *27*(3), 233–246. doi:10.1016/j.jom.2008.09.001

Hilmola, O. P., Hejazi, A., and Ojala, L. (2005). Supply chain management research using case studies: a literature analysis. *International Journal of Integrated Supply Management*, *1*(3), 294–311.

Ho, C. F., Tai, Y. M., and Lee, M. X. (2007). Information Sharing and Coordination Mechanism for Supply Chain Management: A Case Study of the Automotive Industry. *2007 International Conference on Wireless Communications, Networking and Mobile Computing*, 4862–4865. doi:10.1109/WICOM.2007.1193

Hong, P. C., Dobrzykowski, D. D., and Vonderembse, M. A. (2010a). Integration of supply chain IT and lean practices for mass customization: Benchmarking of product and service focused manufacturers. *Benchmarking: An International Journal*, *17*(4), 561–592. doi:10.1108/14635771011060594

Hoole, R. (2005). Five ways to simplify your supply chain. *Supply Chain Management: An International Journal*, *10*(1), 3–6. doi:10.1108/13598540510578306

Horvath, L. (2001). Collaboration: the key to value creation in supply chain management. *Supply Chain Management: An International Journal*, *6*(5), 205–207. doi:10.1108/EUM0000000006039

Howitt, D. D., and Cramer, D. D. (2010). *Introduction to Statistics in Psychology* (3rd ed., p. 672). Edinburgh, England: Prentice Hall.

Hsien-Jen, L. (2012). An integrated supply chain inventory model with imperfect-quality items, controllable lead time and distribution-free demand. *Yugoslav Journal of Operations Research*, *22*(2), 19–19. doi:10.2298/YJOR110506019L

Hsuan Mikkola, J., and Skjott-Larsen, T. (2004). Supply-chain integration: implications for mass customization, modularization and postponement strategies. *Production Planning and Control*, *15*(4), 352–361. doi:10.1080/0953728042000238845

Hunt, D. M., Geiger-Oneto, S., and Varca, P. E. (2012). Satisfaction in the context of customer co-production: A behavioral involvement perspective. *Journal of Consumer Behaviour*, *11*(5), 347–356. doi:10.1002/cb.1370

Huo, B. (2012). The impact of supply chain integration on company performance: an organizational capability perspective. *Supply Chain Management: An International Journal*, *17*(6), 596–610. doi:10.1108/13598541211269210

Ivanov, D. (2009). Supply chain multi-structural (re)-design. *International Journal of Integrated Supply Management*, *5*(1), 19–37. doi:10.1504/IJISM.2009.026203

Jayaram, J., and Tan, K. C. (2010). Supply chain integration with third-party logistics providers. *International Journal of Production Economics*, *125*(2), 262–271. doi:10.1016/j.ijpe.2010.02.014

Jharkharia, S., and Shankar, R. (2007). Selection of logistics service provider: An analytic network process (ANP) approach. *Omega*, *35*(3), 274–289. doi:10.1016/j.omega.2005.06.005

Johnsen, T. E. (2009). Supplier involvement in new product development and innovation: Taking stock and looking to the future. *Journal of Purchasing and Supply Management*, *15*(3), 187–197. doi:10.1016/j.pursup.2009.03.008

Jr, R. G. R., Chen, H., Upreti, R., Fawcett, S. E., and Adams, F. G. (2009). The moderating role of barriers on the relationship between drivers to supply chain integration and firm performance. *International Journal of Physical Distribution and Logistics Management*, *39*(10), 826–840. doi:10.1108/09600030911011432

Jüttner, U. (2005). Supply chain risk management: Understanding the business requirements from a practitioner perspective. *The International Journal of Logistics Management*, *16*(1), 120–141. doi:10.1108/09574090510617385

Kammerer, D. (2009) The effects of customer benefit and regulation on environmental product innovation: Empirical evidence from appliance manufacturers in Germany. *Ecological Economics*, 68(8-9), 2285-2295. doi: 10.1016/j.ecolecon.2009.02.016

Kanda, A., and Deshmukh, S. G. (2008). Supply chain coordination: Perspectives, empirical studies and research directions. *International Journal of Production Economics*, *115*(2), 316–335. doi:10.1016/j.ijpe.2008.05.011

Kang, N., Kim, J., and Park, Y. (2007). Integration of marketing domain and RandD domain in NPD design process. *Industrial Management and Data Systems*, *107*(6), 780–801. doi:10.1108/02635570710758725

Kao, H. Y., Huang, C. H., and Li, H. L. (2005). Supply chain diagnostics with dynamic Bayesian networks. *Computers and Industrial Engineering*, *49*(2), 339–347. doi:10.1016/j.cie.2005.06.002

Ketchen,, D. J., Rebarick, W., Hult, G. T. M., and Meyer, D. (2008). Best value supply chains: A key competitive weapon for the 21st century. *Business Horizons*, *51*(3), 235–243. doi:10.1016/j.bushor.2008.01.012

Khalfan, M. (2012). Supply chain integration through innovative procurement. *Malaysian construction research journal*, *8*(1), 52–70.

Khouja, M. (2003). Optimizing inventory decisions in a multi-stage multi-customer supply chain. *Transportation Research Part E: Logistics and Transportation Review*, *39*(3), 193–208. doi:10.1016/S1366-5545(02)00036-4

Kiekintveld, C., Miller, J., Jordan, P. R., Callender, L. F., and Wellman, M. P. (2009). Forecasting market prices in a supply chain game. *Electronic Commerce Research and Applications*, *8*(2), 63–77. doi:10.1016/j.elerap.2008.11.005

Kim, B., and Oh, H. (2005). The impact of decision-making sharing between supplier and manufacturer on their collaboration performance. *Supply Chain Management: An International Journal*, *10*(3), 223–236. doi:10.1108/13598540510606287

Kim, C., Lee, H., Seol, H., and Lee, C. (2011). Identifying core technologies based on technological cross-impacts: An association rule mining (ARM) and analytic network process (ANP) approach. *Expert Systems with Applications*, *38*(10), 12559–12564. doi:10.1016/j.eswa.2011.04.042

Kim, S. W. (2006). Effects of supply chain management practices, integration and competition capability on performance. *Supply Chain Management: An International Journal*, *11*(3), 241–248. doi:10.1108/13598540610662149

Kim, S. W. (2009). An investigation on the direct and indirect effect of supply chain integration on firm performance. *International Journal of Production Economics*, *119*(2), 328–346. doi:10.1016/j.ijpe.2009.03.007

Knoppen, D., Christiaanse, E., and Huysman, M. (2010). Supply chain relationships: Exploring the linkage between inter-organisational adaptation and learning. *Journal of Purchasing and Supply Management*, *16*(3), 195–205. doi:10.1016/j.pursup.2010.03.001

Kocoglu, I., Imamoglu, S. Z., Ince, H., and Keskin, H. (2011). The effect of supply chain integration on information sharing:Enhancing the supply chain performance. *Procedia - Social and Behavioral Sciences*, *24*(1), 1630–1649. doi:10.1016/j.sbspro.2011.09.016

Koh, S. C. L., Saad, S., and Arunachalam, S. (2006). Competing in the 21st century supply chain through supply chain management and enterprise resource planning integration. *International Journal of Physical Distribution and Logistics Management*, *36*(6), 455–465. doi:10.1108/09600030610677401

Kroes, J. R., and Ghosh, S. (2010). Outsourcing congruence with competitive priorities: Impact on supply chain and firm performance. *Journal of Operations Management*, *28*(2), 124–143. doi:10.1016/j.jom.2009.09.004

Kumar, D., Singh, J., and Singh, O. P. (2011). A decision support system for supplier selection for Indian textile industry using analytic hierarchy process based on fuzzy simulation. *International Journal of Business Performance and Supply Chain Modelling*, *3*(4), 364–382. doi:10.1504/IJBPSCM.2011.043836

Kumar, D., Singh, J., and Singh, O. P. (2012). WITHDRAWN: A fuzzy logic based decision support system for the evaluation of suppliers in supply chain management practices. *Mathematical and Computer Modelling*. doi:10.1016/j.mcm.2012.01.020

Kuo, Y. F., Wu, C. M., and Deng, W. J. (2009). The relationships among service quality, perceived value, customer satisfaction, and post-purchase intention in mobile value-added services. *Computers in Human Behavior*, *25*(4), 887–896. doi:10.1016/j.chb.2009.03.003

Lai, F., Zhang, M., Lee, D. M. S., and Zhao, X. (2012). The Impact of Supply Chain Integration on Mass Customization Capability: An Extended Resource-Based View. *IEEE Transactions on Engineering Management*, *59*(3), 443–456. doi:10.1109/TEM.2012.2189009

Lam, C. Y., and Ip, W. H. (2011). A customer satisfaction inventory model for supply chain integration. *Expert Systems with Applications*, *38*(1), 875–883. doi:10.1016/j.eswa.2010.07.063

Lambert, D. M. (2008). *Supply Chain Management: Processes, Partnerships, Performance, 3rd edition* (p. 431). Supply Chain Management Institute.

Lambert, D. M., and Cooper, M. C. (2000). Issues in Supply Chain Management. *Industrial Marketing Management*, *29*(1), 65–83. doi:10.1016/S0019-8501(99)00113-3

Langseth, H., and Portinale, L. (2007). Bayesian networks in reliability. *conference on Mathematical Models in Reliability,* (Vol. 92, pp. 92–108). Citeseer. doi::10.1016/j.ress.2005.11.037

Lapierre, J. (2000). Customer-perceived value in industrial contexts. *Journal of Business and Industrial Marketing*, *15*(2/3), 122–145. doi:10.1108/08858620010316831

Larson, P. D., and Kulchitsky, J. D. (2008). The promise of information sharing and the peril of information overload. *International Journal of Logistics Systems and Management*, *4*(4), 423-436. doi:10.1504/IJLSM.2008.017593

Lau, A. K. W., Yam, R. C. M., and Tang, E. P. Y. (2010). Supply chain integration and product modularity: An empirical study of product performance for selected Hong Kong manufacturing industries. *International Journal of Operations and Production Management*, *30*(1), 20–56. doi:10.1108/01443571011012361

Lau, A. K. W., Yam, R. C. M., Tang, E. P. Y., and Sun, H. Y. (2010). Factors influencing the relationship between product modularity and supply chain integration. *International Journal of Operations and Production Management*, *30*(9), 951–977. doi:10.1108/01443571011075065

Leary, D. E. O. (2008). Supporting Decisions in Real-Time Enterprises : Autonomic Supply Chain Systems. *International Handbooks Information System* (pp. 19–37).

Lee, Y. H., Cho, M. K., Kim, S. J., and Kim, Y. B. (2002). Supply chain simulation with discrete–continuous combined modeling. *Computers and Industrial Engineering*, *43*(1-2), 375–392. doi:10.1016/S0360-8352(02)00080-3

Lei, L., Ye, Z., Chen, W., and Yi, J. (2012). The Study of Multi-task Tracking and Evaluation Model Based on Group Enterprise Collaboration Office Platform. *2012 International Conference on Computing, Measurement, Control and Sensor Network*, 371–373. doi:10.1109/CMCSN.2012.91

Li, C., Xu, Y., and Li, H. (2005). An empirical study of dynamic customer relationship management. *Journal of Retailing and Consumer Services*, *12*(6), 431–441. doi:10.1016/j.jretconser.2005.01.003

Li, J., and Gao, Y. (2010). Base on Bayesian Network of supply chain enterprises collaborative sensitivity analysis. *2010 International Conference on Logistics Systems and Intelligent Management (ICLSIM)* (Vol. 1, pp. 160–163). IEEE. doi:10.1109/ICLSIM.2010.5461447

Li, M., and Wang, L. (2011). Feature fatigue analysis in product development using Bayesian networks. *Expert Systems with Applications*, *38*(8), 10631–10637. doi:10.1016/j.eswa.2011.02.126

Li, S., Rao, S., Ragunathan, T., and Ragunathan, B. (2005). Development and validation of a measurement instrument for studying supply chain management practices. *Journal of Operations Management*, *23*(6), 618–641. doi:10.1016/j.jom.2005.01.002

Li, X., and Chandra, C. (2007). A knowledge integration framework for complex network management. *Industrial Management and Data Systems*, *107*(8), 1089–1109. doi:10.1108/02635570710822769

Li, X. Z., and Ding, Y. J. (2012). Knowledge Flow Modeling and Analysis in Supply Chain Based on Stochastic Petri Net. *Advanced Materials Research*, *459*, 381–385. doi:10.4028/www.scientific.net/AMR.459.381

Liao, S. H., Hsieh, C. L., and Lin, Y. S. (2010). A multi-objective evolutionary optimization approach for an integrated location-inventory distribution network problem under vendor-managed inventory systems. *Annals of Operations Research*, *186*(1), 213–229. doi:10.1007/s10479-010-0801-3

Lin, C. C., and Lin, C. W. (2011). Defective item inventory model with remanufacturing or replenishing in an integrated supply chain. *International Journal of Integrated Supply Management*, *6*(3/4), 254–269. doi:10.1504/IJISM.2011.044889

Ling, L., Liang, N. A., Gou, Q., and Du, S. (2011). ATC-based task allocation in virtual enterprise. *International Journal of Integrated Supply Management*, *6*(1), 92–107. doi:10.1504/IJISM.2011.038334

Lintukangas, K., Peltola, S., and Virolainen, V. M. (2009). Some issues of supply management integration. *Journal of Purchasing and Supply Management*, *15*(4), 240–248. doi:10.1016/j.pursup.2009.03.001

Liu, G., Shah, R., and Schroeder, R. G. (2006). Linking Work Design to Mass Customization: A Sociotechnical Systems Perspective. *Decision Sciences*, *37*(4), 519–545. doi:10.1111/j.1540-5414.2006.00137.x

Liu, G., Shah, R., and Schroeder, R. G. (2012). The relationships among functional integration , mass customisation , and firm performance. *International Journal of Production Research*, *50*(3), 677–690.

Liu, H., Ke, W., Wei, K. K., Gu, J., and Chen, H. (2010). The role of institutional pressures and organizational culture in the firm's intention to adopt internet-enabled supply chain management systems. *Journal of Operations Management*, *28*(5), 372–384. doi:10.1016/j.jom.2009.11.010

Liu, S., Kasturiratne, D., and Moizer, J. (2012). A hub-and-spoke model for multi-dimensional integration of green marketing and sustainable supply chain management. *Industrial Marketing Management*, *41*(4), 581–588. doi:10.1016/j.indmarman.2012.04.005

Lo, S. M., and Power, D. (2010). An empirical investigation of the relationship between product nature and supply chain strategy. *Supply Chain Management: An International Journal*, *15*(2), 139–153. doi:10.1108/13598541011028741

Lockamy, A., and McCormack, K. (2010). Analysing risks in supply networks to facilitate outsourcing decisions. *International Journal of Production Research*, *48*(2), 593–611. doi:10.1080/00207540903175152

Lockamy, A., and McCormack, K. (2012). Modeling supplier risks using Bayesian networks. *Industrial Management and Data Systems*, *112*(2), 313–333. doi:10.1108/02635571211204317

Lockstrom, M., Schadel, J., Harrison, N., Moser, R., and Malhotra, M. K. (2010). Antecedents to supplier integration in the automotive industry: A multiple-case study of foreign subsidiaries in China. *Journal of Operations Management*, *28*(3), 240–256. doi:10.1016/j.jom.2009.11.004

Lockstrom, M., Schadel, J., Moser, R., and Harrison, N. (2011). Domestic Supplier Integration in the Chinese Automotive Industry: The Buyer's Perspective. *Journal of Supply Chain Management*, *47*(4), 44–63. doi:10.1111/j.1745-493X.2011.03239.x

Lockstrom, M., Schadel, J., Moser, R., and Harrison, N. J. (2010). Successful supplier integration in the Chinese automotive industry: a theoretical framework. *International Journal of Integrated Supply Management*, *5*(3), 260–283.

Lutz, S., and Ritter, T. (2009). Outsourcing, supply chain upgrading and connectedness of a firm's competencies. *Industrial Marketing Management*, *38*(4), 387–393. doi:10.1016/j.indmarman.2009.03.005

Lyu, J., Ding, J. H., and Chen, P. S. (2010). Coordinating replenishment mechanisms in supply chain: From the collaborative supplier and store-level retailer perspective. *International Journal of Production Economics*, *123*(1), 221–234. doi:10.1016/j.ijpe.2009.07.017

Mahadevan, S., Zhang, R., and Smith, N. (2001). Bayesian networks for system reliability reassessment. *Structural Safety*, *23*(3), 231–251. doi:10.1016/S0167-4730(01)00017-0

Maleki, M., Bashkite, V., and Cruz-Machado, V. (2012). Integration of supply chain performance with customer values through combining analytical network process and bayesian network. *23rd*

International DAAAM Symposium (Vol. 23, pp. 297–300). Vienna, Asutria: DAAAM International.

Maleki, M., and Cruz-Machado, V. (2013a). Supply chain performance monitoring using Bayesian networks. *International Journal of Business and Supply Chain Modelling*, *5*(2), 177-197. doi: 10.1504/IJBPSCM.2013.053492

Maleki, M., and Cruz-Machado, V. (2013b). Generic Integration model of practices in Lean, Agile, Resilient, and Green Supply Chain. *Review of International Comparative Management*, 14(2), 237-248.

Maleki, M., and Cruz-Machado, V. (2013c). An Empirical Review on Supply Chain Integration. *Management and Production Engineering Review*, *4*(1), 85–96. doi:10.2478/mper-2013-0010

Maleki, M., Espadinha-cruz, P., Valente, R., and Cruz-Machado, V. (2011). Supply Chain Integration Methodology: LARGe Supply Chain. *ENEGI2011 Conference* (pp. 57–66). Guimaraes, Portugal: University of Minho.

Maleki, M., Grilo, A., and Cruz-Machado, V. (2011). Obstacles of Stochastic Modeling in Supply Chain. *ENEGI2011 Conference* (pp. 41–46). Guimaraes, Portugal: University of Minho.

Maleki, M., Liiv, I., Shevtshenko, E., and Cruz-Machado, V. (2012). Classification of Supply Chain Practices According to Customer Values in Automotive Industry. In T. Otto (Ed.), *Proceedings of the 8th International Conference of DAAAM Baltic Industrial Engineering, April 19-21, 2012* (pp. 542–547). Tallinn, Estonia: Tallinn University of Technology.

Maleki, M., Shevtshenko, E., and Cruz-Machado, V. (2013). Development of Supply Chain Integration model through application of analytic network process and Bayesian network. *International Journal of Integrated Supply Management*, 8(1/2/3), 67-89. doi: 10.1504/IJBPIM.2013.054680

Manuj, I., and Mentzer, J. T. (2008). Global supply chain risk management strategies. *International Journal of Physical Distribution and Logistics Management*, *38*(3), 192–223. doi:10.1108/09600030810866986

McCarthy-Byrne, T. M., and Mentzer, J. T. (2011). Integrating supply chain infrastructure and process to create joint value. *International Journal of Physical Distribution and Logistics Management*, *41*(2), 135–161. doi:10.1108/09600031111118530

Meena, P. L., Sarmah, S. P., and Sinha, S. (2012). Measuring satisfaction in buyer-supplier relationship from suppliers perspective. *International Journal of Business Performance and Supply Chain Modelling*, *4*(1), 60–74. doi:10.1504/IJBPSCM.2012.044974

Melo, M. T., Nickel, S., and Saldanha-da-Gama, F. (2009). Facility location and supply chain management – A review. *European Journal of Operational Research*, *196*(2), 401–412. doi:10.1016/j.ejor.2008.05.007

Mendes Primo, M. A. (2010). Supply chain integration mechanisms for alleviating supply problems in manufacturing firms. *Operations Management Research*, *3*(1-2), 43–59. doi:10.1007/s12063-009-0027-1

Mennini, F. S., Panatto, D., Marcellusi, A., Cristoforoni, P., Vincenzo, R., Di Capua, E., Ferrandina, G., *et al*. (2011). Time trade-off procedure for measuring health utilities loss with human papillomavirus-induced diseases: a multicenter, retrospective, observational pilot study in Italy. *Clinical therapeutics*, *33*(8), 1084–1095.e4. doi:10.1016/j.clinthera.2011.06.012

Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., and Zacharia, Z. G. (2001). Defining Supply Chain Management. *Journal of Business Logistics*, *22*(2), 1–25. doi:10.1002/j.2158-1592.2001.tb00001.x

Min, H., and Zhou, G. (2002). Supply chain modeling: past, present and future. *Computers and Industrial Engineering*, *43*(1-2), 231–249. doi:10.1016/S0360-8352(02)00066-9

Miocevic, D. (2011). Organizational buying effectiveness in supply chain context: Conceptualization and empirical assessment. *Journal of Purchasing and Supply Management*, *17*(4), 246–255. doi:10.1016/j.pursup.2011.09.001

Mitra, S., and Singhal, V. (2008). Supply chain integration and shareholder value : Evidence from consortium based industry exchanges. *Journal of Operations Management*, *26*, 96–114. doi:10.1016/j.jom.2007.05.002

Mohammadi Bidhandi, H., Mohd. Yusuff, R., Megat Ahmad, M. M. H., and Abu Bakar, M. R. (2009). Development of a new approach for deterministic supply chain network design. *European Journal of Operational Research*, *198*(1), 121–128. doi:10.1016/j.ejor.2008.07.034

Mondragon, A. E. C., Lalwani, C., and Mondragon, C. E. C. (2011). Measures for auditing performance and integration in closed-loop supply chains. *Supply Chain Management: An International Journal*, *16*(1), 43–56. doi:10.1108/13598541111103494

Moore, C., Bruce, M., and Birtwistle, G. (2012). *International Retail Marketing* (p. 280). Routledge.

Moreno-Luzón, M. D., and Peris, F. J. (1998). Strategic approaches, organizational design and quality management: Integration in a fit and contingency model. *International Journal of Quality Science*, *3*(4), 328–347. doi:10.1108/13598539810243667

Morton, F. S., and Zettelmeyer, F. (2004). The Strategic Positioning of Store Brands in Retailer – Manufacturer Negotiations. *Review of Industrial Organization*, *24*, 161–194.

Mujuni Katunzi, T. (2011). Obstacles to Process Integration along the Supply Chain: Manufacturing Firms Perspective. *International Journal of Business and Management*, *6*(5), 105–113. doi:10.5539/ijbm.v6n5p105

Muller, A., Suhner, M., and Iung, B. (2008). Formalisation of a new prognosis model for supporting proactive maintenance implementation on industrial system. *Reliability Engineering and System Safety*, *93*(2), 234–253. doi:10.1016/j.ress.2006.12.004

Mun, J., Shin, M., Lee, K., and Jung, M. (2009). Manufacturing enterprise collaboration based on a goal-oriented fuzzy trust evaluation model in a virtual enterprise. *Computers and Industrial Engineering*, *56*(3), 888–901. doi:10.1016/j.cie.2008.09.022

Muscio, A., Nardone, G., and Dottore, A. (2010). Understanding demand for innovation in the food industry. *Measuring Business Excellence*, *14*(4), 35–48. doi:10.1108/13683041011093749

Nagar, L., and Jain, K. (2008). Supply chain planning using multi-stage stochastic programming. *Supply Chain Management: An International Journal*, *13*(3), 251–256. doi:10.1108/13598540810871299

Narasimhan, R., Kim, S. W., and Tan, K. C. (2008). An empirical investigation of supply chain strategy typologies and relationships to performance. *International Journal of Production Research*, *46*(18), 5231–5259. doi:10.1080/00207540600847137

Näslund, D., and Hulthen, H. (2012). Supply chain management integration: a critical analysis. *Benchmarking: An International Journal*, *19*(4), 481–501. doi:10.1108/14635771211257963

Neapolitan, R. E. (2003). *Learning Bayesian Networks*. New Jersey, USA.: Prentice Hall.

Nyaga, G. N., Whipple, J. M., and Lynch, D. F. (2010). Examining supply chain relationships: Do buyer and supplier perspectives on collaborative relationships differ? *Journal of Operations Management*, *28*(2), 101–114. doi:10.1016/j.jom.2009.07.005

Oke, A., and Kach, A. (2012). Linking sourcing and collaborative strategies to financial performance: The role of operational innovation. *Journal of Purchasing and Supply Management*, *18*(1), 46–59. doi:10.1016/j.pursup.2012.01.001

Olausson, D., Magnusson, T., and Lakemond, N. (2009). Preserving the link between RandD and manufacturing: Exploring challenges related to vertical integration and product/process newness. *Journal of Purchasing and Supply Management*, *15*(2), 79–88. doi:10.1016/j.pursup.2008.12.004

Olhager, J. (2003). Strategic positioning of the order penetration point. *International Journal of Production Economics*, *85*(3), 319–329. doi:10.1016/S0925-5273(03)00119-1

Olhager, J., and Prajogo, D. I. (2012). The impact of manufacturing and supply chain improvement initiatives: A survey comparing make-to-order and make-to-stock firms. *Omega*, *40*(2), 159–165. doi:10.1016/j.omega.2011.05.001

Oliver, R. K., and Webber, M. D. (1982). Supply-chain management: logistics catches up with strategy. *Outlook, Booz, Allen and Hamilton Inc*.

Osegowitsch, T., and Madhok, A. (2003). Vertical integration is dead, or is it? *Business Horizons*, *46*(2), 25–34.

Pagell, M., and Wu, Z. (2009). Building a More Complete Theory of Sustainable Supply Chain Managemnt Using Case Studies of 10 Examples. *Journal of Supply Chain Management*, *45*(2), 37–56. doi:10.1111/j.1745-493X.2009.03162.x

Panchal, G., and Jain, V. (2011). A review on select models for supply chain formation. *International Journal of Business Performance and Supply Chain Modelling*, *3*(2), 113–123. doi:10.1504/IJBPSCM.2011.041374

Panetto, H., and Molina, A. (2008). Enterprise integration and interoperability in manufacturing systems: Trends and issues. *Computers in Industry*, *59*(7), 641–646. doi:10.1016/j.compind.2007.12.010

Panicker, V. V., and Sridharan, R. (2011). Modelling supply chain decision problem with fixed charge – a review. *International Journal of Business Performance and Supply Chain Modelling*, *3*(3), 195–207. doi:10.1504/IJBPSCM.2011.042007

Parmar, D., Wu, T., Callarman, T., Fowler, J., and Wolfe, P. (2010). A clustering algorithm for supplier base management. *International Journal of Production Research*, *48*(13), 3803–3821. doi:10.1080/00207540902942891

Paulraj, A., Lado, A., Chen, I. (2008). Inter-organizational communication as a relational competency: Antecedents and performance outcomes in collaborative buyer–supplier relationships. *Journal of Operations Management*, 26(1), 45-64. doi: 10.1016/j.jom.2007.04.001

Pengzhong Li (Ed.). (2011). *Supply Chain Management*. *Supply Chain Management* (p. 590). InTech.

Petersen, K. J., Handfield, R. B., and Ragatz, G. L. (2005). Supplier integration into new product development: coordinating product, process and supply chain design. *Journal of Operations Management*, *23*(3-4), 371–388. doi:10.1016/j.jom.2004.07.009

Ponis, S. T., Tatsiopoulos, I. P., Tsitsiriggos, K. C., and Christou, I. T. (2007). Integrating Enterprise Resource Planning vendor evaluation into a proposed ERP selection methodology. *International Journal of Integrated Supply Management*, *3*(4), 364–384.

Power, D. (2005). Supply chain management integration and implementation: a literature review. *Supply Chain Management: An International Journal*, *10*(4), 252–263. doi:10.1108/13598540510612721

Prajogo, D., and Olhager, J. (2012). Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration. *International Journal of Production Economics*, *135*(1), 514–522. doi:10.1016/j.ijpe.2011.09.001

Radhakrishnan, P., Prasad, V. ., and Gopalan, M. . (2009). Genetic Algorithm Based Inventory Optimization Analysis in Supply Chain Management. *IEEE International Advance Computing Conference*, (March), 6–7.

Ramdas, K., and Spekman, R. E. (2000). Chain or Shackles: Understanding What Drives Supply-Chain Performance. *Interfaces*, *30*(4), 3–21. doi:10.1287/inte.30.4.3.11644

Ravi, V., Shankar, R., and Tiwari, M. (2005). Analyzing alternatives in reverse logistics for end-of-life computers: ANP and balanced scorecard approach. *Computers and Industrial Engineering*, *48*(2), 327–356. doi:10.1016/j.cie.2005.01.017

Reijers, H. a., Mans, R. S., and Van der Toorn, R. a. (2009). Improved model management with aggregated business process models. *Data and Knowledge Engineering*, *68*(2), 221–243. doi:10.1016/j.datak.2008.09.004

Remigio, H. (2012). *Modelling resilience in supply chain*. Universidade Nova de Lisboa.

Richey, R. G., Roath, A. S., Whipple, J. M., and Fawcett, S. E. (2010). Exploring a Governance Theory of Supply Chain Management: Barriers and Facilitators To Integration. *Journal of Business Logistics*, *31*(1), 237–256. doi:10.1002/j.2158-1592.2010.tb00137.x

Romano, P. (2003). Co-ordination and integration mechanisms to manage logistics processes across supply networks. *Journal of Purchasing and Supply Management*, *9*(3), 119–134. doi:10.1016/S1478-4092(03)00008-6

Roth, A. V., and Van der Velde, M. (1991). Operations as marketing: A competitive service strategy. *Journal of Operations Management*, *10*(3), 303–328. doi:10.1016/0272-6963(91)90071-5

Rothaermel, F. T., Hitt, M. A., and Jobe, L. A. (2006). Balancing vertical integration and strategic outsourcing: effects on product portfolio, product success, and firm performance. *Strategic Management Journal*, *27*(11), 1033–1056. doi:10.1002/smj.559

Ryu, I., So, S., and Koo, C. (2009). The role of partnership in supply chain performance. *Industrial Management and Data Systems*, *109*(4), 496–514. doi:10.1108/02635570910948632

Saaty, T.L. (1996). *Decision making with dependence and feedback: The analytic hierarchy process*. RWS, Pittsburgh.

Saaty, T.L. (2004). Decision making — the Analytic Hierarchy and Network Processes (AHP/ANP). *Journal of Systems Science and Systems Engineering*, 13(1), 1-35. doi: 10.1007/s11518-006-0151-5

Saaty, T. L. (2008). Relative Measurement and its Generalization in Decision Making: Why Pairwise Comparisons are Central in Mathematics for the Measurement of Intangible Factors – The Analytic Hierarchy/Network Process. *Review of the Royal Spanish Academy of Sciences, Series A, Mathematics*, *102*(2), 215–318.

Saaty, T. L. (2012). *The Analytic Hierarchy Process and The Analytic Network Process: SuperDecisions Software Guide*. Pittsburgh, USA: Creative Decisions Foundation.

Saeed, K. A., Malhotra, M. K., and Grover, V. (2011). Interorganizational System Characteristics and Supply Chain Integration: An Empirical Assessment. *Decision Sciences*, *42*(1), 7–42. doi:10.1111/j.1540-5915.2010.00300.x

Sambasivan, M., Nandan, T., and Mohamed, Z. A. (2009). Consolidation of performance measures in a supply chain environment. *Journal of Enterprise Information Management*, *22*(6), 660–689. doi:10.1108/17410390910999576

Sambasivan, M., and Yen, C. N. (2010). Strategic alliances in a manufacturing supply chain: Influence of organizational culture from the manufacturer's perspective. *International Journal of Physical Distribution and Logistics Management*, *40*(6), 456–474. doi:10.1108/09600031011062191

Sana, S. S. (2011). A production-inventory model of imperfect quality products in a three-layer supply chain. *Decision Support Systems*, *50*(2), 539–547. doi:10.1016/j.dss.2010.11.012

Santoso, T., Ahmed, S., Goetschalckx, M., and Shapiro, A. (2005). A stochastic programming approach for supply chain network design under uncertainty. *European Journal of Operational Research*, *167*(1), 96–115. doi:10.1016/j.ejor.2004.01.046

Savino, M. M., and Neubert, G. (2007). A faster Enterprise Resources Planning implementation for Euro Coin Supply Chain within the SCOR model. *International Journal of Integrated Supply Management*, *3*(4), 385–405.

Schliephake, K., Stevens, G., and Clay, S. (2009). Making resources work more efficiently – the importance of supply chain partnerships. *Journal of Cleaner Production*, *17*(14), 1257–1263. doi:10.1016/j.jclepro.2009.03.020

Schoenherr, T., and Swink, M. (2012). Revisiting the arcs of integration: Cross-validations and extensions. *Journal of Operations Management*, *30*(1-2), 99–115. doi:10.1016/j.jom.2011.09.001

Sengupta, K., Heiser, D. R., and Cook, L. S. (2006). Manufacturing and Service Supply Chain Performance: A Comparative Analysis. *Journal of Supply Chain Management*, *42*(4), 4–15. doi:10.1111/j.1745-493X.2006.00018.x

Serdarasan, S., and Tanyas, M. (2012). Dealing with Complexity in the Supply Chain: The Effect of Supply Chain Management Initiatives. *Journal of Enterprise Information Management, Forthcoming*, 1–25.

Sezen, B. (2008). Relative effects of design, integration and information sharing on supply chain performance. *Supply Chain Management: An International Journal*, *13*(3), 233–240. doi:10.1108/13598540810871271

Shepherd, C., and Günter, H. (2006). Measuring supply chain performance: current research and future directions. *International Journal of Productivity and Performance Management*, *55*(3/4), 242–258. doi:10.1108/17410400610653219

Shevtshenko, E., and Wang, Y. (2009). Decision support under uncertainties based on robust Bayesian networks in reverse logistics management. *International Journal of Computer Applications in Technology*, *36*(3/4), 247–258. doi:10.1504/IJCAT.2009.028047

Shub, A. N., and Stonebraker, P. W. (2009). The human impact on supply chains: evaluating the importance of "soft" areas on integration and performance. *Supply Chain Management: An International Journal*, *14*(1), 31–40. doi:10.1108/13598540910927287

Shunk, D. L., Kim, J. I., and Nam, H. Y. (2003). The application of an integrated enterprise modeling methodology—FIDO—to supply chain integration modeling. *Computers and Industrial Engineering*, *45*(1), 167–193. doi:10.1016/S0360-8352(03)00024-X

Sinkovics, R. R., Jean, R. J. B., Roath, A. S., and Cavusgil, S. T. (2011). Does IT Integration Really Enhance Supplier Responsiveness in Global Supply Chains? *Management International Review*, *51*(2), 193–212. doi:10.1007/s11575-011-0069-0

Smith, A. D. (2012). Vertically integrated product/process strategies in highly competitive environments: case study of the flexible door industry. *International Journal of Logistics Systems and Management*, *11*(1), 93–113. doi:10.1504/IJLSM.2012.044051

Smith, S. D., Beausang, P., Moriarty, D., and Campbell, J. M. (2008). Subjectivity in data extraction - A case study based on construction hazard identification. *4th Annual ARCOM Conference* (pp. 1065–73). Cardiff, UK: Dainty, A (Ed.).

Sodhi, M. S., and Tang, C. S. (2009). Modeling supply-chain planning under demand uncertainty using stochastic programming: A survey motivated by asset–liability management. *International Journal of Production Economics*, *121*(2), 728–738. doi:10.1016/j.ijpe.2009.02.009

Soni, G., and Kodali, R. (2012). A critical review of empirical research methodology in supply chain management. *Journal of Manufacturing Technology Management*, *23*(6), 753–779. doi:10.1108/17410381211253326

Soosay, C. a., Hyland, P. W., and Ferrer, M. (2008). Supply chain collaboration: capabilities for continuous innovation. *Supply Chain Management: An International Journal*, *13*(2), 160–169. doi:10.1108/13598540810860994

Sparks, B., Butcher, K., and Bradley, G. (2008). Dimensions and correlates of consumer value: An application to the timeshare industry. *International Journal of Hospitality Management*, *27*(1), 98–108. doi:10.1016/j.ijhm.2007.07.003

Spralls, S. a., Hunt, S. D., and Wilcox, J. B. (2011). Extranet Use and Building Relationship Capital in Interfirm Distribution Networks: The Role of Extranet Capability. *Journal of Retailing*, *87*(1), 59–74. doi:10.1016/j.jretai.2010.09.001

Stonebraker, P. W., and Liao, J. (2006). Supply chain integration: exploring product and environmental contingencies. *Supply Chain Management: An International Journal*, *11*(1), 34–43. doi:10.1108/13598540610642457

Stuart, I., McCutcheon, D., Handfield, R., McLachlin, R., and Samson, D. (2002). Effective case research in operations management: a process perspective. *Journal of Operations Management*, *20*(5), 419–433. doi:10.1016/S0272-6963(02)00022-0

Sun, S. (2008). Organizational Culture and Its Themes. *International Journal of Business and Management*, *3*(12), 137–141.

Suzuki, A., Jarvis, L. S., and Sexton, R. J. (2011). Partial Vertical Integration, Risk Shifting, and Product Rejection in the High-Value Export Supply Chain: The Ghana Pineapple Sector. *World Development*, *39*(9), 1611–1623. doi:10.1016/j.worlddev.2011.02.007

Svensson, C., and Barfod, A. (2002). Limits and opportunities in mass customization for “build to order” SMEs. *Computers in Industry*, *49*(1), 77–89. doi:10.1016/S0166-3615(02)00060-X

Tan, K. C., Kannan, V. R., and Handfield, R. B. (1998). Supply chain management: supplier performance and firm performance. *International Journal of Purchasing and Materials Management*, *34*(3), 2–9.

Tan, Keah Choon. (2002). Supply Chain Management: Practices, Concerns, and Performance Issues. *Journal of Supply Chain Management*, *38*(1), 42–53. doi:10.1111/j.1745-493X.2002.tb00119.x

Tan, Keah Choon, Lyman, S. B., and Wisner, J. D. (2002). Supply chain management: a strategic perspective. *International Journal of Operations and Production Management*, *22*(6), 614–631. doi:10.1108/01443570210427659

Tang, O., and Nurmaya Musa, S. (2011). Identifying risk issues and research advancements in supply chain risk management. *International Journal of Production Economics*, *133*(1), 25–34. doi:10.1016/j.ijpe.2010.06.013

Tarn, J. M., Yen, D. C., and Beaumont, M. (2002). Exploring the rationales for ERP and SCM integration. *Industrial Management and Data Systems*, *102*(1), 26–34. doi:10.1108/02635570210414631

Terjesen, S., Patel, P. C., and Sanders, N. R. (2012). Managing Differentiation-Integration Duality in Supply Chain Integration. *Decision Sciences*, *43*(2), 303–339.

Terpend, R., Tyler, B. B., Krause, D. R., and Handfield, R. B. (2008). Buyer-Supplier Relationships: Derived Value Over Two Decades. *Journal of Supply Chain Management*, *44*(2), 28–55. doi:10.1111/j.1745-493X.2008.00053.x

Thapa, G. B., Dhamala, T. N., and Pant, S. R. (2011). Cross-Docking Operations for Supply Chain Logistics in JIT Production and Distribution Systems. *Journal of the Institute of Engineering*, *8*(1-2), 219–230. doi:10.3126/jie.v8i1-2.5114

Tomlin, B. (2006). On the Value of Mitigation and Contingency Strategies for Managing Supply Chain Disruption Risks. *Management Science*, *52*(5), 639–657. doi:10.1287/mnsc.1060.0515

Towill, D. R., Childerhouse, P., and Disney, S. M. (2002). Integrating the automotive supply chain: where are we now? *International Journal of Physical Distribution and Logistics Management*, *32*(2), 79–95. doi:10.1108/09600030210421705

Tracy, S. J. (2012). The Toxic and Mythical Combination of a Deductive Writing Logic for Inductive Qualitative Research. *Qualitative Communication Research*, *1*(1), 109–142.

Trkman, P., and McCormack, K. (2009). Supply chain risk in turbulent environments—A conceptual model for managing supply chain network risk. *International Journal of Production Economics*, *119*(2), 247–258. doi:10.1016/j.ijpe.2009.03.002

Trkman, P., Štemberger, M. I., Jaklic, J., and Groznik, A. (2007a). Process approach to supply chain integration. *Supply Chain Management: An International Journal*, *12*(2), 116–128. doi:10.1108/13598540710737307

Trkman, P., Štemberger, M. I., Jaklic, J., and Groznik, A. (2007b). Process approach to supply chain integration. *Supply Chain Management: An International Journal*, *12*(2), 116–128. doi:10.1108/13598540710737307

Tsay, A. A. (2010). *Supply Chain Outsourcing*. Hoboken, NJ, USA: Wiley Encyclopedia of Operations Research and Management Science. doi:10.1002/9780470400531.eorms0854

Tse, D. K., Lee, K., Vertinsky, I., and Wehrung, D. A. (1988). Does culture matter? A cross-cultural study of executives' choice, decisiveness, and risk adjustment in international marketing. *The Journal of Marketing*, *52*, 81–95.

Tseng, M. L., Chiang, J. H., and Lan, L. W. (2009). Selection of optimal supplier in supply chain management strategy with analytic network process and choquet integral. *Computers and Industrial Engineering*, *57*(1), 330–340. doi:10.1016/j.cie.2008.12.001

Tseng, S.-M. (2012). Correlations between external knowledge and the knowledge chain as impacting service quality. *Journal of Retailing and Consumer Services*, *19*(4), 429–437. doi:10.1016/j.jretconser.2012.04.004

Tu, Q., Vonderembse, M.A., Ragu-Nathan, T.S. (2001). The impact of time-based manufacturing practices on mass customization and value to customer. *Journal of Operations Management*, 19 (2), 201–217. doi: 10.1016/S0272-6963(00)00056-5

Ulaga, W. (2011). Investigating customer value in global business markets: Commentary essay. *Journal of Business Research*, *64*(8), 928–930. doi:10.1016/j.jbusres.2011.04.005

Vallejo, C., Romero, D., and Molina, A. (2012). Enterprise integration engineering reference framework and toolbox. *International Journal of Production Research*, *50*(6), 1489–1511. doi:10.1080/00207543.2011.560200

Van Donk, D. P., and Van der Vaart, T. (2005). A Critical Discussion on the Theoretical and Methodological Advancements in Supply Chain Integration Research. *Research Methodologies in Supply Chain Management* (pp. 32–46). Physica - Verlag Heidelberg.

Van der Vaart, T., and Van Donk, D. (2008). A critical review of survey-based research in supply chain integration. *International Journal of Production Economics*, *111*(1), 42–55. doi:10.1016/j.ijpe.2006.10.011

Vijayasarathy, L. R. (2010). Supply integration: An investigation of its multi-dimensionality and relational antecedents. *International Journal of Production Economics*, *124*(2), 489–505. doi:10.1016/j.ijpe.2010.01.010

Villena, V. H., Gomez-mejia, L. R., and Revilla, E. (2009). The Decision of the Supply Chain Executive to Support or Impede Supply Chain Integration: A Multidisciplinary Behavioral Agency Perspective. *Decision Sciences*, *40*(4), 635–665.

Wang, M., Liu, J., Wang, H., Cheung, W., and Xie, X. (2008). On-demand e-supply chain integration: A multi-agent constraint-based approach. *Expert Systems with Applications*, *34*(4), 2683–2692. doi:10.1016/j.eswa.2007.05.041

Wang, W. Y. C., and Chan, H. K. (2010). Virtual organization for supply chain integration: Two cases in the textile and fashion retailing industry. *International Journal of Production Economics*, *127*(2), 333–342. doi:10.1016/j.ijpe.2009.08.006

Wang, Y. (2010). Imprecise probabilities based on generalized intervals for system reliability assessment. *International Journal of Reliability and Safety*, *4*(4), 319–342.

Wazed, M. A., Ahmed, S., and Nukman, Y. (2011). Application of Taguchi method to analyse the impacts of common process and batch size in multistage production system under uncertain conditions. *European J. of Industrial Engineering*, *5*(2), 215. doi:10.1504/EJIE.2011.039873

Weske, M. (2012). Business Process Management Architectures. *Business Process Management* (pp. 333–371). Berlin, Heidelberg: Springer Berlin Heidelberg. doi:10.1007/978-3-642-28616-2_7

Wheel Wright, S. C. (1984). Manufacturing strategy: Defining the missing link. *Strategic Management Journal*, *5*(1), 77–91. doi:10.1002/smj.4250050106

Whicker, L., Bernon, M., Templar, S., and Mena, C. (2009). Understanding the relationships between time and cost to improve supply chain performance. *International Journal of Production Economics*, *121*(2), 641–650. doi:10.1016/j.ijpe.2006.06.022

Wilhelm, M. M. (2011). Managing coopetition through horizontal supply chain relations: Linking dyadic and network levels of analysis. *Journal of Operations Management*, *29*(7-8), 663–676. doi:10.1016/j.jom.2011.03.003

Williamson, O. E. (2008). Outsourcing: Transaction Cost Economics and Supply Chain Management. *The Journal of Supply Chain Management*, *44*(2), 5–16. doi:10.1111/j.1745-493X.2008.00051.x

Leverkuhn, A. (2013). What Is Customer Value? *WiseGEEK*, Retrieved March 31, 2013, from http://www.wisegeek.com/what-is-customer-value.htm

Witten, I. H., and Frank, E. (2005). *Data Mining: Practical Machine Learning Tools and Techniques, Second Edition* (2nd ed.). San Francisco, California, USA: Morgan Kaufmann.

Wolf, J. (2011). Sustainable Supply Chain Management Integration: A Qualitative Analysis of the German Manufacturing Industry. *Journal of Business Ethics*, *102*(2), 221–235. doi:10.1007/s10551-011-0806-0

Wong, C. Y., Boon-itt, S., and Wong, C. W. Y. (2011). The contingency effects of environmental uncertainty on the relationship between supply chain integration and operational performance. *Journal of Operations Management*, *29*(6), 604–615. doi:10.1016/j.jom.2011.01.003

Wong, W. P. (2009). Performance evaluation of supply chain in stochastic environment: using a simulation based DEA framework. *International Journal of Business Performance and Supply Chain Modelling*, *1*(2/3), 203 – 228.

Woodside, A. G., and Wilson, E. J. (2003). Case study research methods for theory building. *Journal of Business and Industrial Marketing*, *18*(6/7), 493–508. doi:10.1108/08858620310492374

Worm, S., Ulaga, W., and Zitzlsperger, D. (2009). Understanding the value created by customer solutions. *Journal of Marketing*, 5–6.

Wu, C., and Barnes, D. (2011). A literature review of decision-making models and approaches for partner selection in agile supply chains. *Journal of Purchasing and Supply Management*, *17*(4), 256–274. doi:10.1016/j.pursup.2011.09.002

Wu, W.-W., and Lee, Y. T. (2007). Selecting knowledge management strategies by using the analytic network process. *Expert Systems with Applications*, *32*(3), 841–847. doi:10.1016/j.eswa.2006.01.029

Wu, Z., Choi, T. Y., and Rungtusanatham, M. J. (2010). Supplier–supplier relationships in buyer–supplier–supplier triads: Implications for supplier performance. *Journal of Operations Management*, *28*(2), 115–123. doi:10.1016/j.jom.2009.09.002

Xu, L., Tan, W., Zhen, H., and Shen, W. (2008). An approach to enterprise process dynamic modeling supporting enterprise process evolution. *Information Systems Frontiers*, *10*(5), 611–624. doi:10.1007/s10796-008-9114-3

Yan, R., Wang, J., and Zhou, B. (2010). Channel integration and profit sharing in the dynamics of multi-channel firms. *Journal of Retailing and Consumer Services*, *17*(5), 430–440. doi:10.1016/j.jretconser.2010.04.004

Yang, Z., and Peterson, R. T. (2004). Customer perceived value, satisfaction, and loyalty: The role of switching costs. *Psychology and Marketing*, *21*(10), 799–822. doi:10.1002/mar.20030

Yao, J., and Liu, L. (2009). Optimization analysis of supply chain scheduling in mass customization. *International Journal of Production Economics*, *117*(1), 197–211. doi:10.1016/j.ijpe.2008.10.008

Yeung, J. H. Y., Selen, W., Zhang, M., and Huo, B. (2009). The effects of trust and coercive power on supplier integration. *International Journal of Production Economics*, *120*(1), 66–78. doi:10.1016/j.ijpe.2008.07.014

Yuan, W. F., Liu, S.-F., Fang, Z. G., and Chen, H. Z. (2009). Comprehensive evaluation on suppliers of Aircraft based on grey Bayesian network model. *IEEE International Conference on Grey Systems and Intelligent Services (GSIS 2009)*, 552–558. doi:10.1109/GSIS.2009.5408250

Zailani, S., and Rajagopal, P. (2005). Supply chain integration and performance: US versus East Asian companies. *Supply Chain Management: An International Journal*, *10*(5), 379–393. doi:10.1108/13598540510624205

Zhu, J. Y., and Deshmukh, A. (2003). Application of Bayesian decision networks to life cycle engineering in Green design and manufacturing. *Engineering Applications of Artificial Intelligence*, *16*(2), 91–103. doi:10.1016/S0952-1976(03)00057-5

Zhu, Q., Sarkis, J., and Lai, K. (2012). Examining the effects of green supply chain management practices and their mediations on performance improvements. *International Journal of Production Research*, *50*(5), 1377–1394. doi:10.1080/00207543.2011.571937

Zook, M. A., and Shelton, T. (2012). The integration of virtual flows into material movements within the global economy. In P. V. Hall and M. Hesse (Eds.), *Cities, Regions and Flows* (p. 288). Routledge.

Appendix A: Collected data on customer values

This appendix presents collected data about six customer values used in the first case study (section 5.1). This data was collected from end customers through an online questionnaire using a comparative approach. Respondents were asked to compare each pair of customer values in six industry sector. Given the fact that six customer values are considered, each end customer answered 15 questions in six industries, which is 60 questions. The customer value dataset includes responses of 131 people.

The considered customer values are:

1. Time
2. Quality
3. Cost
4. Customization
5. Know-how
6. Respect for the environment

This data is collected with respect to six industries:

1. Automotive
2. Electronics
3. Fashion
4. Food
5. Furniture
6. Pharmaceutical

Customer Value Data: Automotive Industry

T: Time
Q: Quality
C: Cost
Cu: Customization
K: Know-how
R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
1	3	2	2	1	3	2	2	0	4	4	0	3	1	2	2	0	4	2	2	2	2	0	4	2	2	0	4	0	4
0	4	1	3	2	2	2	2	3	1	1	3	2	2	4	0	2	2	4	0	4	0	4	0	2	2	2	2	2	2
0	4	2	2	1	3	2	2	2	2	3	1	3	1	2	2	3	1	1	3	2	2	3	1	2	2	3	1	1	3
1	3	0	4	2	2	3	1	3	1	2	2	2	2	3	1	3	1	4	0	4	0	4	0	2	2	2	2	2	2
0	4	3	1	1	3	1	3	1	3	2	2	2	2	2	2	2	2	3	1	3	1	3	1	2	2	1	3	1	3
0	4	0	4	0	4	2	2	0	4	0	4	0	4	2	2	3	1	4	0	4	0	4	0	2	2	4	0	2	2
0	4	3	1	3	1	1	3	0	4	4	0	3	1	4	0	2	2	3	1	1	3	1	3	1	3	1	3	2	2
2	2	1	3	3	1	3	1	3	1	2	2	3	1	3	1	1	3	3	1	4	0	3	1	1	3	1	3	2	2
0	4	1	3	1	3	0	4	0	4	4	0	3	1	3	1	1	3	1	3	1	3	1	3	1	3	0	4	1	3
0	4	0	4	4	0	0	4	1	3	4	0	0	4	4	0	4	0	4	0	4	0	4	0	4	0	0	4	0	4
1	3	0	4	0	4	0	4	1	3	3	1	3	1	4	0	3	1	1	3	2	2	1	3	2	2	1	3	2	2
0	4	1	3	1	3	4	0	2	2	2	2	3	1	4	0	3	1	2	2	4	0	3	1	4	0	2	2	1	3
1	3	0	4	2	2	1	3	2	2	1	3	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2	2	2
0	4	0	4	1	3	2	2	1	3	2	2	4	0	4	0	2	2	3	1	4	0	2	2	2	2	1	3	1	3
0	4	2	2	1	3	4	0	1	3	4	0	4	0	4	0	1	3	1	3	4	0	1	3	4	0	1	3	0	4
0	4	0	4	1	3	2	2	0	4	2	2	3	1	3	1	1	3	4	0	3	1	2	2	1	3	0	4	0	4
0	4	1	3	3	1	0	4	1	3	2	2	3	1	2	2	2	2	4	0	2	2	1	3	0	4	0	4	2	2
0	4	0	4	2	2	2	2	2	2	3	1	4	0	3	1	3	1	4	0	3	1	2	2	1	3	1	3	3	1
2	2	1	3	1	3	0	4	1	3	2	2	3	1	3	1	3	1	4	0	2	2	1	3	1	3	1	3	1	3
1	3	0	4	2	2	1	3	1	3	2	2	3	1	2	2	2	2	3	1	2	2	3	1	1	3	1	3	2	2
0	4	1	3	3	1	2	2	2	2	3	1	4	0	3	1	3	1	4	0	3	1	3	1	1	3	1	3	1	3
0	4	0	4	2	2	1	3	0	4	2	2	3	1	3	1	2	2	4	0	2	2	1	3	1	3	0	4	0	4
0	4	0	4	3	1	1	3	1	3	0	4	3	1	2	2	1	3	4	0	4	0	4	0	1	3	1	3	2	2
0	4	0	4	0	4	0	4	0	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	1	3	2	2	3	1	4	0	3	1	2	2	1	3	2	2	0	4	1	3	2	2	3	1	4	0	3	1
0	4	0	4	0	4	0	4	0	4	1	3	2	2	2	2	1	3	2	2	2	2	2	2	2	2	0	4	1	3
1	3	1	3	3	1	3	1	1	3	3	1	2	2	3	1	1	3	3	1	3	1	1	3	1	3	1	3	1	3
0	4	1	3	1	3	1	3	1	3	3	1	3	1	3	1	3	1	4	0	3	1	2	2	3	1	1	3	0	4
1	3	1	3	1	3	1	3	0	4	1	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	3	2	2	2	2	1	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	1	2	2	2	2	1	3	1	3	3	1
1	3	0	4	3	1	2	2	2	2	3	1	4	0	2	2	3	1	4	0	2	2	3	1	2	2	0	4	0	4
1	3	2	2	2	2	1	3	1	3	3	1	3	1	3	1	3	1	2	2	3	1	2	2	2	2	1	3	1	3
0	4	1	3	0	4	0	4	1	3	1	3	0	4	0	4	1	3	0	4	0	4	1	3	0	4	1	3	1	3
0	4	0	4	3	1	2	2	0	4	3	1	3	1	3	1	0	4	2	2	3	1	1	3	1	3	0	4	1	3
1	3	0	4	3	1	1	3	0	4	3	1	3	1	1	3	2	2	3	1	3	1	1	3	2	2	0	4	0	4
1	3	1	3	2	2	2	2	0	4	3	1	2	2	2	2	1	3	3	1	2	2	1	3	2	2	1	3	1	3
0	4	1	3	2	2	3	1	1	3	1	3	3	1	3	1	2	2	4	0	3	1	2	2	3	1	0	4	0	4
0	4	0	4	3	1	3	1	0	4	1	3	4	0	4	0	1	3	4	0	4	0	1	3	2	2	0	4	0	4
2	2	1	3	1	3	1	3	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	1	3	1	3	3	1
0	4	0	4	0	4	0	4	0	4	3	1	4	0	4	0	2	2	1	3	1	3	1	3	2	2	1	3	1	3
1	3	1	3	2	2	2	2	1	3	3	1	2	2	2	2	2	2	3	1	3	1	2	2	2	2	2	2	2	2
1	3	1	3	1	3	1	3	2	2	3	1	3	1	3	1	2	2	3	1	3	1	2	2	3	1	2	2	1	3
1	3	0	4	1	3	3	1	3	1	2	2	3	1	2	2	2	2	3	1	3	1	3	1	2	2	2	2	2	2
0	4	0	4	1	3	1	3	0	4	2	2	3	1	3	1	2	2	4	0	3	1	3	1	3	1	3	1	2	2
0	4	1	3	1	3	1	3	0	4	4	0	4	0	3	1	3	1	3	1	2	2	3	1	1	3	1	3	1	3
1	3	2	2	3	1	0	4	1	3	3	1	3	1	2	2	1	3	2	2	1	3	2	2	1	3	0	4	1	3
1	3	2	2	1	3	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1
1	3	1	3	2	2	1	3	0	4	3	1	3	1	1	3	1	3	3	1	3	1	1	3	1	3	1	3	1	3
1	3	1	3	2	2	1	3	1	3	2	2	3	1	2	2	2	2	3	1	3	1	3	1	2	2	1	3	2	2
1	3	1	3	3	1	2	2	1	3	3	1	3	1	2	2	2	2	3	1	3	1	1	3	2	2	2	2	2	2
2	2	2	2	2	2	3	1	1	3	1	3	2	2	2	2	1	3	3	1	3	1	1	3	3	1	1	3	1	3
0	4	3	1	0	4	4	0	0	4	0	4	0	4	4	0	4	0	0	4	0	4	4	0	4	0	0	4	4	0
3	1	0	4	2	2	2	2	0	4	1	3	3	1	2	2	0	4	3	1	3	1	1	3	2	2	0	4	0	4
0	4	1	3	0	4	1	3	0	4	0	4	1	3	1	3	0	4	0	4	1	3	0	4	0	4	1	3	1	3

Customer Value Data: Automotive Industry

T: Time
Q: Quality
C: Cost
Cu: Customization
K: Know-how
R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
0	4	0	4	3	1	1	3	1	3	2	2	4	0	3	1	3	1	4	0	3	1	3	1	1	3	1	3	3	1
1	3	1	3	3	1	0	4	0	4	2	2	4	0	2	2	1	3	2	2	2	2	1	3	1	3	0	4	1	3
1	3	1	3	3	1	3	1	1	3	3	1	4	0	4	0	2	2	3	1	2	2	2	2	1	3	0	4	0	4
1	3	1	3	1	3	1	3	0	4	3	1	2	2	3	1	0	4	1	3	1	3	0	4	2	2	0	4	0	4
1	3	3	1	1	3	1	3	1	3	3	1	3	1	3	1	1	3	3	1	3	1	1	3	3	1	1	3	1	3
1	3	1	3	4	0	3	1	1	3	2	2	4	0	3	1	2	2	4	0	3	1	2	2	1	3	0	4	0	4
0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	0	4	0	4	0	4
0	4	1	3	0	4	3	1	4	0	3	1	3	1	2	2	1	3	4	0	2	2	1	3	3	1	0	4	0	4
0	4	0	4	0	4	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
1	3	2	2	2	2	1	3	3	1	0	4	3	1	3	1	3	1	4	0	4	0	3	1	1	3	3	1	2	2
3	1	1	3	1	3	1	3	1	3	3	1	2	2	3	1	3	1	1	3	2	2	3	1	3	1	3	1	3	1
1	3	0	4	2	2	1	3	1	3	1	3	3	1	3	1	2	2	4	0	4	0	3	1	2	2	2	2	2	2
1	3	1	3	1	3	2	2	1	3	1	3	3	1	3	1	1	3	3	1	3	1	2	2	1	3	1	3	1	3
3	1	1	3	3	1	1	3	3	1	3	1	3	1	3	1	3	1	3	1	1	3	2	2	1	3	1	3	3	1
2	2	2	2	2	2	2	2	1	3	2	2	2	2	2	2	1	3	2	2	2	2	1	3	2	2	1	3	1	3
0	4	0	4	0	4	0	4	0	4	2	2	3	1	2	2	2	2	3	1	3	1	3	1	2	2	2	2	2	2
2	2	2	2	2	2	3	1	2	2	2	2	1	3	4	0	2	2	2	2	1	3	4	0	2	2	0	4	2	2
1	3	1	3	1	3	1	3	1	3	3	1	3	1	1	3	1	3	2	2	2	2	2	2	2	2	2	2	2	2
0	4	1	3	2	2	2	2	3	1	3	1	3	1	2	2	3	1	1	3	1	3	2	2	3	1	3	1	3	1
0	4	0	4	3	1	1	3	1	3	1	3	4	0	4	0	3	1	4	0	3	1	4	0	0	4	0	4	3	1
0	4	0	4	2	2	1	3	2	2	2	2	4	0	2	2	3	1	4	0	4	0	4	0	1	3	1	3	3	1
0	4	1	3	1	3	3	1	4	0	3	1	2	2	3	1	3	1	3	1	2	2	3	1	3	1	3	1	2	2
0	4	0	4	0	4	4	0	0	4	2	2	2	2	4	0	2	2	2	2	4	0	2	2	4	0	2	2	0	4
2	2	3	1	3	1	2	2	1	3	2	2	3	1	2	2	2	2	3	1	3	1	2	2	2	2	1	3	1	3
0	4	0	4	1	3	1	3	1	3	2	2	4	0	3	1	3	1	4	0	4	0	4	0	1	3	2	2	2	2
1	3	1	3	3	1	0	4	3	1	1	3	3	1	4	0	1	3	2	2	3	1	1	3	3	1	0	4	0	4
0	4	0	4	1	3	0	4	0	4	4	0	3	1	3	1	0	4	1	3	0	4	0	4	1	3	0	4	0	4
1	3	0	4	1	3	0	4	0	4	1	3	3	1	2	2	1	3	3	1	3	1	2	2	3	1	1	3	1	3
0	4	2	2	3	1	3	1	3	1	3	1	3	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	1	2	2	1	3	2	2	1	3	2	2	2	2	4	0	2	2	2	2	2	2	2	2	2	2	4	0	2	2
1	3	1	3	3	1	3	1	1	3	1	3	3	1	3	1	1	3	4	0	3	1	2	2	3	1	0	4	0	4
0	4	1	3	1	3	2	2	0	4	1	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	3	2	2	2	2	3	1	2	2	3	1	3	1	3	1	3	1	2	2	2	2	2	2	2	2	2	2	2	2
0	4	1	3	1	3	1	3	1	3	3	1	1	3	3	1	1	3	1	3	1	3	1	3	1	3	3	1	3	1
1	3	1	3	2	2	2	2	1	3	1	3	2	2	2	2	1	3	2	2	2	2	2	2	2	2	2	2	2	2
0	4	1	3	1	3	0	4	0	4	2	2	4	0	2	2	2	2	2	2	1	3	1	3	2	2	0	4	1	3
0	4	0	4	0	4	3	1	0	4	4	0	4	0	4	0	1	3	2	2	2	2	1	3	3	1	1	3	0	4
1	3	0	4	3	1	1	3	0	4	2	2	3	1	3	1	3	1	4	0	3	1	3	1	3	1	1	3	3	1
0	4	0	4	1	3	0	4	1	3	4	0	3	1	2	2	2	2	4	0	0	4	2	2	4	0	2	2	2	2
1	3	1	3	3	1	2	2	1	3	4	0	1	3	3	1	4	0	4	0	4	0	4	0	1	3	3	1	3	1
0	4	0	4	0	4	0	4	2	2	3	1	2	2	4	0	2	2	1	3	1	3	0	4	0	4	1	3	0	4
1	3	1	3	2	2	2	2	2	2	1	3	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2
1	3	1	3	0	4	1	3	4	0	1	3	1	3	3	1	4	0	1	3	1	3	1	3	3	1	3	1	1	3
0	4	0	4	1	3	1	3	1	3	3	1	3	1	4	0	4	0	3	1	2	2	3	1	2	2	2	2	2	2
1	3	1	3	0	4	2	2	2	2	2	2	4	0	4	0	3	1	3	1	3	1	3	1	2	2	2	2	2	2
0	4	1	3	3	1	1	3	3	1	2	2	3	1	2	2	2	2	3	1	2	2	2	2	1	3	2	2	1	3
1	3	1	3	2	2	1	3	2	2	3	1	4	0	4	0	3	1	2	2	2	2	3	1	3	1	3	1	3	1
3	1	1	3	1	3	0	4	3	1	3	1	3	1	1	3	3	1	1	3	0	4	3	1	0	4	3	1	3	1
3	1	1	3	1	3	0	4	3	1	3	1	3	1	1	3	3	1	1	3	0	4	3	1	0	4	3	1	3	1
1	3	1	3	2	2	2	2	1	3	3	1	3	1	2	2	2	2	3	1	2	2	2	2	2	2	1	3	1	3
0	4	0	4	4	0	4	0	2	2	0	4	4	0	4	0	2	2	4	0	4	0	2	2	4	0	2	2	3	1
0	4	0	4	2	2	1	3	1	3	0	4	2	2	1	3	1	3	2	2	1	3	1	3	1	3	1	3	1	3
0	4	1	3	1	3	1	3	1	3	4	0	4	0	4	0	4	0	3	1	3	1	2	2	2	2	2	2	2	2
0	4	0	4	2	2	1	3	1	3	0	4	4	0	3	1	2	2	4	0	3	1	4	0	1	3	0	4	1	3
0	4	1	3	0	4	1	3	4	0	3	1	4	0	3	1	4	0	3	1	2	2	3	1	3	1	3	1	4	0

Customer Value Data: Automotive Industry

T: Time
Q: Quality
C: Cost
Cu: Customization
K: Know-how
R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
1	3	1	3	1	3	1	3	0	4	3	1	4	0	3	1	3	1	1	3	3	1	1	3	3	1	1	3	1	3
0	4	2	2	2	2	2	2	3	1	2	2	2	2	1	3	2	2	2	2	2	2	2	2	2	2	2	2	3	1
3	1	1	3	3	1	2	2	3	1	2	2	2	2	2	2	3	1	3	1	2	2	3	1	1	3	3	1	3	1
2	2	4	0	2	2	2	2	1	3	3	1	3	1	3	1	2	2	3	1	2	2	1	3	2	2	0	4	0	4
0	4	0	4	0	4	0	4	4	0	0	4	2	2	2	2	4	0	4	0	4	0	4	0	4	0	4	0	4	0
1	3	0	4	3	1	1	3	0	4	2	2	3	1	2	2	2	2	1	3	2	2	2	2	2	2	1	3	2	2
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2	2	3	1	2	2	2	2	3	1	3	1	4	0	3	1	4	0	4	0	3	1	1	3	3	1	0	4	0	4
1	3	1	3	3	1	3	1	1	3	3	1	4	0	4	0	2	2	3	1	2	2	2	2	1	3	0	4	0	4
1	3	1	3	1	3	1	3	0	4	3	1	2	2	3	1	0	4	1	3	1	3	0	4	2	2	0	4	0	4
1	3	3	1	1	3	1	3	1	3	3	1	3	1	3	1	1	3	3	1	3	1	1	3	3	1	1	3	1	3
1	3	1	3	4	0	3	1	1	3	2	2	4	0	3	1	2	2	4	0	3	1	2	2	1	3	0	4	0	4
0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	0	4	0	4	0	4
0	4	1	3	0	4	3	1	4	0	3	1	3	1	2	2	1	3	4	0	2	2	1	3	3	1	0	4	0	4
0	4	0	4	0	4	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
1	3	2	2	2	2	1	3	3	1	0	4	3	1	3	1	3	1	4	0	4	0	3	1	1	3	3	1	2	2
3	1	1	3	1	3	1	3	1	3	3	1	2	2	3	1	3	1	1	3	2	2	3	1	3	1	3	1	3	1
1	3	0	4	2	2	1	3	1	3	1	3	3	1	3	1	2	2	4	0	4	0	3	1	2	2	2	2	2	2
1	3	1	3	1	3	2	2	1	3	1	3	3	1	3	1	1	3	3	1	3	1	2	2	1	3	1	3	1	3
3	1	1	3	3	1	1	3	3	1	3	1	3	1	3	1	3	1	3	1	1	3	2	2	1	3	1	3	3	1
2	2	2	2	2	2	2	2	1	3	2	2	2	2	2	2	1	3	2	2	2	2	1	3	2	2	1	3	1	3

Customer Value Data: Electronics Industry

T: Time
Q: Quality
C: Cost
Cu: Customization
K: Know-how
R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
1	3	2	2	2	2	2	2	0	4	2	2	3	1	1	3	0	4	2	2	3	1	0	4	3	1	0	4	0	4
1	3	2	2	1	3	1	3	1	3	3	1	4	0	4	0	4	0	4	0	4	0	4	0	2	2	2	2	2	2
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Customer Value Data: Electronics Industry

T: Time
Q: Quality
C: Cost
Cu: Customization
K: Know-how
R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
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Customer Value Data: Electronics Industry

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T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
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1	3	1	3	3	1	2	2	1	3	1	3	3	1	3	1	2	2	3	1	3	1	2	2	1	3	1	3	1	3
0	4	1	3	1	3	1	3	3	1	4	0	4	0	3	1	3	1	1	3	1	3	1	3	1	3	1	3	3	1
2	2	2	2	2	2	2	2	1	3	2	2	2	2	2	2	1	3	2	2	2	2	1	3	2	2	1	3	1	3

Customer Value Data: Fashion Industry

T: Time
Q: Quality
C: Cost
Cu: Customization
K: Know-how
R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
0	4	4	0	3	1	1	3	0	4	2	2	3	1	3	1	0	4	1	3	3	1	0	4	2	2	0	4	0	4
0	4	0	4	0	4	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	3	1	3	1	3	1
1	3	0	4	2	2	2	2	2	2	1	3	3	1	3	1	3	1	4	0	4	0	3	1	2	2	2	2	2	2
0	4	0	4	0	4	0	4	2	2	2	2	2	2	2	2	2	2	3	1	2	2	2	2	2	2	2	2	2	2
1	3	3	1	1	3	2	2	3	1	3	1	2	2	2	2	3	1	1	3	2	2	2	2	3	1	3	1	2	2
4	0	0	4	0	4	2	2	1	3	2	2	1	3	2	2	2	2	4	0	4	0	3	1	4	0	3	1	2	2
1	3	1	3	0	4	4	0	2	2	3	1	3	1	3	1	4	0	3	1	2	2	2	2	4	0	3	1	2	2
0	4	1	3	0	4	3	1	2	2	2	2	1	3	2	2	3	1	3	1	3	1	4	0	3	1	3	1	2	2
0	4	1	3	0	4	4	0	0	4	3	1	0	4	4	0	3	1	1	3	1	3	1	3	4	0	1	3	1	3
0	4	0	4	2	2	2	2	2	2	2	2	0	4	2	2	0	4	2	2	2	2	2	2	0	4	0	4	2	2
0	4	1	3	1	3	2	2	2	2	3	1	3	1	3	1	3	1	2	2	3	1	3	1	3	1	2	2	2	2
1	3	1	3	0	4	1	3	1	3	2	2	2	2	3	1	3	1	1	3	3	1	3	1	3	1	2	2	2	2
1	3	1	3	2	2	2	2	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2	2	2
0	4	0	4	2	2	2	2	2	2	4	0	4	0	4	0	4	0	3	1	3	1	3	1	2	2	2	2	2	2
0	4	0	4	0	4	4	0	1	3	4	0	0	4	4	0	0	4	0	4	4	0	4	0	4	0	1	3	0	4
0	4	0	4	0	4	0	4	0	4	2	2	3	1	3	1	1	3	3	1	3	1	1	3	3	1	0	4	0	4
1	3	1	3	4	0	2	2	2	2	3	1	4	0	2	2	3	1	4	0	2	2	3	1	0	4	0	4	2	2
0	4	0	4	2	2	1	3	2	2	3	1	4	0	3	1	3	1	4	0	3	1	2	2	0	4	0	4	2	2
1	3	1	3	3	1	4	0	2	2	3	1	4	0	3	1	2	2	4	0	3	1	2	2	1	3	1	3	1	3
0	4	0	4	0	4	0	4	0	4	2	2	3	1	3	1	2	2	4	0	4	0	3	1	2	2	2	2	2	2
0	4	0	4	2	2	2	2	1	3	0	4	2	2	2	2	1	3	4	0	4	0	4	0	2	2	1	3	1	3
1	3	1	3	1	3	1	3	1	3	3	1	3	1	3	1	2	2	2	2	2	2	1	3	2	2	0	4	0	4
0	4	0	4	2	2	2	2	1	3	0	4	2	2	2	2	1	3	4	0	4	0	4	0	2	2	1	3	1	3
0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	0	4	0	4	2	2	0	4	2	2	3	1	2	2	3	1	4	0	4	0	3	1	2	2	1	3	1	3
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1	3	1	3	1	3	4	0	2	2	3	1	3	1	3	1	3	1	3	1	3	1	2	2	4	0	2	2	0	4
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0	4	1	3	0	4	0	4	1	3	1	3	0	4	0	4	1	3	0	4	0	4	1	3	0	4	1	3	1	3
2	2	0	4	1	3	3	1	0	4	0	4	2	2	2	2	0	4	3	1	3	1	0	4	1	3	0	4	0	4
0	4	0	4	0	4	1	3	0	4	3	1	2	2	3	1	0	4	1	3	1	3	0	4	3	1	1	3	0	4
1	3	1	3	1	3	1	3	1	3	2	2	2	2	2	2	1	3	2	2	2	2	1	3	2	2	1	3	1	3
1	3	1	3	3	1	3	1	2	2	1	3	3	1	4	0	2	2	4	0	4	0	2	2	1	3	0	4	1	3
1	3	1	3	2	2	3	1	1	3	1	3	3	1	4	0	1	3	4	0	3	1	1	3	3	1	1	3	1	3
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0	4	1	3	0	4	2	2	1	3	3	1	3	1	2	2	2	2	3	1	2	2	1	3	2	2	2	2	3	1
0	4	0	4	0	4	2	2	0	4	3	1	4	0	2	2	1	3	2	2	2	2	2	2	2	2	2	2	2	2
0	4	1	3	3	1	3	1	2	2	3	1	3	1	3	1	3	1	3	1	3	1	1	3	3	1	1	3	1	3
1	3	0	4	0	4	2	2	1	3	2	2	3	1	2	2	2	2	3	1	3	1	2	2	2	2	1	3	2	2
0	4	0	4	0	4	0	4	1	3	1	3	1	3	3	1	3	1	1	3	3	1	3	1	4	0	3	1	3	1
0	4	1	3	2	2	2	2	2	2	4	0	4	0	4	0	4	0	1	3	2	2	2	2	3	1	2	2	2	2
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	3	1	3	1	3	2	2	2	2	3	1	2	2	2	2	2	2	1	3	2	2	2	2	3	1	2	2	2	2
1	3	0	4	4	0	3	1	1	3	1	3	3	1	3	1	1	3	4	0	3	1	1	3	3	1	0	4	0	4
0	4	0	4	1	3	1	3	1	3	2	2	3	1	4	0	3	1	2	2	3	1	3	1	3	1	3	1	1	3
0	4	0	4	1	3	1	3	0	4	3	1	4	0	4	0	2	2	3	1	3	1	3	1	2	2	2	2	2	2
3	1	2	2	3	1	2	2	1	3	3	1	3	1	3	1	1	3	3	1	3	1	1	3	2	2	1	3	1	3

Customer Value Data: Fashion Industry

T: Time
Q: Quality
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T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
0	4	4	0	0	4	4	0	4	0	1	3	3	1	4	0	4	0	0	4	4	0	4	0	4	0	4	0	4	0
2	2	0	4	2	2	2	2	0	4	0	4	2	2	3	1	2	2	3	1	4	0	2	2	2	2	0	4	0	4
2	2	0	4	2	2	2	2	2	2	0	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	3	0	4	1	3	1	3	1	3	3	1	3	1	3	1	3	1	3	1	3	1	3	1	1	3	1	3	3	1
2	2	2	2	2	2	2	2	0	4	4	0	4	0	4	0	0	4	2	2	2	2	0	4	2	2	0	4	0	4
1	3	1	3	2	2	4	0	0	4	3	1	3	1	4	0	1	3	2	2	4	0	1	3	3	1	1	3	0	4
2	2	2	2	2	2	2	2	0	4	4	0	4	0	4	0	0	4	2	2	2	2	0	4	2	2	0	4	0	4
0	4	2	2	2	2	0	4	0	4	3	1	3	1	3	1	4	0	3	1	3	1	3	1	1	3	2	2	3	1
1	3	3	1	1	3	1	3	2	2	2	2	3	1	3	1	2	2	2	2	2	2	1	3	2	2	1	3	2	2
0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	0	4	0	4	0	4
0	4	1	3	1	3	2	2	1	3	3	1	2	2	4	0	2	2	2	2	3	1	2	2	4	0	1	3	0	4
0	4	0	4	2	2	0	4	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
1	3	1	3	1	3	3	1	1	3	3	1	1	3	3	1	2	2	2	2	3	1	3	1	3	1	4	0	1	3
1	3	1	3	1	3	3	1	3	1	3	1	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1
0	4	1	3	2	2	1	3	1	3	3	1	3	1	2	2	3	1	3	1	3	1	3	1	2	2	2	2	2	2
1	3	1	3	1	3	3	1	1	3	3	1	3	1	2	2	1	3	3	1	3	1	1	3	3	1	1	3	1	3
1	3	1	3	1	3	1	3	2	2	3	1	2	2	2	2	2	2	3	1	3	1	3	1	1	3	2	2	2	2
1	3	2	2	2	2	2	2	0	4	1	3	2	2	2	2	0	4	2	2	2	2	0	4	2	2	0	4	0	4
1	3	1	3	1	3	1	3	2	2	3	1	2	2	2	2	2	2	3	1	3	1	3	1	1	3	2	2	2	2
2	2	2	2	1	3	2	2	4	0	2	2	0	4	3	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	3	1	3	1	3	1	3	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2	2	2
1	3	0	4	1	3	3	1	4	0	3	1	3	1	3	1	3	1	3	1	3	1	4	0	3	1	3	1	2	2
1	3	1	3	2	2	1	3	2	2	1	3	3	1	3	1	3	1	3	1	3	1	3	1	1	3	1	3	1	3
1	3	1	3	1	3	2	2	2	2	2	2	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2
2	2	0	4	2	2	3	1	3	1	1	3	3	1	3	1	1	3	4	0	4	0	4	0	1	3	3	1	1	3
2	2	2	2	4	0	4	0	2	2	2	2	4	0	4	0	2	2	4	0	2	2	2	2	0	4	0	4	0	4
1	3	0	4	0	4	1	3	1	3	0	4	0	4	0	4	1	3	4	0	4	0	4	0	3	1	3	1	1	3
0	4	0	4	0	4	4	0	1	3	2	2	4	0	4	0	3	1	4	0	4	0	3	1	4	0	3	1	0	4
1	3	0	4	0	4	1	3	1	3	0	4	0	4	0	4	1	3	4	0	4	0	4	0	3	1	3	1	1	3
0	4	1	3	1	3	1	3	0	4	4	0	4	0	4	0	0	4	1	3	1	3	0	4	1	3	0	4	0	4
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0	4	1	3	0	4	1	3	0	4	3	1	2	2	3	1	2	2	0	4	2	2	0	4	4	0	0	4	0	4
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1	3	1	3	3	1	1	3	3	1	2	2	3	1	2	2	3	1	3	1	3	1	3	1	1	3	1	3	1	3
1	3	1	3	1	3	1	3	1	3	3	1	3	1	3	1	3	1	2	2	2	2	2	2	2	2	1	3	1	3
1	3	1	3	1	3	2	2	2	2	3	1	3	1	3	1	1	3	2	2	2	2	2	2	3	1	3	1	2	2
0	4	3	1	0	4	0	4	3	1	3	1	2	2	4	0	3	1	2	2	2	2	3	1	3	1	3	1	3	1
2	2	3	1	2	2	2	2	2	2	2	2	2	2	3	1	1	3	2	2	2	2	2	2	2	2	2	2	2	2
0	4	1	3	0	4	1	3	0	4	3	1	2	2	3	1	2	2	0	4	2	2	0	4	4	0	0	4	0	4
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3	1	0	4	3	1	4	0	4	0	1	3	1	3	4	0	4	0	3	1	4	0	4	0	4	0	1	3	1	3
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4	0	4	0	2	2	4	0	2	2	3	1	4	0	4	0	4	0	1	3	1	3	1	3	0	4	1	3	1	3
1	3	0	4	1	3	2	2	2	2	1	3	3	1	3	1	2	2	4	0	4	0	4	0	3	1	2	2	2	2
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3	1	1	3	2	2	3	1	3	1	1	3	1	3	3	1	2	2	1	3	3	1	2	2	4	0	3	1	1	3
1	3	3	1	2	2	2	2	3	1	2	2	3	1	3	1	3	1	3	1	3	1	3	1	2	2	3	1	3	1
1	3	1	3	3	1	1	3	3	1	2	2	2	2	2	2	3	1	3	1	2	2	1	3	1	3	2	2	3	1
1	3	1	3	1	3	1	3	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	1	3	3	1	3	1
1	3	1	3	1	3	1	3	1	3	3	1	1	3	1	3	3	1	3	1	3	1	1	3	1	3	1	3	3	1
1	3	1	3	1	3	1	3	1	3	3	1	1	3	1	3	3	1	3	1	3	1	1	3	1	3	1	3	3	1

Customer Value Data: Fashion Industry

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T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
0	4	1	3	2	2	2	2	1	3	3	1	3	1	3	1	2	2	3	1	3	1	2	2	2	2	1	3	1	3
0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	4	0	1	3	0	4	0	4	0	4	0	4	0	4
0	4	0	4	2	2	1	3	1	3	0	4	2	2	1	3	1	3	2	2	1	3	1	3	1	3	1	3	1	3
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
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1	3	0	4	1	3	1	3	2	2	2	2	1	3	2	2	2	2	1	3	2	2	2	2	3	1	2	2	2	2
2	2	2	2	2	2	2	2	2	2	4	0	4	0	4	0	4	0	2	2	2	2	2	2	2	2	2	2	2	2
0	4	2	2	2	2	2	2	0	4	4	0	3	1	3	1	2	2	2	2	2	2	1	3	2	2	1	3	1	3
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0	4	1	3	1	3	3	1	0	4	3	1	4	0	4	0	0	4	1	3	4	0	0	4	3	1	0	4	0	4
1	3	1	3	2	2	4	0	0	4	3	1	3	1	4	0	1	3	2	2	4	0	1	3	3	1	1	3	0	4
2	2	2	2	2	2	2	2	0	4	4	0	4	0	4	0	0	4	2	2	2	2	0	4	2	2	0	4	0	4
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1	3	3	1	1	3	1	3	2	2	2	2	3	1	3	1	2	2	2	2	2	2	1	3	2	2	1	3	2	2
0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	0	4	0	4	0	4
0	4	1	3	1	3	2	2	1	3	3	1	2	2	4	0	2	2	2	2	3	1	2	2	4	0	1	3	0	4
0	4	0	4	2	2	0	4	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
1	3	1	3	1	3	3	1	1	3	3	1	1	3	3	1	2	2	2	2	3	1	3	1	3	1	4	0	1	3
1	3	1	3	1	3	3	1	3	1	3	1	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1
0	4	1	3	2	2	1	3	1	3	3	1	3	1	2	2	3	1	3	1	3	1	3	1	2	2	2	2	2	2
1	3	1	3	1	3	3	1	1	3	3	1	3	1	2	2	1	3	3	1	3	1	1	3	3	1	1	3	1	3
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	3	2	2	2	2	2	2	0	4	1	3	2	2	2	2	0	4	2	2	2	2	0	4	2	2	0	4	0	4

Customer Value Data: Food Industry

T: Time | C: Cost | K: Know-how
Q: Quality | Cu: Customization | R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
0	4	0	4	3	1	0	4	1	3	2	2	1	3	1	3	2	2	2	2	3	1	2	2	3	1	2	2	1	3
1	3	1	3	1	3	1	3	4	0	3	1	3	1	3	1	4	0	4	0	4	0	4	0	3	1	3	1	3	1
0	4	2	2	2	2	2	2	1	3	4	0	4	0	4	0	4	0	2	2	2	2	2	2	2	2	2	2	2	2
0	4	0	4	1	3	2	2	2	2	4	0	4	0	4	0	4	0	4	0	4	0	4	0	2	2	2	2	2	2
0	4	3	1	1	3	2	2	2	2	3	1	2	2	2	2	3	1	1	3	2	2	3	1	3	1	3	1	2	2
0	4	0	4	0	4	0	4	0	4	2	2	4	0	4	0	2	2	4	0	4	0	3	1	2	2	1	3	1	3
0	4	2	2	3	1	0	4	0	4	3	1	3	1	4	0	1	3	3	1	2	2	2	2	3	1	1	3	3	1
2	2	1	3	3	1	3	1	2	2	2	2	4	0	3	1	2	2	3	1	4	0	3	1	3	1	3	1	3	1
0	4	4	0	0	4	0	4	1	3	1	3	3	1	3	1	1	3	1	3	1	3	1	3	1	3	1	3	1	3
0	4	2	2	0	4	2	2	2	2	2	2	4	0	2	2	2	2	0	4	0	4	0	4	0	4	0	4	2	2
2	2	3	1	1	3	1	3	2	2	2	2	1	3	2	2	2	2	1	3	1	3	2	2	1	3	2	2	2	2
2	2	3	1	4	0	3	1	1	3	3	1	4	0	3	1	1	3	4	0	2	2	1	3	0	4	0	4	1	3
1	3	1	3	1	3	2	2	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2	2	2
0	4	0	4	3	1	3	1	3	1	4	0	4	0	4	0	4	0	4	0	4	0	4	0	2	2	2	2	2	2
0	4	4	0	0	4	4	0	4	0	4	0	0	4	4	0	4	0	0	4	4	0	4	0	4	0	4	0	0	4
1	3	1	3	3	1	4	0	1	3	3	1	4	0	4	0	2	2	3	1	4	0	2	2	3	1	0	4	0	4
0	4	2	2	4	0	3	1	2	2	2	2	4	0	3	1	3	1	4	0	3	1	3	1	2	2	3	1	2	2
0	4	1	3	4	0	2	2	0	4	4	0	4	0	3	1	3	1	4	0	3	1	2	2	0	4	0	4	2	2
2	2	1	3	4	0	3	1	1	3	3	1	4	0	4	0	2	2	4	0	3	1	2	2	0	4	0	4	1	3
0	4	1	3	1	3	2	2	2	2	2	2	2	2	2	2	2	2	3	1	3	1	3	1	3	1	2	2	2	2
0	4	0	4	3	1	3	1	3	1	3	1	4	0	3	1	3	1	4	0	3	1	3	1	1	3	1	3	2	2
0	4	1	3	1	3	1	3	0	4	4	0	4	0	2	2	2	2	1	3	2	2	0	4	2	2	0	4	0	4
1	3	0	4	4	0	4	0	2	2	4	0	4	0	4	0	2	2	4	0	4	0	4	0	3	1	1	3	0	4
0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	4	0	2	2	2	2	2	2	2	2	2	2	2	2
0	4	2	2	2	2	2	2	2	2	4	0	1	3	2	2	1	3	3	1	2	2	4	0	3	1	2	2	1	3
0	4	0	4	0	4	0	4	0	4	3	1	4	0	4	0	4	0	3	1	3	1	2	2	2	2	1	3	1	3
0	4	1	3	1	3	0	4	1	3	4	0	4	0	4	0	4	0	3	1	1	3	1	3	0	4	1	3	1	3
1	3	1	3	3	1	3	1	3	1	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	1	3	1	3
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	3	1	3	1	3	1	3	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2
0	4	2	2	3	1	3	1	2	2	3	1	4	0	4	0	2	2	4	0	3	1	2	2	0	4	2	2	3	1
0	4	0	4	3	1	1	3	2	2	2	2	4	0	4	0	3	1	4	0	4	0	3	1	2	2	1	3	1	3
0	4	1	3	2	2	2	2	2	2	1	3	4	0	4	0	4	0	3	1	3	1	3	1	2	2	2	2	2	2
0	4	1	3	0	4	0	4	1	3	1	3	0	4	0	4	1	3	0	4	0	4	1	3	0	4	1	3	1	3
0	4	0	4	1	3	3	1	0	4	1	3	3	1	3	1	0	4	1	3	2	2	0	4	3	1	0	4	0	4
0	4	1	3	1	3	1	3	0	4	3	1	2	2	3	1	2	2	3	1	2	2	0	4	3	1	0	4	0	4
0	4	0	4	0	4	0	4	0	4	1	3	2	2	2	2	1	3	2	2	2	2	1	3	2	2	1	3	1	3
0	4	0	4	3	1	3	1	1	3	2	2	3	1	3	1	2	2	3	1	3	1	2	2	1	3	0	4	1	3
3	1	1	3	3	1	2	2	1	3	2	2	2	2	3	1	1	3	3	1	3	1	1	3	1	3	1	3	1	3
1	3	1	3	1	3	1	3	3	1	1	3	3	1	3	1	3	1	1	3	1	3	1	3	2	2	2	2	3	1
2	2	1	3	0	4	1	3	1	3	4	0	4	0	3	1	3	1	3	1	3	1	2	2	0	4	0	4	2	2
0	4	0	4	0	4	2	2	0	4	4	0	4	0	4	0	4	0	4	0	4	0	3	1	2	2	2	2	2	2
0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	2	2	4	0	3	1	2	2	2	2	1	3	1	3
0	4	1	3	2	2	2	2	1	3	2	2	3	1	3	1	2	2	3	1	3	1	2	2	2	2	2	2	2	2
2	2	1	3	3	1	4	0	3	1	1	3	3	1	3	1	2	2	4	0	4	0	2	2	3	1	2	2	2	2
0	4	3	1	1	3	1	3	1	3	4	0	4	0	4	0	4	0	2	2	2	2	2	2	1	3	2	2	3	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	3	3	1	2	2	2	2	2	2	4	0	4	0	4	0	2	2	1	3	2	2	2	2	3	1	2	2	2	2
1	3	1	3	3	1	2	2	1	3	3	1	3	1	3	1	3	1	3	1	2	2	1	3	3	1	0	4	0	4
1	3	1	3	2	2	2	2	1	3	2	2	3	1	3	1	3	1	3	1	3	1	2	2	2	2	2	2	1	3
0	4	1	3	1	3	1	3	0	4	3	1	3	1	3	1	3	1	3	1	3	1	2	2	1	3	1	3	1	3
2	2	3	1	3	1	1	3	1	3	2	2	3	1	2	2	1	3	3	1	1	3	1	3	1	3	1	3	1	3
0	4	4	0	0	4	0	4	4	0	4	0	0	4	0	4	4	0	0	4	0	4	4	0	0	4	4	0	4	0

Customer Value Data: Food Industry

T: Time
Q: Quality
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T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
1	3	0	4	2	2	2	2	1	3	1	3	2	2	2	2	1	3	3	1	3	1	1	3	2	2	2	2	1	3
0	4	1	3	0	4	2	2	2	2	1	3	1	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	2	2	1	3	1	3	1	3	4	0	4	0	4	0	4	0	3	1	1	3	2	2	1	3	3	1	3	1
0	4	2	2	0	4	1	3	0	4	2	2	4	0	4	0	2	2	4	0	4	0	2	2	3	1	2	2	0	4
1	3	2	2	3	1	3	1	1	3	3	1	4	0	3	1	2	2	1	3	3	1	1	3	2	2	1	3	1	3
1	3	1	3	1	3	1	3	0	4	4	0	4	0	4	0	4	0	2	2	2	2	0	4	2	2	0	4	0	4
2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	0	4	3	1	0	4	2	2	4	0
2	2	2	2	4	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	1	3	1	1	3	0	4	1	3
0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	0	4	0	4	0	4
0	4	1	3	1	3	2	2	0	4	4	0	3	1	1	3	2	2	1	3	1	3	1	3	0	4	0	4	4	0
0	4	0	4	0	4	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
1	3	3	1	3	1	4	0	3	1	1	3	4	0	4	0	3	1	3	1	4	0	3	1	1	3	1	3	1	3
1	3	1	3	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2
0	4	1	3	1	3	1	3	3	1	3	1	2	2	3	1	4	0	3	1	3	1	4	0	1	3	3	1	3	1
0	4	2	2	2	2	3	1	1	3	3	1	3	1	3	1	2	2	3	1	3	1	1	3	2	2	1	3	1	3
0	4	3	1	3	1	3	1	3	1	4	0	3	1	3	1	3	1	2	2	1	3	1	3	2	2	2	2	2	2
1	3	1	3	2	2	2	2	0	4	3	1	2	2	2	2	0	4	2	2	2	2	0	4	2	2	0	4	0	4
1	3	3	1	1	3	2	2	3	1	3	1	3	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	2	2	4	0	2	2	3	1	2	2	1	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	1	3	1	3	1	3	1	3	4	0	4	0	4	0	4	0	1	3	1	3	1	3	1	3	2	2	2	2
0	4	0	4	1	3	2	2	1	3	3	1	3	1	4	0	4	0	1	3	1	3	3	1	3	1	3	1	2	2
1	3	0	4	2	2	2	2	2	2	1	3	2	2	2	2	2	2	3	1	3	1	3	1	1	3	1	3	1	3
1	3	1	3	4	0	4	0	4	0	2	2	4	0	4	0	3	1	4	0	4	0	4	0	2	2	0	4	2	2
0	4	3	1	1	3	3	1	4	0	3	1	3	1	4	0	3	1	3	1	3	1	3	1	2	2	3	1	0	4
2	2	3	1	2	2	2	2	0	4	3	1	4	0	2	2	2	2	2	2	0	4	0	4	2	2	0	4	1	3
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	0	4	0	4	3	1	1	3	2	2	4	0	3	1	3	1	4	0	4	0	3	1	3	1	1	3	0	4
1	3	0	4	3	1	4	0	0	4	0	4	1	3	1	3	4	0	4	0	4	0	4	0	3	1	3	1	1	3
0	4	1	3	1	3	1	3	0	4	4	0	4	0	4	0	0	4	0	4	0	4	0	4	0	4	0	4	0	4
2	2	1	3	3	1	2	2	2	2	1	3	3	1	2	2	2	2	4	0	4	0	3	1	2	2	1	3	1	3
0	4	3	1	0	4	3	1	3	1	4	0	0	4	3	1	3	1	2	2	0	4	1	3	2	2	3	1	3	1
0	4	1	3	2	2	2	2	0	4	2	2	2	2	2	2	0	4	2	2	2	2	0	4	2	2	0	4	0	4
1	3	1	3	3	1	3	1	3	1	1	3	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2	2	2
0	4	1	3	1	3	2	2	2	2	2	2	2	2	2	2	2	2	3	1	3	1	3	1	3	1	1	3	1	3
0	4	0	4	0	4	3	1	1	3	3	1	2	2	3	1	3	1	1	3	2	2	2	2	2	2	1	3	2	2
0	4	3	1	0	4	3	1	3	1	4	0	0	4	3	1	3	1	2	2	0	4	1	3	2	2	3	1	3	1
1	3	2	2	3	1	2	2	1	3	1	3	2	2	2	2	1	3	2	2	2	2	2	2	2	2	1	3	2	2
0	4	2	2	2	2	1	3	0	4	4	0	3	1	2	2	1	3	2	2	3	1	0	4	2	2	0	4	0	4
0	4	1	3	2	2	2	2	0	4	2	2	2	2	2	2	0	4	2	2	2	2	0	4	2	2	0	4	0	4
0	4	1	3	3	1	1	3	3	1	3	1	4	0	2	2	3	1	3	1	3	1	2	2	1	3	1	3	3	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	0	4	4	0	0	4	2	2	3	1	1	3	3	1	3	1	3	1	3	1	3	1	1	3	3	1	3	1
0	4	4	0	4	0	0	4	2	2	4	0	4	0	0	4	4	0	4	0	0	4	1	3	0	4	2	2	4	0
0	4	0	4	2	2	2	2	2	2	3	1	4	0	4	0	4	0	3	1	3	1	3	1	2	2	2	2	2	2
2	2	3	1	0	4	2	2	2	2	2	2	2	2	1	3	2	2	1	3	2	2	3	1	2	2	2	2	1	3
0	4	1	3	0	4	3	1	0	4	4	0	2	2	3	1	2	2	1	3	2	2	0	4	3	1	1	3	0	4
2	2	2	2	2	2	2	2	2	2	4	0	4	0	4	0	2	2	4	0	4	0	2	2	2	2	1	3	1	3
1	3	1	3	3	1	1	3	3	1	2	2	2	2	2	2	1	3	3	1	2	2	3	1	1	3	2	2	3	1
0	4	1	3	1	3	1	3	3	1	3	1	3	1	4	0	4	0	3	1	1	3	3	1	1	3	3	1	3	1
0	4	0	4	1	3	0	4	0	4	3	1	1	3	0	4	0	4	3	1	1	3	2	2	1	3	1	3	2	2
0	4	0	4	1	3	0	4	0	4	3	1	1	3	0	4	0	4	3	1	1	3	2	2	1	3	1	3	2	2
0	4	2	2	3	1	2	2	1	3	3	1	3	1	3	1	3	1	3	1	2	2	1	3	2	2	1	3	1	3
0	4	0	4	1	3	0	4	0	4	4	0	2	2	4	0	4	0	4	0	3	1	4	0	0	4	0	4	0	4

Customer Value Data: Food Industry

T: Time
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T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K
0	4	0	4	2	2	1	3	1	3	0	4	2	2	1	3
0	4	2	2	0	4	0	4	0	4	4	0	4	0	4	0
1	3	1	3	3	1	2	2	3	1	1	3	3	1	3	1
1	3	1	3	0	4	3	1	4	0	3	1	4	0	4	0
0	4	3	1	3	1	4	0	3	1	3	1	1	3	3	1
1	3	1	3	1	3	2	2	2	2	3	1	2	2	2	2
0	4	2	2	2	2	2	2	2	2	4	0	4	0	4	0
0	4	2	2	2	2	2	2	0	4	3	1	2	2	2	2
0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0
0	4	2	2	2	2	2	2	0	4	3	1	3	1	4	0
0	4	0	4	0	4	0	4	0	4	4	0	3	1	2	2
0	4	4	0	0	4	4	0	0	4	4	0	3	1	4	0
1	3	2	2	3	1	3	1	1	3	3	1	4	0	3	1
1	3	1	3	1	3	1	3	0	4	4	0	4	0	4	0
2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1
2	2	2	2	4	0	2	2	2	2	2	2	2	2	2	2
0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4
0	4	1	3	1	3	2	2	0	4	4	0	3	1	1	3
0	4	0	4	0	4	1	3	1	3	1	3	1	3	1	3
1	3	3	1	3	1	4	0	3	1	1	3	4	0	4	0
1	3	1	3	3	1	3	1	3	1	3	1	3	1	3	1
0	4	1	3	1	3	1	3	3	1	3	1	2	2	3	1
0	4	2	2	2	2	3	1	1	3	3	1	3	1	3	1
0	4	3	1	3	1	3	1	3	1	4	0	3	1	3	1
1	3	1	3	2	2	2	2	0	4	3	1	2	2	2	2

Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
1	3	2	2	1	3	1	3	1	3	1	3	1	3
4	0	2	2	2	2	2	2	2	2	2	2	2	2
4	0	4	0	4	0	4	0	1	3	3	1	3	1
3	1	3	1	4	0	3	1	3	1	3	1	1	3
3	1	1	3	4	0	1	3	4	0	1	3	0	4
4	0	2	2	2	2	2	2	2	2	2	2	2	2
4	0	0	4	0	4	2	2	0	4	0	4	0	4
0	4	2	2	2	2	1	3	2	2	0	4	0	4
4	0	4	0	4	0	0	4	4	0	0	4	0	4
2	2	3	1	3	1	0	4	3	1	0	4	0	4
2	2	2	2	2	2	2	2	2	2	1	3	1	3
0	4	3	1	3	1	0	4	3	1	0	4	0	4
2	2	1	3	3	1	1	3	2	2	1	3	1	3
4	0	2	2	2	2	0	4	2	2	0	4	0	4
3	1	3	1	0	4	3	1	0	4	2	2	4	0
2	2	2	2	3	1	3	1	1	3	0	4	1	3
0	4	4	0	4	0	4	0	0	4	0	4	0	4
2	2	1	3	1	3	1	3	0	4	0	4	4	0
1	3	1	3	1	3	1	3	1	3	1	3	1	3
3	1	3	1	4	0	3	1	1	3	1	3	1	3
3	1	3	1	3	1	3	1	3	1	3	1	2	2
4	0	3	1	3	1	4	0	1	3	3	1	3	1
2	2	3	1	3	1	1	3	2	2	1	3	1	3
3	1	2	2	1	3	1	3	2	2	2	2	2	2
0	4	2	2	2	2	0	4	2	2	0	4	0	4

Customer Value Data: Furniture Industry

T: Time
Q: Quality
C: Cost
Cu: Customization
K: Know-how
R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
1	3	1	3	2	2	3	1	0	4	1	3	2	2	3	1	0	4	1	3	3	1	0	4	3	1	0	4	0	4
0	4	0	4	1	3	3	1	4	0	2	2	4	0	4	0	4	0	4	0	4	0	4	0	3	1	3	1	2	2
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	0	4	0	4	3	1	3	1	2	2	3	1	3	1	4	0	4	0	4	0	4	0	2	2	2	2	2	2
1	3	1	3	1	3	2	2	1	3	3	1	2	2	2	2	3	1	1	3	3	1	3	1	3	1	3	1	2	2
0	4	0	4	0	4	0	4	0	4	0	4	2	2	2	2	4	0	4	0	4	0	4	0	2	2	4	0	2	2
1	3	3	1	0	4	0	4	3	1	2	2	1	3	3	1	2	2	1	3	1	3	1	3	3	1	2	2	1	3
3	1	2	2	1	3	3	1	0	4	2	2	2	2	3	1	3	1	4	0	4	0	3	1	2	2	1	3	1	3
0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	1	3	3	1	3	1	1	3	1	3	1	3	1	3
0	4	0	4	0	4	4	0	2	2	2	2	0	4	4	0	2	2	4	0	4	0	0	4	4	0	0	4	2	2
1	3	1	3	1	3	1	3	1	3	3	1	3	1	3	1	3	1	3	1	2	2	2	2	2	2	2	2	2	2
2	2	2	2	1	3	2	2	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	1	3	1	3	3	1
1	3	1	3	2	2	2	2	2	2	1	3	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2	2	2
0	4	0	4	2	2	2	2	2	2	3	1	4	0	4	0	4	0	4	0	4	0	4	0	2	2	2	2	2	2
0	4	0	4	0	4	4	0	4	0	4	0	0	4	4	0	4	0	0	4	4	0	4	0	4	0	4	0	0	4
0	4	0	4	1	3	4	0	0	4	2	2	3	1	4	0	1	3	3	1	4	0	1	3	4	0	0	4	0	4
0	4	1	3	4	0	3	1	2	2	3	1	4	0	2	2	2	2	4	0	2	2	2	2	2	2	0	4	2	2
0	4	0	4	0	4	1	3	2	2	3	1	4	0	2	2	3	1	4	0	3	1	2	2	0	4	1	3	3	1
1	3	1	3	0	4	3	1	1	3	3	1	1	3	4	0	1	3	2	2	4	0	2	2	4	0	2	2	0	4
0	4	0	4	1	3	1	3	1	3	2	2	2	2	2	2	2	2	3	1	3	1	2	2	3	1	3	1	2	2
1	3	1	3	3	1	3	1	3	1	3	1	4	0	3	1	3	1	4	0	3	1	3	1	1	3	1	3	2	2
1	3	1	3	1	3	2	2	1	3	2	2	3	1	3	1	2	2	2	2	2	2	1	3	2	2	1	3	1	3
0	4	0	4	2	2	1	3	2	2	0	4	3	1	3	1	2	2	4	0	4	0	4	0	1	3	1	3	2	2
0	4	0	4	0	4	0	4	0	4	2	2	2	2	2	2	2	2	0	4	0	4	0	4	0	4	0	4	0	4
2	2	4	0	0	4	2	2	4	0	2	2	2	2	3	1	2	2	2	2	2	2	3	1	2	2	4	0	2	2
0	4	0	4	0	4	2	2	1	3	2	2	3	1	4	0	3	1	4	0	4	0	1	3	2	2	1	3	1	3
0	4	0	4	1	3	1	3	0	4	4	0	3	1	3	1	1	3	4	0	3	1	1	3	0	4	0	4	3	1
1	3	1	3	1	3	3	1	1	3	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	1	3	1	3
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	3	1	3	1	3	1	3	2	2	3	1	3	1	3	1	3	1	1	3	1	3	1	3	1	3	2	2	2	2
0	4	1	3	2	2	2	2	1	3	2	2	3	1	3	1	2	2	4	0	3	1	2	2	3	1	2	2	1	3
0	4	1	3	1	3	2	2	1	3	3	1	4	0	4	0	3	1	4	0	4	0	3	1	2	2	1	3	1	3
1	3	1	3	2	2	2	2	0	4	1	3	2	2	1	3	0	4	3	1	2	2	0	4	3	1	0	4	0	4
0	4	1	3	0	4	0	4	1	3	1	3	0	4	0	4	1	3	0	4	0	4	1	3	0	4	1	3	1	3
3	1	2	2	0	4	2	2	0	4	1	3	2	2	3	1	0	4	3	1	3	1	0	4	2	2	0	4	0	4
1	3	1	3	1	3	3	1	0	4	3	1	3	1	3	1	1	3	3	1	3	1	1	3	2	2	0	4	0	4
1	3	1	3	2	2	1	3	0	4	2	2	2	2	2	2	1	3	2	2	2	2	1	3	2	2	1	3	1	3
0	4	0	4	3	1	3	1	0	4	2	2	3	1	3	1	2	2	3	1	3	1	2	2	3	1	2	2	1	3
3	1	0	4	1	3	4	0	1	3	1	3	1	3	4	0	1	3	3	1	4	0	1	3	1	3	1	3	1	3
1	3	1	3	1	3	3	1	3	1	1	3	3	1	3	1	3	1	2	2	2	2	2	2	2	2	2	2	2	2
0	4	0	4	1	3	1	3	0	4	4	0	3	1	3	1	2	2	3	1	2	2	2	2	1	3	0	4	0	4
2	2	1	3	2	2	2	2	1	3	2	2	3	1	3	1	3	1	2	2	3	1	3	1	2	2	2	2	2	2
0	4	0	4	1	3	3	1	1	3	3	1	3	1	3	1	1	3	3	1	3	1	3	1	3	1	1	3	1	3
0	4	0	4	3	1	4	0	4	0	2	2	3	1	4	0	3	1	4	0	4	0	3	1	2	2	2	2	2	2
0	4	0	4	0	4	0	4	0	4	1	3	2	2	3	1	2	2	3	1	4	0	3	1	3	1	2	2	2	2
0	4	1	3	0	4	1	3	2	2	4	0	4	0	4	0	4	0	1	3	1	3	2	2	3	1	3	1	2	2
4	0	3	1	0	4	0	4	3	1	3	1	0	4	0	4	4	0	3	1	0	4	4	0	0	4	4	0	4	0
1	3	1	3	1	3	3	1	2	2	3	1	1	3	2	2	2	2	1	3	3	1	2	2	3	1	2	2	2	2
3	1	1	3	0	4	1	3	0	4	2	2	3	1	3	1	0	4	3	1	3	1	1	3	4	0	2	2	1	3
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	1	3	1	3	4	0	1	3	3	1	3	1	3	1	3	1	3	1	4	0	4	0	2	2	2	2	2	2
1	3	2	2	3	1	3	1	1	3	2	2	3	1	3	1	1	3	3	1	3	1	1	3	2	2	1	3	1	3

Customer Value Data: Furniture Industry

T: Time
C: Cost
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Q: Quality
Cu: Customization
R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
4	0	3	1	0	4	0	4	3	1	3	1	0	4	0	4	4	0	3	1	0	4	4	0	0	4	4	0	4	0
1	3	0	4	1	3	0	4	1	3	1	3	1	3	1	3	1	3	3	1	3	1	2	2	2	2	1	3	1	3
0	4	0	4	2	2	2	2	0	4	0	4	1	3	1	3	1	3	0	4	2	2	1	3	2	2	0	4	0	4
0	4	0	4	1	3	1	3	1	3	3	1	3	1	3	1	3	1	3	1	2	2	2	2	3	1	2	2	2	2
0	4	0	4	3	1	1	3	0	4	2	2	4	0	3	1	2	2	4	0	3	1	2	2	0	4	0	4	0	4
0	4	1	3	2	2	1	3	0	4	3	1	4	0	3	1	2	2	4	0	3	1	1	3	2	2	1	3	1	3
1	3	1	3	1	3	1	3	0	4	3	1	3	1	3	1	0	4	1	3	1	3	0	4	2	2	0	4	0	4
0	4	1	3	1	3	1	3	1	3	3	1	3	1	3	1	3	1	3	1	3	1	3	1	1	3	3	1	3	1
1	3	2	2	3	1	3	1	2	2	2	2	4	0	3	1	2	2	4	0	3	1	2	2	1	3	0	4	1	3
0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	0	4	0	4	0	4
0	4	0	4	0	4	1	3	0	4	3	1	3	1	2	2	1	3	2	2	2	2	2	2	4	0	2	2	0	4
0	4	0	4	0	4	1	3	0	4	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
0	4	0	4	1	3	3	1	3	1	3	1	3	1	4	0	3	1	2	2	3	1	3	1	4	0	3	1	1	3
0	4	0	4	1	3	1	3	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1
0	4	0	4	1	3	1	3	2	2	3	1	2	2	3	1	2	2	2	2	3	1	2	2	1	3	2	2	3	1
1	3	1	3	2	2	3	1	1	3	1	3	3	1	3	1	1	3	3	1	3	1	1	3	1	3	1	3	1	3
0	4	0	4	0	4	0	4	1	3	2	2	2	2	3	1	1	3	1	3	1	3	2	2	2	2	1	3	1	3
2	2	2	2	2	2	2	2	1	3	2	2	2	2	2	2	0	4	2	2	2	2	0	4	2	2	0	4	0	4
3	1	1	3	3	1	2	2	2	2	1	3	3	1	2	2	2	2	3	1	3	1	3	1	2	2	2	2	2	2
2	2	2	2	2	2	2	2	4	0	1	3	3	1	2	2	2	2	2	2	0	4	2	2	2	2	2	2	2	2
2	2	1	3	2	2	3	1	2	2	1	3	2	2	1	3	2	2	2	2	1	3	3	1	3	1	2	2	1	3
1	3	0	4	1	3	4	0	2	2	2	2	2	2	3	1	3	1	3	1	3	1	3	1	2	2	3	1	2	2
1	3	0	4	3	1	3	1	3	1	1	3	3	1	3	1	3	1	3	1	3	1	3	1	1	3	1	3	1	3
0	4	0	4	1	3	2	2	2	2	2	2	2	2	3	1	3	1	3	1	3	1	4	0	2	2	3	1	2	2
1	3	2	2	2	2	3	1	3	1	3	1	3	1	3	1	4	0	3	1	3	1	4	0	3	1	4	0	3	1
1	3	1	3	1	3	4	0	2	2	2	2	3	1	4	0	2	2	4	0	4	0	2	2	4	0	2	2	0	4
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	0	4	0	4	1	3	1	3	2	2	4	0	3	1	3	1	4	0	4	0	3	1	1	3	1	3	1	3
3	1	3	1	4	0	3	1	1	3	1	3	1	3	1	3	0	4	0	4	1	3	0	4	1	3	0	4	1	3
0	4	0	4	1	3	2	2	0	4	4	0	4	0	4	0	0	4	2	2	1	3	0	4	1	3	0	4	0	4
0	4	0	4	2	2	1	3	0	4	2	2	3	1	3	1	1	3	3	1	3	1	2	2	3	1	1	3	0	4
2	2	2	2	2	2	2	2	1	3	3	1	3	1	3	1	3	1	2	2	2	2	2	2	3	1	3	1	2	2
3	1	3	1	0	4	0	4	0	4	1	3	0	4	1	3	0	4	1	3	1	3	0	4	1	3	0	4	0	4
3	1	1	3	3	1	3	1	3	1	1	3	3	1	3	1	3	1	3	1	3	1	3	1	1	3	1	3	1	3
1	3	1	3	1	3	1	3	1	3	1	3	1	3	2	2	1	3	2	2	2	2	2	2	3	1	1	3	1	3
2	2	2	2	2	2	2	2	1	3	3	1	3	1	3	1	3	1	2	2	2	2	2	2	3	1	3	1	2	2
1	3	1	3	0	4	0	4	3	1	3	1	0	4	0	4	4	0	1	3	1	3	4	0	4	0	4	0	4	0
2	2	2	2	2	2	2	2	2	2	1	3	1	3	2	2	2	2	1	3	2	2	1	3	2	2	2	2	2	2
0	4	0	4	1	3	1	3	0	4	3	1	4	0	2	2	2	2	3	1	3	1	1	3	1	3	0	4	0	4
3	1	3	1	0	4	0	4	0	4	1	3	0	4	1	3	0	4	1	3	1	3	0	4	1	3	0	4	0	4
1	3	1	3	0	4	3	1	3	1	3	1	3	1	3	1	3	1	4	0	4	0	3	1	1	3	3	1	3	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	0	4	3	1	3	1	3	1	3	1	3	1	4	0	4	0	4	0	4	0	4	0	1	3	3	1	3	1
3	1	2	2	0	4	4	0	0	4	2	2	4	0	4	0	2	2	4	0	3	1	2	2	4	0	2	2	2	2
1	3	0	4	1	3	1	3	2	2	1	3	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2
3	1	2	2	1	3	4	0	2	2	1	3	3	1	2	2	2	2	0	4	2	2	3	1	2	2	4	0	2	2
1	3	1	3	0	4	3	1	0	4	3	1	3	1	4	0	2	2	3	1	4	0	1	3	3	1	1	3	0	4
0	4	1	3	0	4	1	3	2	2	4	0	2	2	2	2	4	0	1	3	1	3	3	1	2	2	4	0	4	0
1	3	1	3	3	1	1	3	3	1	2	2	2	2	2	2	3	1	3	1	2	2	3	1	1	3	2	2	3	1
0	4	0	4	1	3	0	4	3	1	3	1	3	1	3	1	3	1	3	1	1	3	3	1	1	3	3	1	3	1
0	4	3	1	1	3	0	4	2	2	1	3	3	1	1	3	3	1	3	1	1	3	3	1	1	3	1	3	3	1
0	4	3	1	1	3	0	4	2	2	1	3	3	1	1	3	3	1	3	1	1	3	3	1	1	3	1	3	3	1

Customer Value Data: Furniture Industry

T: Time
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T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
1	3	1	3	2	2	2	2	1	3	3	1	3	1	2	2	2	2	3	1	2	2	3	1	2	2	1	3	1	3
1	3	0	4	2	2	1	3	2	2	3	1	2	2	3	1	4	0	4	0	4	0	0	4	1	3	1	3	1	3
0	4	0	4	2	2	1	3	1	3	0	4	2	2	1	3	1	3	2	2	1	3	1	3	1	3	1	3	1	3
0	4	0	4	3	1	0	4	2	2	3	1	3	1	3	1	3	1	2	2	2	2	2	2	2	2	2	2	2	2
1	3	0	4	1	3	3	1	2	2	0	4	4	0	4	0	4	0	4	0	4	0	4	0	0	4	0	4	3	1
1	3	0	4	4	0	4	0	3	1	1	3	4	0	4	0	3	1	4	0	4	0	3	1	3	1	1	3	0	4
0	4	0	4	0	4	0	4	0	4	4	0	2	2	4	0	2	2	1	3	2	2	1	3	3	1	1	3	1	3
0	4	0	4	0	4	1	3	3	1	3	1	2	2	2	2	3	1	1	3	2	2	3	1	2	2	2	2	3	1
2	2	2	2	2	2	2	2	3	1	2	2	2	2	2	2	3	1	2	2	2	2	3	1	2	2	3	1	3	1
1	3	2	2	2	2	2	2	0	4	2	2	2	2	3	1	0	4	2	2	2	2	0	4	3	1	0	4	0	4
0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	0	4	4	0	4	0	0	4	4	0	4	0	0	4
0	4	0	4	0	4	1	3	0	4	2	2	3	1	3	1	2	2	3	1	3	1	2	2	2	2	1	3	0	4
0	4	1	3	1	3	1	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	3	1	3
1	3	1	3	3	1	0	4	0	4	4	0	3	1	4	0	0	4	3	1	1	3	0	4	2	2	0	4	0	4
0	4	1	3	2	2	1	3	0	4	3	1	4	0	3	1	2	2	4	0	3	1	1	3	2	2	1	3	1	3
1	3	1	3	1	3	1	3	0	4	3	1	3	1	3	1	0	4	1	3	1	3	0	4	2	2	0	4	0	4
0	4	1	3	1	3	1	3	1	3	3	1	3	1	3	1	3	1	3	1	3	1	3	1	1	3	3	1	3	1
1	3	2	2	3	1	3	1	2	2	2	2	4	0	3	1	2	2	4	0	3	1	2	2	1	3	0	4	1	3
0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	0	4	0	4	0	4
0	4	0	4	0	4	1	3	0	4	3	1	3	1	2	2	1	3	2	2	2	2	2	2	4	0	2	2	0	4
0	4	0	4	0	4	1	3	0	4	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
0	4	0	4	1	3	3	1	3	1	3	1	3	1	4	0	3	1	2	2	3	1	3	1	4	0	3	1	1	3
0	4	0	4	1	3	1	3	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1
0	4	0	4	1	3	1	3	2	2	3	1	2	2	3	1	2	2	2	2	3	1	2	2	1	3	2	2	3	1
1	3	1	3	2	2	3	1	1	3	1	3	3	1	3	1	1	3	3	1	3	1	1	3	1	3	1	3	1	3
0	4	0	4	0	4	0	4	1	3	2	2	2	2	3	1	1	3	1	3	1	3	2	2	2	2	1	3	1	3
2	2	2	2	2	2	2	2	1	3	2	2	2	2	2	2	0	4	2	2	2	2	0	4	2	2	0	4	0	4

Customer Value Data: Pharmaceutical Industry

T: Time
Q: Quality
C: Cost
Cu: Customization
K: Know-how
R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
0	4	3	1	1	3	0	4	2	2	2	2	3	1	1	3	3	1	1	3	0	4	1	3	0	4	2	2	4	0
0	4	2	2	0	4	0	4	4	0	4	0	4	0	2	2	3	1	3	1	0	4	3	1	0	4	2	2	4	0
0	4	2	2	2	2	2	2	1	3	4	0	4	0	4	0	4	0	2	2	2	2	2	2	2	2	1	3	1	3
0	4	0	4	3	1	0	4	0	4	4	0	4	0	4	0	4	0	0	4	0	4	0	4	2	2	1	3	1	3
0	4	2	2	1	3	1	3	2	2	4	0	3	1	3	1	3	1	1	3	3	1	3	1	3	1	3	1	2	2
0	4	0	4	0	4	0	4	2	2	4	0	2	2	2	2	4	0	4	0	2	2	4	0	4	0	4	0	2	2
0	4	4	0	2	2	0	4	1	3	2	2	0	4	0	4	2	2	1	3	1	3	2	2	3	1	3	1	2	2
0	4	2	2	3	1	3	1	2	2	2	2	3	1	3	1	3	1	1	3	3	1	3	1	3	1	3	1	2	2
0	4	4	0	4	0	0	4	4	0	4	0	4	0	4	0	4	0	4	0	3	1	1	3	1	3	1	3	3	1
2	2	2	2	4	0	0	4	0	4	4	0	4	0	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4
0	4	1	3	4	0	2	2	3	1	4	0	4	0	2	2	3	1	4	0	2	2	3	1	2	2	2	2	4	0
0	4	4	0	3	1	1	3	4	0	4	0	4	0	3	1	3	1	1	3	0	4	1	3	0	4	1	3	3	1
1	3	1	3	2	2	2	2	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2	2	2
0	4	0	4	2	2	1	3	2	2	3	1	4	0	4	0	4	0	4	0	4	0	4	0	0	4	2	2	4	0
0	4	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	0	4	0	4	4	0
2	2	3	1	3	1	2	2	4	0	3	1	3	1	2	2	3	1	2	2	1	3	1	3	2	2	1	3	1	3
0	4	4	0	4	0	0	4	3	1	4	0	4	0	2	2	4	0	4	0	0	4	0	4	0	4	0	4	4	0
0	4	0	4	2	2	0	4	0	4	4	0	4	0	4	0	4	0	4	0	1	3	3	1	0	4	0	4	3	1
1	3	1	3	3	1	1	3	1	3	2	2	4	0	2	2	2	2	3	1	3	1	2	2	2	2	1	3	1	3
0	4	0	4	0	4	0	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	1	2	2	2	2	2	2
0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	4	0	4	0	4	0	2	2	3	1	2	2	2	2
0	4	1	3	2	2	2	2	0	4	4	0	4	0	4	0	2	2	1	3	2	2	0	4	2	2	0	4	0	4
0	4	0	4	2	2	2	2	2	2	2	2	4	0	4	0	4	0	4	0	4	0	4	0	2	2	1	3	1	3
0	4	2	2	2	2	2	2	2	2	4	0	4	0	4	0	4	0	4	0	4	0	4	0	2	2	0	4	0	4
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	0	4	2	2	0	4	0	4	3	1	4	0	4	0	3	1	4	0	4	0	2	2	2	2	1	3	1	3
0	4	3	1	1	3	0	4	3	1	4	0	4	0	4	0	3	1	3	1	1	3	1	3	1	3	1	3	1	3
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3	1	0	4	3	1	1	3	0	4	2	2	3	1	2	2	0	4	3	1	3	1	0	4	3	1	0	4	0	4
1	3	1	3	1	3	2	2	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2	2	2
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3	1	0	4	3	1	1	3	0	4	2	2	3	1	2	2	0	4	3	1	3	1	0	4	3	1	0	4	0	4
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0	4	3	1	4	0	3	1	2	2	4	0	4	0	4	0	3	1	4	0	3	1	2	2	1	3	0	4	0	4
1	3	1	3	1	3	3	1	1	3	3	1	1	3	3	1	1	3	3	1	3	1	1	3	3	1	1	3	1	3
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0	4	0	4	4	0	0	4	0	4	4	0	4	0	2	2	2	2	4	0	4	0	2	2	3	1	1	3	1	3
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2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	2	2	2	2	1	3	2	2	4	0	4	0	3	1	2	2	1	3	1	3	2	2	1	3	2	2	2	2
0	4	1	3	0	4	0	4	0	4	3	1	3	1	3	1	2	2	1	3	1	3	1	3	3	1	1	3	1	3
1	3	1	3	2	2	2	2	1	3	2	2	3	1	3	1	3	1	3	1	3	1	3	1	2	2	1	3	1	3
0	4	0	4	0	4	0	4	0	4	2	2	4	0	4	0	2	2	4	0	4	0	2	2	2	2	2	2	2	2
1	3	2	2	3	1	1	3	1	3	2	2	2	2	2	2	1	3	3	1	2	2	1	3	1	3	1	3	1	3
0	4	4	0	4	0	0	4	4	0	3	1	4	0	0	4	4	0	4	0	0	4	4	0	0	4	4	0	4	0

Customer Value Data: Pharmaceutical Industry

T: Time C: Cost K: Know-how
Q: Quality Cu: Customization R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
2	2	3	1	2	2	1	3	2	2	1	3	2	2	2	2	3	1	3	1	2	2	2	2	3	1	0	4	1	3
0	4	4	0	2	2	2	2	2	2	4	0	2	2	2	2	4	0	2	2	2	2	2	2	2	2	2	2	2	2
0	4	1	3	1	3	1	3	1	3	4	0	4	0	4	0	4	0	3	1	1	3	3	1	1	3	1	3	2	2
0	4	0	4	4	0	0	4	0	4	2	2	4	0	2	2	2	2	4	0	2	2	3	1	0	4	0	4	2	2
0	4	3	1	1	3	4	0	0	4	3	1	2	2	4	0	3	1	1	3	4	0	1	3	4	0	3	1	0	4
0	4	2	2	2	2	2	2	0	4	4	0	4	0	4	0	0	4	2	2	2	2	0	4	2	2	0	4	0	4
4	0	4	0	4	0	4	0	2	2	4	0	4	0	4	0	2	2	4	0	2	2	2	2	1	3	1	3	2	2
1	3	3	1	3	1	2	2	3	1	3	1	3	1	3	1	3	1	2	2	3	1	2	2	2	2	1	3	1	3
0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	0	4	0	4	0	4
0	4	1	3	4	0	0	4	1	3	4	0	2	2	1	3	3	1	4	0	0	4	2	2	0	4	0	4	4	0
1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
0	4	0	4	0	4	0	4	0	4	1	3	4	0	4	0	2	2	4	0	4	0	4	0	3	1	3	1	1	3
0	4	0	4	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2
0	4	0	4	3	1	0	4	3	1	1	3	3	1	2	2	3	1	3	1	1	3	3	1	1	3	3	1	3	1
0	4	0	4	2	2	0	4	1	3	2	2	3	1	3	1	2	2	3	1	3	1	2	2	2	2	1	3	1	3
0	4	1	3	1	3	0	4	1	3	4	0	3	1	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
0	4	2	2	2	2	0	4	0	4	4	0	2	2	0	4	0	4	2	2	0	4	0	4	0	4	0	4	0	4
3	1	3	1	4	0	0	4	3	1	3	1	3	1	1	3	2	2	3	1	0	4	2	2	2	2	2	2	2	2
0	4	2	2	3	1	4	0	2	2	2	2	2	2	1	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
0	4	2	2	2	2	2	2	2	2	4	0	4	0	4	0	4	0	1	3	1	3	1	3	1	3	2	2	2	2
0	4	4	0	1	3	0	4	2	2	4	0	4	0	4	0	4	0	1	3	1	3	3	1	1	3	3	1	3	1
1	3	1	3	2	2	1	3	2	2	2	2	3	1	1	3	1	3	3	1	3	1	3	1	1	3	1	3	1	3
1	3	3	1	4	0	1	3	4	0	3	1	4	0	2	2	4	0	4	0	1	3	3	1	0	4	2	2	4	0
0	4	4	0	4	0	0	4	4	0	4	0	4	0	4	0	4	0	3	1	3	1	3	1	1	3	2	2	2	2
4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	2	2	0	4	0	4	0	4
1	3	1	3	2	2	1	3	2	2	2	2	3	1	1	3	1	3	3	1	3	1	3	1	1	3	1	3	1	3
0	4	0	4	0	4	4	0	2	2	3	1	4	0	4	0	3	1	4	0	4	0	3	1	4	0	3	1	0	4
0	4	0	4	0	4	2	2	4	0	4	0	4	0	0	4	4	0	4	0	0	4	4	0	0	4	0	4	4	0
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1	3	1	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
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0	4	4	0	0	4	0	4	4	0	4	0	2	2	2	2	3	1	0	4	0	4	3	1	2	2	3	1	3	1
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1	3	2	2	1	3	2	2	2	2	3	1	3	1	3	1	3	1	1	3	2	2	2	2	3	1	3	1	1	3
1	3	1	3	1	3	1	3	1	3	4	0	4	0	4	0	4	0	3	1	3	1	3	1	3	1	3	1	3	1
0	4	4	0	4	0	2	2	1	3	4	0	4	0	2	2	2	2	4	0	2	2	1	3	0	4	0	4	4	0
0	4	1	3	1	3	1	3	2	2	3	1	3	1	4	0	3	1	3	1	3	1	3	1	3	1	3	1	2	2
2	2	0	4	2	2	0	4	1	3	2	2	3	1	1	3	2	2	1	3	3	1	4	0	1	3	2	2	4	0
1	3	1	3	1	3	1	3	1	3	3	1	3	1	3	1	3	1	1	3	3	1	1	3	3	1	3	1	1	3
2	2	2	2	2	2	2	2	2	2	4	0	2	2	2	2	3	1	2	2	2	2	3	1	2	2	3	1	3	1
1	3	1	3	3	1	1	3	3	1	2	2	2	2	2	2	2	2	3	1	2	2	3	1	1	3	2	2	3	1
0	4	1	3	1	3	1	3	1	3	4	0	4	0	4	0	4	0	2	2	2	2	2	2	3	1	4	0	3	1
0	4	0	4	1	3	0	4	0	4	3	1	3	1	4	0	3	1	3	1	3	1	4	0	0	4	0	4	1	3
0	4	0	4	1	3	0	4	0	4	3	1	3	1	4	0	3	1	3	1	3	1	4	0	0	4	0	4	1	3
0	4	0	4	2	2	2	2	0	4	4	0	4	0	4	0	4	0	3	1	3	1	2	2	2	2	1	3	1	3
0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	4	0	0	4	0	4	0	4	0	4	0	4	0	4

Customer Value Data: Pharmaceutical Industry

T: Time
Q: Quality
C: Cost
Cu: Customization
K: Know-how
R: Respect for the environment

T	Q	T	C	T	Cu	T	K	T	R	Q	C	Q	Cu	Q	K	Q	R	C	Cu	C	K	C	R	Cu	K	C	R	K	R
0	4	0	4	0	4	1	3	1	3	0	4	0	4	1	3	1	3	0	4	1	3	1	3	1	3	1	3	1	3
2	2	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	0	4	0	4	0	4	2	2	2	2	2	2
0	4	0	4	1	3	1	3	3	1	2	2	2	2	3	1	4	0	3	1	2	2	4	0	1	3	3	1	4	0
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0	4	3	1	3	1	0	4	3	1	4	0	4	0	1	3	3	1	4	0	0	4	1	3	0	4	0	4	4	0
0	4	4	0	0	4	0	4	2	2	4	0	3	1	3	1	2	2	1	3	1	3	2	2	3	1	3	1	3	1
2	2	2	2	2	2	2	2	2	2	4	0	4	0	4	0	4	0	2	2	2	2	2	2	2	2	2	2	2	2
0	4	2	2	2	2	2	2	0	4	3	1	3	1	3	1	2	2	3	1	3	1	1	3	2	2	0	4	0	4
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2	2	4	0	4	0	2	2	2	2	4	0	4	0	2	2	2	2	3	1	2	2	2	2	0	4	2	2	2	2
0	4	0	4	0	4	0	4	0	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	4	0	4
0	4	4	0	1	3	3	1	0	4	4	0	4	0	1	3	0	4	4	0	1	3	0	4	0	4	0	4	0	4
0	4	3	1	1	3	4	0	0	4	3	1	2	2	4	0	3	1	1	3	4	0	1	3	4	0	3	1	0	4
0	4	2	2	2	2	2	2	0	4	4	0	4	0	4	0	0	4	2	2	2	2	0	4	2	2	0	4	0	4
4	0	4	0	4	0	4	0	2	2	4	0	4	0	4	0	2	2	4	0	2	2	2	2	1	3	1	3	2	2
1	3	3	1	3	1	2	2	3	1	3	1	3	1	3	1	3	1	2	2	3	1	2	2	2	2	1	3	1	3
0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	0	4	4	0	4	0	4	0	0	4	0	4	0	4
0	4	1	3	4	0	0	4	1	3	4	0	2	2	1	3	3	1	4	0	0	4	2	2	0	4	0	4	4	0
1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
0	4	0	4	0	4	0	4	0	4	1	3	4	0	4	0	2	2	4	0	4	0	4	0	3	1	3	1	1	3
0	4	0	4	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	2	2	2	2
0	4	0	4	3	1	0	4	3	1	1	3	3	1	2	2	3	1	3	1	1	3	3	1	1	3	3	1	3	1
0	4	0	4	2	2	0	4	1	3	2	2	3	1	3	1	2	2	3	1	3	1	2	2	2	2	1	3	1	3
0	4	1	3	1	3	0	4	1	3	4	0	3	1	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
0	4	2	2	2	2	0	4	0	4	4	0	2	2	0	4	0	4	2	2	0	4	0	4	0	4	0	4	0	4

Appendix B: Interview with supply chain expert

Part 1: Pairwise comparison of Manufacturing Practices

Pairwise comparison with respect to COST																				
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Decrease work in process
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Mixed Production planning	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials

Pairwise comparison with respect to QUALITY																				
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Decrease work in process
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Mixed Production planning	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials

Pairwise comparison with respect to TIME																				
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Decrease work in process
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Mixed Production planning	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials

Pairwise comparison with respect to CUSTOMIZATION																				
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Decrease work in process
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Mixed Production planning	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials

Pairwise comparison with respect to KNOW-HOW																				
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Decrease work in process
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Mixed Production planning	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials

Pairwise comparison with respect to RESPECT ENVIRONMENT																				
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Decrease work in process
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Cross functional operations	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Implementation of standards
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Decrease work in process	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Mixed Production planning
Implementation of standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials
Mixed Production planning	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Use recyclable materials

Part 2: Pairwise comparison of Logistics Practices

Pairwise comparison with respect to COST																				
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Information sharing with customer
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Just in time	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories

Pairwise comparison with respect to QUALITY																				
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Information sharing with customer
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Just in time	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories

Pairwise comparison with respect to TIME																				
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Information sharing with customer
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Just in time	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories

Pairwise comparison with respect to CUSTOMIZATION																				
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Information sharing with customer
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Just in time	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories

Pairwise comparison with respect to KNOW-HOW																				
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Information sharing with customer
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Just in time	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories

Pairwise comparison with respect to RESPECT FOR THE ENVIRONMENT																				
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Information sharing with customer
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Implement standards	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Just in time
Information sharing with customer	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories
Just in time	>9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5<	Visibility of up/down stream inventories