A Model for Enhancing Trust in South African Automotive Supply Chains Through Information Technology

Roxanne Piderit

2012

A Model for Enhancing Trust in South African Automotive Supply Chains Through Information Technology

by

Roxanne Piderit

S209202656

Thesis

submitted in fulfillment of the requirements for the degree

Philosophiae Doctor

in

Information Technology

the

Department of Information Technology

of the

Nelson Mandela Metropolitan University

Promoter: **Prof. Stephen Flowerday**

Co-Promoter: **Prof. Rossouw von Solms**

January 2012

Abstract

The South African automotive industry is recognised as an important sector for the economy and has thus been prioritised by the South African government. The success of the automotive manufacturers depends on the efficiency and effectiveness of their supply chain. Due to the large number of suppliers involved in these supply chains, enhancing trust in the inter-organisational relationships can ensure the competitiveness of the supply chain. Additionally, insufficient trust can disrupt information sharing between supply chain partners which further impacts on supply chain operations and hence supply chain competitiveness. Thus, both insufficient trust and insufficient information sharing are viewed as contributing factors to the inefficiency and ineffectiveness of a supply chain's operations.

The use of Information Technology to facilitate inter-organisational relationships, in particular in terms of improving information sharing, is an important consideration in this research project. As in the Prisoner's Dilemma, when supply chain members share information freely, trust levels are increased, hence supply chain effectiveness and efficiency is achieved and therefore the competitiveness of the supply chain is optimised. This study addresses the problem of enhancing trust in automotive supply chains using Information Technology.

Previous studies have recognised the importance of trust and information sharing in supply chain relationships. These previous studies have also considered the effect of trust on information sharing, or the effect of information sharing on trust in a single direction. Thus, to address this research problem, a cyclical relationship between trust and information sharing is proposed. In this respect, Information Technology should be used to nurture this cyclical relationship between trust and information sharing.

A model for the enhancement of trust in automotive supply chains through Information Technology is proposed to achieve the objectives of this research project. This model includes risk perception; information sharing as a means of

enhancing trust; a trust area that consists of both supply chain partner trustworthiness and system trust; the resultant trusting behaviour; and the resultant improved information sharing. As this study is concerned with the use of IT to enhance trust, the inclusion of system trust as a component of the model is a significant contribution of this study which is complementary to the proposed cyclical relationship between trust and information sharing.

Keywords: Automotive Supply Chains; Governance; Information Sharing; Information Technology; Organisational Information Processing Theory; Prisoner's Dilemma; Trust

Declaration

I, Roxanne Piderit, hereby declare that:

- The work in this dissertation is my own work.
- All sources used or referred to have been documented and recognised.
- This dissertation has not previously been submitted in full or partial fulfillment of the requirements for an equivalent or higher qualification at any other recognised educational institution.

_____

Acknowledgements

I wish to express my gratitude and appreciation to the following people for their support, guidance and advice during this research project:

- I have been indebted in the preparation of this thesis to my promoter, Prof Flowerday, whose patience and academic experience have been invaluable to me.

- I would like to thank my co-promoter, Prof Von Solms, for the guidance and constructive feedback which enabled me to complete this thesis.

- My parents have been a constant source of support – emotional, moral and of course financial – during my postgraduate years, and this thesis would certainly not have existed without them.

- I am grateful for the endless support and encouragement of my family, friends and colleagues.

Table of Contents

CHAPTER 3: ESTABLISHING TRUST IN INTER-ORGANISATIONAL RELATIONSHIPS

List of Figures

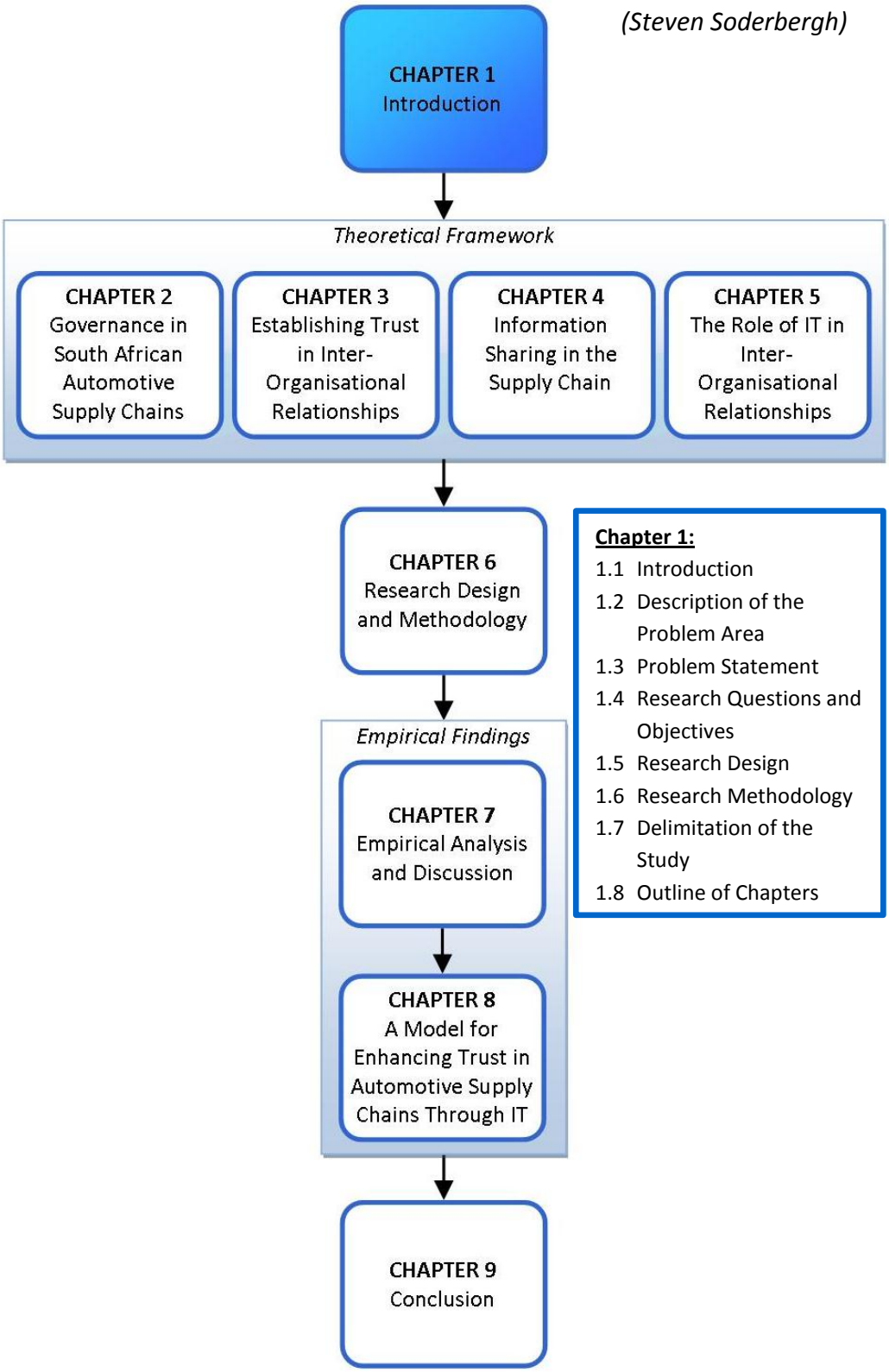
List of Tables

Chapter 1:

Introduction

"When things go right it's hard to figure out why, but when things go wrong it's really easy."

(Steven Soderbergh)



1.1. Introduction

Globally, governments are recognising the potential impact that automotive manufacturers can have on an economy and have become dedicated to attracting automakers to their countries and regions. For South Africa, attracting automotive manufacturers and their suppliers to invest in the economy has become increasingly important (Barnes & Morris, 2008). Fingar (2002) discusses the social problems rife in South Africa, namely: high unemployment, rampant poverty and the AIDS epidemic, which require significant foreign investment in order to overcome. In addition to this, the automotive sector accounts for seven percent of South Africa's Gross Domestic Product (GDP) and provides employment to more than 120 000 workers (Barnes & Morris, 2008). Thus, the South African government has made the automotive industry a priority through various policy adjustments, including the move from an import substitution policy to one of export-led growth (Barnes & Morris, 2008). These policies are all aimed to convince multinational automotive manufacturers and suppliers to strengthen and deepen their South African operations (Lorentzen, 2006). As these automotive manufacturers depend on a substantial network of suppliers which can consist of over 200 suppliers, including first, second and third tier suppliers, the automotive supply chain is the focus of this research project.

Peterson (2002) recognises that these supply chains have moved beyond the traditional channel master model, where the Original Equipment Manufacturer (OEM) dominates and specifies the terms of trade across the whole supply chain, to a chain organism model, where there is no dominant firm and the OEM needs to form strong relationships with the suppliers. Due to the numerous suppliers involved in the supply chain, ensuring trust and good governance in these supply chain relationships can save time and reduce costs, thus improving the competitiveness of the supply chain as a whole. This is especially relevant in the automotive industry where manufacturers are under enormous pressure to reduce time to market, increase flexibility and lower costs in order to compete successfully (Pagano & Zagnoli, 2001). The existence of trust in the supply chain relationship

leads to reduced costs and more efficient and effective operations. This is substantiated by Fachinelli, Ueltschy and Ueltschy (2007) who view trust as a prerequisite for supply chain success. Thus, this study seeks to establish how trust can be established through the appropriate use of Information Technology (IT) to manage the inter-organisational relationship.

Therefore, one needs to consider the role of IT in these inter-organisational relationships. Cheng, Lai and Singh (2007) view the use of technology to conduct business transactions, share information and facilitate collaboration to be the main determinant of a supply chain's effectiveness. This view is shared by Jharkharia and Shankar (2004) who note that information sharing, supported by IT, is the chief enabler of the effective management of a supply chain. For this reason, there is a global trend toward the IT-enablement of supply chains.

This research project produced a model that can be used to enhance trust through the effective use of IT in automotive supply chains. This introductory chapter begins with a description of the problem area under investigation in this research project. This is followed by the problem statement and research questions and objectives. A brief outline of the research design and research methodology follows. The delimitation of the study and outline of the chapters conclude this chapter.

1.2. Description of the Problem Area

With an increased awareness of the role of trust in the overall efficient and effective performance of the supply chain, the supply chain partners can realign business operations and inter-organisational relationships in order to maximise the contribution to the supply chain as a whole (Ghosh & Fedorowicz, 2008). Covey (2008) emphasises that the presence of trust in an inter-organisational relationship can reduce costs and save time. Thus, trust emerges as an essential element in governing inter-organisational relationships in supply chains. Additionally, Agarwal and Shankar (2003) view the lack of personal interaction and geographic dispersion

of supply chain members to be key components that hinder the development of trust in these inter-organisational relationships.

Hence, ensuring South Africa continues to be a viable production site for automotive OEMs who have invested significantly in South Africa, is reliant upon the local suppliers and supply chain dynamics. This view is supported by Ward (2009, p. 1) from Toyota who states that *"the strength of the supply chain is critical to the success of the automotive industry in general and of Toyota South Africa in particular."* Furthermore, Mangold (2009, p. 1) from Mercedes-Benz notes that "*local suppliers need to improve competitiveness to ensure that local OEMs can compete with their respective international counterparts.*" These statements highlight the importance of ensuring South African automotive supply chains function efficiently and effectively through the enhancement of the inter-organisational relationships between supply chain partners.

Recent years have seen a shift in the focus of supply chain management research from inter-functional to inter-organisational integration and co-ordination (Jain & Dubey, 2005). Furthermore, there has been an increased interest in the role of trust in facilitating supply chain partnerships (Sahay, 2003). Chu and Fang (2006) acknowledge that a lack of trust among supply chain partners leads to inefficient and ineffective performance. The problem area for this study is described below in terms of the importance of trust in supply chains, determining the level of trust, enhancing trust through governance and using IT to overcome trust issues.

1.2.1. The Importance of Trust in Supply Chains

The importance of trust in managing inter-organisational relationships cannot be ignored. Ghosh and Fedorowicz (2008) explore the key constructs that support the governance of information sharing and material flow co-ordination in supply chains, which include: trust, bargaining power and contract. Furthermore, it is argued that trust as a governance mechanism plays a crucial role in sharing information among business partners (Ghosh & Fedorowicz, 2008). In support of

this view, Wang and Wei (2007) establish that inter-organisational governance can create value through information visibility and supply chain flexibility.

Informal content analysis techniques of relevant articles have been used to create the grid shown in Table 1.1. This grid highlights the key concepts in literature relating to supply chain relationships:

Table 1.1: Supply Chain Relationships (Content Analysis)

	Trust	Information Sharing	Bargaining Power	Contract	Relational Governance	Culture	Decentralised Control	Supply Chain Performance	Commitment	Uncertainty
Yu, Yan and Chang (2001)		X					X			
Childerhouse, Hermiz, Mason-Jones, Popp and Towill (2003)		X								X
Sahay (2003)	X	X								
Gao and Lee (2005)	X						X			
Jain and Dubey (2005)					X					
Kwon and Suh (2005)	X	X								X
Sen, Saha and Banerjee (2005)	X			X						
Sheng, Brown and Nicholson (2005)	X	X								
Todd (2005)	X	X								
Chu and Fang (2006)	X	X						X	X	
Ryu (2006)										X
Costa and Bijlsma-Frankema (2007)	X						X			
Fachinelli, *et al.* (2007)	X					X				
Naesens, Pintelon and Taillieu (2007)	X									
Wang and Wei (2007)		X			X					
Drake and Schlachter (2008)	X	X								
Ghosh and Fedorowicz (2008)	X	X	X	X						
Lindquist, Berglund and Johannesson (2008)	X	X								
Lui (2009)	X			X						
Sengun and Wasti (2009)	X						X	X		

From the content analysis depicted in Table 1.1, trust emerged as the dominant concept relating to supply chain relationships. Additionally, information sharing is also found to be an important factor. As information sharing is facilitated by various forms of technology, the use of IT to enhance trust in automotive supply chains is a valid area of concern for this research project. As trust is vital in supply chain relationships, it is necessary to determine the level of trust in these relationships. Relevant factors for determining trust are highlighted in the next section.

1.2.2. Determining the Level of Trust

Several factors have been identified as determinants of the level of trust between supply chain partners, including perceived satisfaction, the reputation of supply chain partners; and the level and quality of communication between these supply chain partners (Chu & Fang, 2006). Kwon and Suh (2005) found that the level of trust between supply chain partners was highly reliant on the level of asset investment and information sharing structures. Information sharing, in particular, is found to play a role in reducing uncertainty in the supply chain relationship, thereby improving the level of trust (Kwon & Suh, 2005). Naesens, *et al.* (2007) also describe several determinants that affect the level of trust in supply chain relationships, including:

1. The supplier's performance history which is an indicator of their reliability and competence.

2. Cumulative interactions which are a valuable prediction of the supplier's behaviour.

3. Demonstrations of the supplier's good intentions that create goodwill trust in the relationship.

4. A transference process by which trust is based on the trustor's opinions of the supplier's trustworthiness.

The trust required for successful supply chain relationships can be enhanced through the use of good governance practices. Inter-organisational governance is discussed in the next section.

1.2.3. Enhancing Trust through Governance

Jain and Dubey (2005) conceptualise inter-organisational governance as a multidimensional phenomenon that is manifested in structure, processes and contracts. In terms of governance, Jain and Dubey (2005) view a supply chain as either:

1. A business network: in which each firm is autonomous thus creating a need for inter-organisational governance. Moreover, these autonomous firms collectively address problems in the absence of an overarching authority.

2. An extended enterprise: in which a local firm has many stakeholders (including buyers, suppliers and subcontractors) and thus corporate governance is required to maximise the benefits to the stakeholders.

Decentralising control (as in the business network model described above) allows the supply chain to adapt to unforeseen circumstances, however, decentralised decisions often result in suboptimum outcomes at the supply chain level including an increased level of competition between supply chain partners (Gao & Lee, 2005). Ryu (2006) considers how a change in the external circumstances of the supply chain affects differing levels of interdependence between supply chain participants. It was found that where the firms have a low level of interdependence, a change in external circumstances prompts the manufacturers to increase the level of monitoring of their suppliers (Ryu, 2006). However, where the firms have a high level of interdependence, environmental uncertainty had little or no effect on the level of monitoring (Ryu, 2006).

With the complicated network of suppliers that make up an automotive supply chain, the management of the multiple relationships is acknowledged to be critical

to the success of the supply chain (Jain & Dubey, 2005). It stands to reason that inter-organisational systems will play an important role in maintaining these relationships between the supply chain partners. Thus, the use of IT to overcome trust in inter-organisational relationships is outlined next.

1.2.4. Trust and Information Technology

Various forms of IT can play a role in reducing the impact of a lack of trust in the supply chain (Gao & Lee, 2005). For this reason the use of IT is proposed to overcome these inefficiencies. However, these technologies can also have negative effects; for example, inappropriate trust in forecasting technology can lead to incorrect decisions, which in turn may signal an intent to compete with other supply chain partners (Gao & Lee, 2005). This would effectively result in a lack of trust in these supply chain relationships.

Cheng, *et al.* (2007) note that merely ensuring IT is used in supply chain management will not ensure that the supply chain is effective and efficient. It is therefore necessary to ensure that the correct IT has been implemented appropriately. Liu (2007) notes that Electronic Data Interchange (EDI), expert systems, communication technologies, database technology and network technology are required in order to ensure coordination of the entire supply chain and enhance the competitiveness of the supply chain as a whole.

Considering this description of the problem area, it is now necessary to establish the problem statement for this research project.

1.3. Problem Statement

As purported by Covey (2008), insufficient trust and information sharing between supply chain partners leads to inefficient and ineffective operations in the supply chain. For this reason, South African automotive supply chains need to have trust entrenched in the relationships between supply chain partners in order to compete effectively against their global counterparts. ***Thus, both insufficient trust and***

insufficient information sharing are viewed as contributing to the negative effect on competitive advantage in automotive supply chains.

This problem statement will be investigated in terms of the research question and objectives outlined in the section below.

1.4. Research Questions and Objectives

How can IT enhance inter-organisational trust in South African automotive supply chains?

In order to address the research question above, the following primary objective was considered:

1.4.1. Primary Objective

This study aims to formulate a model that can be used to enhance inter-organisational trust in automotive supply chains through the effective use of IT.

The primary objective was achieved through the following secondary objectives:

1.4.2. Secondary Objectives

1. To determine the factors that can enhance trust within an inter-organisational relationship in South African automotive supply chains.

2. To determine the relationship between trust and information sharing in South African automotive supply chains.

3. To determine the IT requirements to facilitate the trust-information sharing relationship in South African automotive supply chains.

The research design that was employed to investigate this research problem is briefly outlined in the next section.

1.5. Research Design

This research design first discusses the underlying theories for this research project. This is followed by the research paradigm.

1.5.1. Underlying Theories

This research project refers to Game Theory (specifically the Prisoner's Dilemma) and Organisational Information Processing Theory (OIPT). Game Theory, in terms of the Prisoner's Dilemma, is used to study the choices made when costs and benefits are not fixed, but are rather dependent on other players and the shared information available to the players. According to Flowerday and Von Solms (2006), the amount of information that the various players have about each other is a key determinant of behaviour. Similarly, in a supply chain context where information is shared freely by all members of the supply chain, the benefits to all members is an increased level of trust in the inter-organisational relationship, and therefore contributes to the effectiveness and efficiency of supply chain operations.

The OIPT identifies information processing needs and capabilities and the need to obtain optimal performance through a balance of these factors. The theory views quality information as a requirement in order to handle uncertainty and improve decision making. According to Premkumar, Ramamurthy and Saunders (2005), organisations have two strategies for dealing with this uncertainty:

1. Develop buffers, for example inventory buffers to reduce the uncertainty related to demand and supply; or

2. Enhance information flow, for example implementing integrated information systems to improve information flow and reduce uncertainty.

Similarly, in supply chains, improving information flow between supply chain partners reduces uncertainty in the relationship.

A more detailed discussion of these theories in relation to the research problem is provided in Chapter Three and Chapter Four. A thorough discussion of the choice of research paradigm is necessary and follows in the next section.

1.5.2. Research Paradigm

Any research will have an underlying research paradigm that guides how the research should be conducted (Collis & Hussey, 2009). There are several paradigms that exist which can be distinguished by the philosophical assumptions on which they are based. This section briefly discusses the research paradigm for this study. Figure 1.1 is used to illustrate this paradigm.

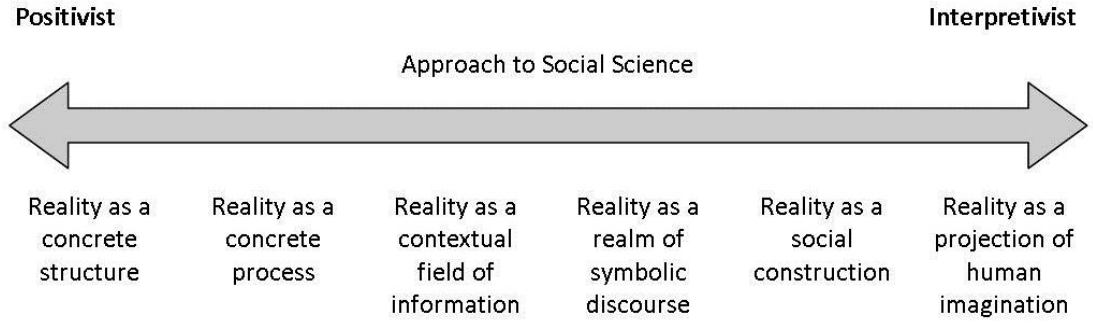


Figure 1.1: Typology of Assumptions on a Continuum of Paradigms (Collis & Hussey, 2009)

As illustrated in Figure 1.1, the positivist and interpretivist approaches are two extreme research paradigms, with several research paradigms combining elements from these two extremes. Collis and Hussey (2009) explain that few people operate purely within any of these forms of research. Using a combination of the elements allows one to take a broader and often complementary view of the research problem or issue (Collis & Hussey, 2009).

This research project focused on enhancing inter-organisational trust through IT in automotive supply chains. Due to the subjective nature of the observations that were used in this study, an interpretivist influence emerged in this study in line with the third stage (reality as a contextual field of information) of the continuum represented in Figure 1.1.

The approach was based on inductive reasoning. In this case, the researcher begins with specific observations, or formulated research questions, from which patterns are identified. This leads to general conclusions. For this research projct these conclusions were recommendations based on a model for the use of IT to enhance inter-organisational trust in the South African automotive supply chain.

Within this paradigm an appropriate research methodology needs to be selected, as is discussed in the section below.

1.6. Research Methodology

In order to study this topic the Design Science Methodology was followed. Design Science is a comprehensive problem solving process that is characterised by detailed evaluation of a project or system with the end goal being the creation of an artifact. For this study the artifact will be a proposed model (Gasser, Majchrzak, & Markus, 2002; Hevner, March, Park, & Ram, 2004). In order to satisfy the iterative nature of Design Science, the Delphi technique was used to refine the research artifact through the use of expert reviews.

This study includes empirical research as well as a literature survey comprised of secondary data that will include theories, models and frameworks. All attempts were made to keep the content as current as possible and this forms the theoretical base of the study.

The data collection methods that will be employed in this study are discussed next.

1.6.1. Data Collection Methods

Case studies, questionnaires and expert reviews were the primary data collection techniques for this study. The case studies took place at two East London-based automotive component suppliers to both local and international automotive OEMs. These organisations were selected because of the researcher's involvement in the Programme for Industrial Manufacturing Excellence (PRIME), which gave initial access to the organisation. Subsequent involvement with the suppliers was,

however, independent of this programme. These organisations are considered to be representative of issues faced in similar component suppliers (based on involvement in PRIME). Thus, as pointed out by Cooper and Schindler (2003), the selection of this organisation can lead to conclusions being drawn about the entire population.

The second research instrument is a formal, web based questionnaire investigating supplier perceptions of trust, information sharing and the role of IT in inter-organisational relationships. As the population of IT personnel at automotive suppliers is unknown, a convenient sample size of fifty applicable IT personnel at automotive suppliers participated in the survey. A pilot study was conducted in order to test the adequacy of this research instrument.

These findings were used to develop the model for enhancing trust in automotive supply chains through IT. This model was then refined using the iterative Delphi technique in the form of expert reviews. According to Klein and Richey (2007), expert review seeks to determine if data exists in support of the components of the proposed model. In this respect, comment from experts was sought on the proposed research model. Seventeen experts participated and provided comment over four rounds of review.

The data collected from these research instruments were analysed using appropriate methods as outlined below.

1.6.2. Data Analysis Methods

The quantitative data from the web-based questionnaire was analysed and the responses summarised to be meaningful and to identify trends through the use of charts and graphs. Some interpretive analysis was conducted to analyse the data collected from the case studies and expert interviews. Recommendations are made based on the findings of the data collected.

1.6.3. Recommendations

On conclusion of the data collection, analysis and evaluation, the developed model was refined. This model provides recommendations based upon the findings of this study. The specific contribution made through the development of this model was the proposal of a cyclical relationship between trust and information sharing. Previous studies have established the value of information sharing in enhancing trust in inter-organisational relationships, or the role of trust in promoting information sharing. Thus, considering these previous studies, this research project suggested and evaluated the cyclical relationship. The delimitation of this study is defined in the next section.

1.7. Delimitation of the Study

The study focuses on trust and IT within automotive supply chains. The investigation focused on suppliers based in the Eastern Cape, South Africa and was limited to suppliers up to the third tier of the supply chain. Existing literature and models regarding this topic are used to form a theoretical base. Components affecting trust and information sharing in inter-organisational supply chain relationships were considered, and emphasis was placed on the selection and use of IT to enhance trust. In considering these components, logistical aspects of the supply chain, human resources concerns and cultural differences were not considered.

1.8. Outline of Chapters

The outline of the chapters for this study is presented in Figure 1.2:

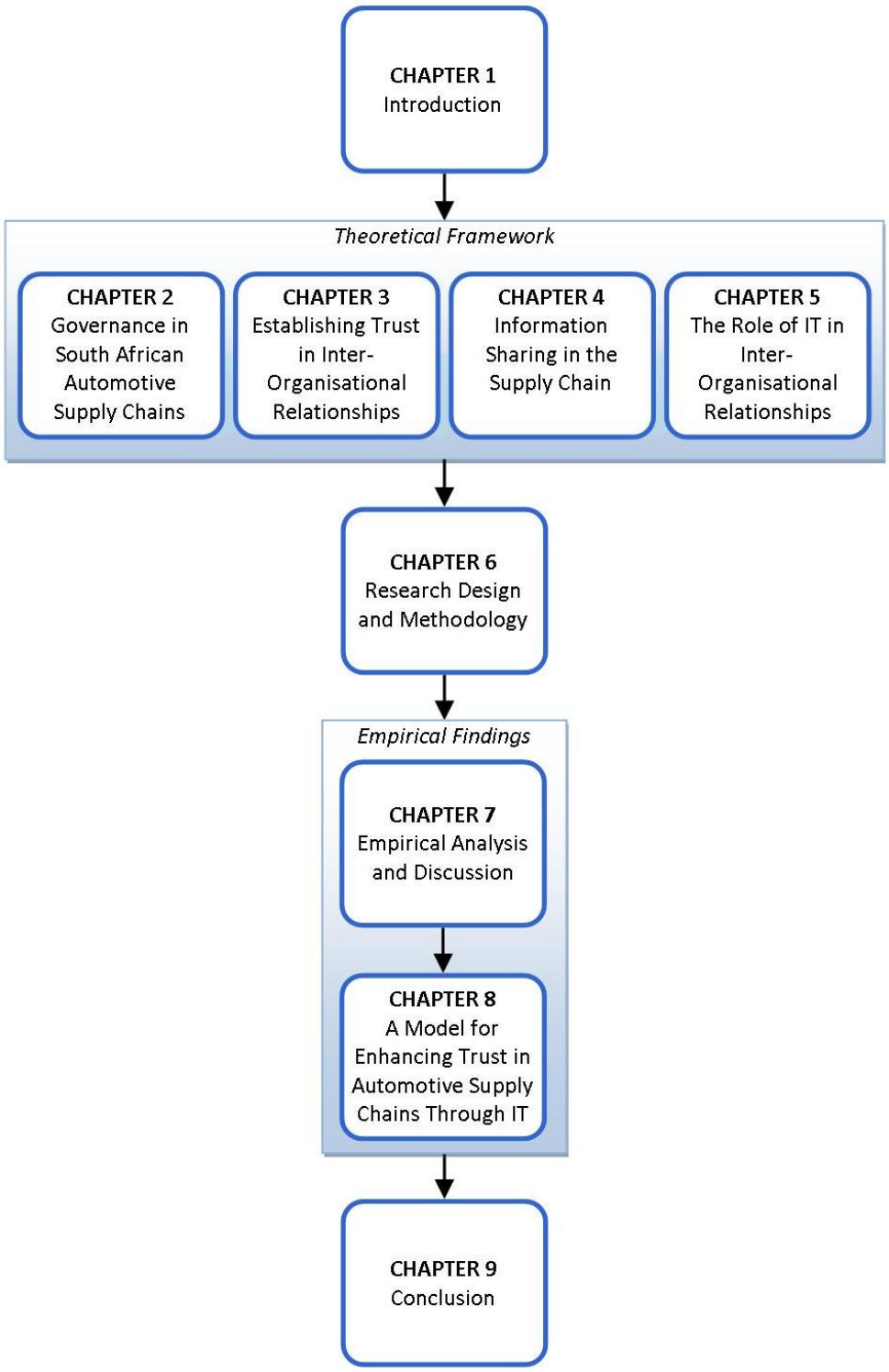


Figure 1.2: Outline of Chapters

Chapter One consists of the background and description of this study. It explains why research in this area is relevant and introduces the problem statement and research objectives.

Chapter Two focuses on the role of governance in South African automotive supply chains. It examines the nature of the South African automotive industry, the definition of governance, governance in supply chains and the relationship between governance and trust.

Chapter Three empasises trust within the context of automotive supply chains. This chapter will examine the definition of trust, the need for trust in supply chain relationships, challenges arising when attempting to establish a trust relationship in a supply chain and the determinants of the level of trust in the supply chain. The Game Theory (the Prisoner's Dilemma) which underpins this research project is explained in detail.

Chapter Four considers the relationship between trust and information sharing in South African automotive supply chains. It examines the Organisational Information Processing Theory (OIPT), the benefits of information sharing in inter-organisational relationships, the attributes required for shared information, the pre-requisites for information sharing and barriers to information sharing. This chapter also provides evidence of information sharing in automotive supply chains, the risks of sharing information, governance mechanisms which regulate information sharing and a preliminary solution for fostering a trust-information sharing relationship.

Chapter Five details the role of IT to establish trust within a supply chain. This chapter explores inter-organisational systems used in automotive supply chains, barriers to the effective use of IT and the dimensions of system trust. Chapter Six discusses the research design and methodology. It describes the methods used for the data collection and data analysis. This section further shows how the obtained data was processed in order to address the research question.

Chapter Seven details and discusses the empirical findings for this study. These empirical findings include: findings from case studies and the web-based questionnaire. In Chapter Eight the proposed model is presented based upon the study's findings. This model is also evaluated through expert review. Chapter Nine

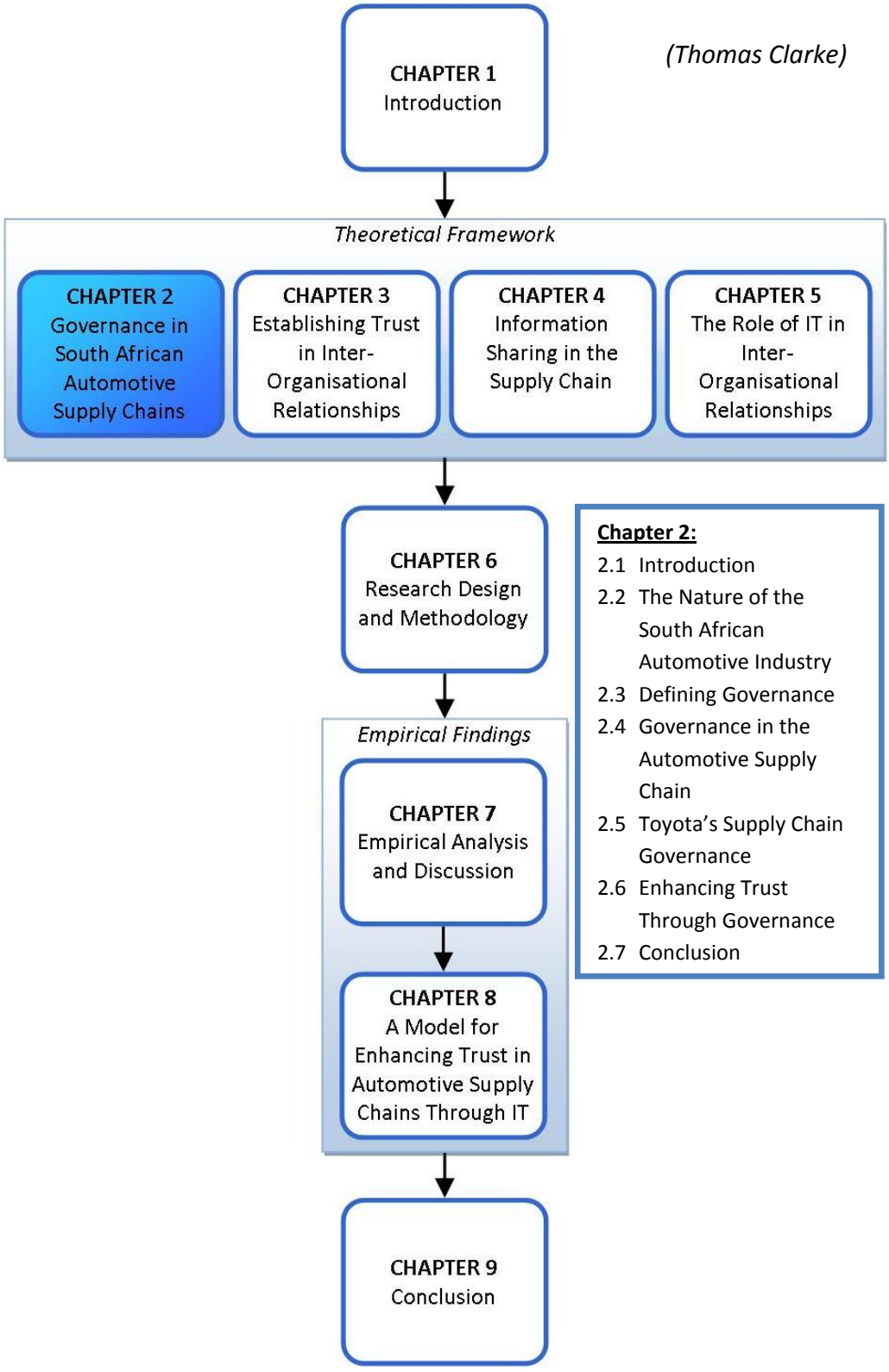
is a summative conclusion that determines if the research has addressed the problems stated and suggests any problems that may require further research.

Chapter 2:

Governance in South African Automotive Supply Chains

"Governance has proved an issue since people began to organise themselves for a common purpose."

(Thomas Clarke)



Chapter 2:

2.1 Introduction
2.2 The Nature of the South African Automotive Industry
2.3 Defining Governance
2.4 Governance in the Automotive Supply Chain
2.5 Toyota's Supply Chain Governance
2.6 Enhancing Trust Through Governance
2.7 Conclusion

2.1. Introduction

Many automotive original equipment manufacturers (OEMs) and component suppliers have realised that operations in South Africa can provide an opportunity for competitive advantage (Department of Trade and Industry, 2005). Relative to the size of the South African market, the automotive sector continues to perform well and has set the standard for the development of other industries within the country (Blackwell Publishing, 2010). Thus, the Department of Trade and Industry (2005) believes that national, provincial and local governments should continue to ensure the success of this sector.

Besides economic benefits, the automotive sector (which includes both component suppliers and assembly operations) is acknowledged as the second largest employer in South Africa (Department of Trade and Industry, 2005). With national unemployment levels estimated at 25 percent (Statistics South Africa, 2011), this is a key indicator of the value of South Africa's automotive industry. Mercedes-Benz South Africa's assembly operation is the largest private sector employer in East London and has invested considerably in relieving the socio-economic issues faced by the local community (Mak'Ochieng, 2003). The primary challenge the automotive industry faces is the increased exposure to international competition since the introduction of the Motor Industry Development Programme (MIDP) in 1995 (Black, 1998). The MIDP has since been replaced by other automotive policies which provide new challenges and opportunities for automotive manufacturers.

These challenges and the changing nature of the automotive industry have necessitated an evolution of the governance structure of supply chains. The focus of this research project is on the establishment of sufficient trust and information sharing in inter-organisational relationships. In addition, this study investigates how these components can be enabled by relevant Information Technology (IT) implementations and appropriate governance mechanisms. Therefore, an investigation of supply chain governance mechanisms is necessary.

This chapter focuses primarily on the governance structures necessary for the establishment of trust in inter-organisational relationships. The chapter begins with an overview of the nature of the South African Automotive Industry to set the context for this study. An elementary definition of governance is then provided to allow for a discussion of the changing nature of governance structures in the automotive industry. This is followed by a discussion of Toyota's method of governing their supply chain. A discussion about the enhancement of trust through governance concludes this chapter.

2.2. The Nature of the South African Automotive Industry

The aim of this research project is to establish the effect of trust and information sharing on the effectiveness and efficiency of an automotive supply chain's operations. For this reason it is important to understand the nature of the South African automotive industry and factors that impact on the efficiency and effectiveness of supply chains in this industry. The value of the automotive industry to the South African economy, automotive policies affecting automotive supply chains, challenges faced by the industry in South Africa and the impact of lean manufacturing are discussed in the sections that follow.

2.2.1. Value to the South African Economy

The automotive industry is one of the strongest and best performing sectors of the South African economy (Department of Trade and Industry, 2005). The Department of Trade and Industry (2005) and the National Association of Automobile Manufacturers of South Africa (2006) report that capital investment by automotive manufacturers is estimated at R 15 billion in total. Lorentzen (2006), however, reports a considerably lower figure of R 10 billion. Trade and Industry Minister Rob Davies acknowledges that the automotive sector accounts for 10 percent of South Africa's current manufacturing investment (Venter, 2010).

After a brief decline in investment in 2003, concerns about the future of the automotive sector were diminished by a dramatic 54 percent increase the following

year (Department of Trade and Industry, 2005). This was mirrored in the components sector which experienced a 14.1 percent decline in investments (Department of Trade and Industry, 2005). The decline was attributed to a brief strengthening of the South African Rand which meant that capital investments were not as costly (Department of Trade and Industry, 2005). Contributing to the level of investment is the fact that all automotive OEMs located in South Africa are now either partly or wholly-owned subsidiaries of their parent company (Franse, 2006).

Despite another economic slump in 2009, the automotive industry has recovered well and vehicle sales have continued to grow and indicate sustainable growth (Blackwell Publishing, 2010). As reported by Trade and Industry Minister Rob Davies, the automotive industry is South Africa's largest manufacturing sector and accounts for 7 percent of the country's Gross Domestic Product (GDP) (Venter, 2010). In addition, the automotive industry accounted for 16 percent of total exports in 2010 and provided 135 000 direct jobs (Venter, 2010).

For this reason, the government has identified the automotive sector as a key area for growth. Thus, targets have been set to produce 1.2 million vehicles and to significantly increase local content in these vehicles by 2020 (Venter, 2010). These goals will be achieved through the Automotive Production and Development Programme (APDP) which will replace the MIDP in January 2013. The automotive policies that impact on automotive manufacturers are discussed in the next section.

2.2.2. Automotive Policies

The primary challenge the automotive industry faces is the increased exposure to international competition since the introduction of the MIDP in 1995 (Black, 1998). The MIDP was modelled on a similar attempt in Australia known as the Automotive Investment and Competitiveness Scheme (Fingar, 2002; Franse, 2006). This scheme ensured the Australian automotive industry was competitive by awarding

import credits to those organisations that performed satisfactorily (Fingar, 2002). Thus, the South African government embarked on a similar approach.

In South Africa, the MIDP promoted an open economy that has resulted in improved levels of capital flow and an improved unemployment statistic (Franse, 2006). The structural changes and resultant sheltered atmosphere of the South African automotive industry encouraged automotive OEMs to invest in the country (Franse, 2006).

Table 2.1 shows the progression of automotive policies in South Africa and the subsequent phased implementation of the MIDP and other policies instituted to benefit the South African automotive industry.

Table 2.1: Development of the Automotive Policies in South Africa (Adapted from: Franse, 2006)

Period	Automotive Policy	Key Policy Instruments
June 1961 to February 1989	Phase I-V Local Content Programme	• Varying content levels implemented by weight • Excise duty rebate scheme
March 1989 to August 1995	Phase VI Structural Adjustment Programme	• Domestic content scheme adjusted for value targets • Import-export complementation scheme introduced
September 1995 to June 2000	Motor Industry Development Programme (First Phase)	• Local Content regulations abolished • Tariff phase-down for imported models and components (Imported vehicles 40% and components 30%) by 2002 • Export credits increased • Duty-free allowance (DFA) and small vehicle incentive scheme implemented

July 2000 to 2007	Motor Industry Development Programme (Second Phase)	• Tariff phase-down to continue until 2007 (Imported vehicles 30% and components 25%) • Import-Export Complementation phase-down from 2003 – 2007 • Introduction of a new production-based DFA in 2000 • Introduction of a productive asset allowance
June 2010 to December 2012	Automotive Investment Scheme (First Phase of Automotive Production and Development Programme)	• Incentives for achievement of stated production milestones • Incentives for stated levels of local content
From January 2013	Automotive Production and Development Programme (Full Implementation)	• Revised tariffs • Local assembly allowances • Production incentives • Continued automotive investment allowances

When the South African government launched the MIDP in 1995 to promote a healthy export environment, Mercedes-Benz was among the first assembly plants to invest further in South Africa (Lorentzen, 2006). Mercedes-Benz's announcement of their intention to invest in the East London facility in November 1998 signalled one of the first successes of the MIDP which was aimed at ensuring multinationals would invest in the country (Lorentzen, 2006). Lorentzen (2006) points out that prior to this announcement the local automotive industry was in a dilemma, characterised by a sharp 25 percent decline in vehicle sales.

The main goal of the MIDP centered on integrating local operations into the significantly more competitive global market (Fingar, 2002). Franse (2006) believes that this integration into the global market would not have been possible without the aid of the MIDP. More importantly, the MIDP was aimed at ensuring the local automotive industry was able to compete internationally and sustain growth (Ellis,

2006). With this in mind, the programme was meant to ensure that the local automotive industry could provide vehicles and components to the world at low costs, with high standards of quality, maintain a stable rate of employment, and make a significant contribution to South Africa's economy (Ellis, 2006).

To achieve these primary goals, certain objectives were set out to structure the implementation of the MIDP. Ellis (2006) lists these as:

1. Gradual integration into the global automotive industry.
2. Increased levels of production due to higher exports.
3. The achievement of modernised and upgraded automotive production facilities.

To accomplish these objectives, Black (1998) discussed the main elements set out in the MIDP. These elements include: an alteration to a tariff programme, the abolishment of the minimum local content requirement, lower light vehicle tariffs and the ability to offset import duties against credits from exporting activities (Black, 1998; Ellis, 2006).

Fingar (2002) reported on the successes of the MIDP which included: an average increase in the export rate of vehicles by 37.5 % per annum and the introduction of eight of the top ten global automotive manufacturers to the local industry (Fingar, 2002). Franse (2006) has attributed improved exports, considerable foreign investment and improved productivity to the MIDP. There is clear consensus that the MIDP has resulted in significantly increased amounts of foreign direct investment (Lorentzen, 2006). As mentioned before, this foreign direct investment currently accounts for 10 percent of South Africa's manufacturing investment. The focus on exports and lowering tariffs has proven successful and a marked increase in vehicle exports has been achieved.

The MIDP has since been replaced by the Automotive Investment Scheme (AIS). The AIS is the first phase of the APDP, providing a transitional period between the

MIDP and the APDP. The AIS is intended to grow and develop the automotive sector through investing in new and replacement automotive models, as well as investing in the manufacturing of automotive components (Department of Trade and Industry, 2010). Thus, this policy recognises the value of the supply chain in the industry's success. The objective is to increase plant production volumes, sustain employment and strengthen the automotive value chain (Department of Trade and Industry, 2010).

Local manufacturers have hereby had to ensure that global production standards are met, including the need to meet lean manufacturing and world class manufacturing requirements, in order to successfully export products globally (Lorentzen, 2006). The full implementation of the APDP will be rolled out in January 2013 to stimulate production, encourage foreign investment and enhance employment in the automotive sector.

While these automotive policies have contributed to the success of the automotive industry, there are challenges that still need to be overcome in order to ensure continued success. These challenges include the volatile Rand exchange rate, competition from Asian automotive manufacturers and challenges related to the work force. These challenges are briefly discussed in the next section.

2.2.3. Challenges Faced by the South African Automotive Industry

The exchange rate has considerable implications for decisions regarding investments in South Africa's automotive industry (Franse, 2006). In particular, the viability of producing a component in South Africa relies heavily upon the exchange rate. Often the volatile Rand value can result in components being imported rather than locally produced, which lowers the local content portion of completed products (Franse, 2006). This is a key reason for the inclusion of local content incentives in the APDP. Furthermore, inflation hurts local manufacturers who cannot recoup these costs due to already saturated vehicle markets (Franse, 2006).

Other challenges for the automotive industry include the growth of Asian competitors, limited production capacity, price pressures enforced by multinational partners in order to retain business, soaring oil and raw material prices, skill shortages and a somewhat volatile work force (Ford Motor Company, 2005). The influence of Asian manufacturers has resulted in the need to adopt lean manufacturing principles and Just In Time (JIT) approaches in order to be competitive, which has provided a challenge for the more traditional manufacturers (Burnes & West, 2000). These traditional manufacturers also need to ensure that their employees can adapt to these changes (Burnes & West, 2000).

The Asian manufacturers have managed to dramatically reduce costs through the implementation of lean manufacturing principles and have thus caused concern for the continued viability of South Africa's automotive sector (Franse, 2006). This manufacturing approach is particularly important as this can improve the effectiveness and efficiency of supply chain operations. Thus, the principles of lean manufacturing are discussed in the next section.

2.2.4. Lean Manufacturing

Lean manufacturing refers to a set of principles developed and implemented by Toyota as part of the Toyota Production System (TPS). This manufacturing approach has replaced mass production that has dominated Western production facilities. Mass production worked for Henry Ford in the 1920s when flexibility and customer choice were not important (Liker, 2004). Thus, it has become necessary to adopt lean manufacturing in order to compete with Asian manufacturers who have successfully implemented this manufacturing approach. Vollmann, Berry, Whybark and Jacobs (2005) coined the term *lean supply chain* which focuses on optimising activities across the entire supply chain.

Lean manufacturing aims to reduce waste in the production process through lowering the amount of inventory on hand (Shapiro, 2007). The dominant guiding principle is to produce and deliver material JIT, and by so doing, reduce the amount of inventory held between the stages of production and throughout the supply

chain (Webster, 2008). Liker (2004) describes lean manufacturing as a five-step process:

1. Defining and understanding what customers (or supply chain partners) perceive to be of value.
2. Defining the value stream.
3. Establishing appropriate flow in the supply chain.
4. Pulling orders from the customer back through the supply chain.
5. Striving for excellence by continuously improving processes and outputs.

The goal of a lean supply chain is to reduce inventory levels, throughput times and the response time needed to complete orders (Vollmann, *et al.*, 2005). This is done by focusing on improvements in quality and continuously improving processes in the organisation. The key aspects of lean manufacturing can be illustrated through the critical success factors described in Table 2.2.

Table 2.2: Critical Success Factors for Lean Manufacturing (Barnes & Morris, 2008)

Market Driver	**Critical Success Measures**	**Indicative Value**
Cost Control	• Total inventory levels • Raw material holding • Work in progress levels • Finished goods holding	Measuring inventory is a sound proxy for measuring cost control at manufacturers. Firms with low inventory operate JIT systems and are thus in control of their costs. Raw material, work in progress and finished goods stock are all cost contributors.

Quality	• Customer return rates • Internal reject rates • Internal scrap rates • Internal rework rates • Return rates to suppliers	Three quality areas are key: Customer returns, internal defects (rejects, reworks, scrap) and supply quality. Customer returns reveal quality satisfaction, but offer insufficient indication of internal quality performance. Firms may have poor internal systems, but provide quality products by following checks at the end of processes, i.e. quality at a cost. Low customer returns need to be supported by low defects and strong supplier quality.
Value Chain Flexibility	• Customer lead times: From finished goods and production • Throughput times • Production lost to changeovers • Supplier lead times	Value chain flexibility is determined by the speed at which a firm accepts a customer order and converts this to a delivered product. Key value chain variables are the flexibility of its suppliers, the flexibility of its operations and the flexibility of its customer interface. Each of these needs to be measured to ascertain the value chain flexibility of the firm.
Value Chain Reliability	• Customer delivery reliability • Production time lost to breakdowns • Predictive/preventative maintenance as a percentage of total maintenance time • Supplier delivery reliability	No firm can operate flexibly without high levels of consistency. Measuring value chain reliability is thus as critical as measuring flexibility. Operational reliability is moreover a central OEM requirement, with on time and in full delivery one of their key demands. Measuring this indicator along with the reliability of a firm's own operation and that of its suppliers is essential.

Human Resource Development	• Training expenditure and provision of formal off-line training • Employee suggestions • Labour, staff, management turnover • Absenteeism rates • Accident frequency rates • Labour unrest downtime	OEM demands are becoming more onerous. Whether firms fail to grasp the opportunities afforded by these demands depends on their resource use, with the most critical of these their human resources. The dimensions to change are manpower, machines, materials and methods, but it is the first that determines ability to deal with the others. Analysing whether firms are investing in employees, fostering continuous improvement, maintaining good industrial relations and generating worker commitment is thus critical.
Product Development	• R&D expenditure • Contribution of new products to total sales	A success determinant for any component firm is its ability to bring new products to market. The product development process is, however, complex given global lead sourcing. Research and Development spending (investment in new product development) thus needs to be disaggregated from new product sales (the life cycle of products being manufactured).

These critical success factors illustrate areas of focus when implementing lean manufacturing, namely: reducing costs and throughput times, improving quality, value chain reliability, the workforce and developing new products. The consequences of failed attempts at lean manufacturing can be detrimental to the supply chain's competiveness. Webster (2008) cites the need for reliable production and delivery practices and the consequence of late deliveries as being influential in the lean supply chain's success. Late deliveries can shut down production across the entire supply chain and therefore need to be avoided. Evidence of this is provided in the case study described in Chapter Seven.

The principle of lean manufacturing is important to this research project, as the success of any lean initiative is dependent on information sharing and collaboration across the entire supply chain (Shapiro, 2007). Production information needs to be shared timeously in order for all supply chain partners to respond and supply necessary components at the correct time. Additionally, lean manufacturing assists with the competitiveness of the supply chain by handling demands faster and at less cost than competitors. Thus, more efficient and effective supply chain operations are achieved.

This brief introduction to the nature of the automotive industry highlights the value of this industry to the South African economy and the challenges faced in order to remain competitive. The complexity of automotive supply chains necessitates an understanding of the changing governance structures. In order to study supply chain governance in the automotive industry, a comprehensive definition of governance is needed. A definition is provided in the next section.

2.3. Defining Governance

The Organisation for Economic Co-operation and Development (2004, p. 11) provides the following definition of corporate governance:

> *"Corporate governance is the system by which business corporations are directed and controlled. The corporate governance structure specifies the distribution of rights and responsibilities among different participants in the corporation, such as the board, managers, shareholders and other stakeholders, and spells out the rules and procedures for making decisions on corporate affairs. By doing this, it also provides the structure through which the company objectives are set, and the means of attaining those objectives and monitoring performance."*

Stakeholders referred to in this definition can include suppliers in the supply chain context. Thus, in the supply chain, governance structures are in place to set objectives and facilitate decision making in the supply chain. The way in which these governance structures can be organised in a supply chain is discussed in section 2.4.

A constant theme of governance is using the organisation's power for an agreed purpose rather than another purpose (Clarke, 2004). Similarly, supply chain governance ensures that all supply chain partners are working toward a common goal. This is discussed in Cadbury's (2004, p. 2) definition:

> *"Corporate governance is concerned with holding the balance between economic and social goals and between individual and communal goals. The governance framework is there to encourage the efficient use of resources and equally to require accountability for the stewardship of those resources. The aim is to align as nearly as possible the interests of individuals, corporations and society."*

The individual and communal goals referred to in this definition can be equated to the goals of individual organisations within the supply chain and the goals of the supply chain as a whole. Therefore, the governance framework of the supply chain needs to ensure alignment of the individual company's goals with that of the supply chain as a whole.

Aligning these goals is not an easy task and this can be exacerbated by an ever-expanding global supply chain. Thus, supply chain governance needs to be an ongoing task to accommodate the diverse interests and enforce cooperative action where needed (Commission on Global Governance, 1995).

This elementary definition of governance establishes a background for the discussion of governance in automotive supply chains which follows. Varying governance models used in supply chains are discussed in the following section.

2.4. Governance in the Automotive Supply Chain

Stephen and Coote (2005) recognise that most literature focuses on supply chain governance issues from a single buyer/single supplier point of view. However, in reality, supply chains form complex networks, the governance of which will differ extensively from the single buyer/single supplier structure. Jain and Dubey (2005) provide a summary of studies that link governance of inter-organisational relationships with the supply chain's performance. This summary highlights the importance of supply chain governance. This summary is provided in Table 2.3 and more recent studies have been included to ensure relevance.

Table 2.3: Determinants and Performance Outcomes of Supply Chain Governance
(Adapted from: Jain & Dubey, 2005)

Authors	Focus of the Study	Relevant Findings
Ian (1993)	Partnership-benefits to buyers	Positive effects of partnership for the buying firms. Productivity improvements (short-term gains) and strategic benefits (long-term gains).
Heide (1994)	Governance	Suggested three ways of organising inter-firm relationships. Established linkage between dependence and type of governance.
Pilling et al. (1994)	TCE and governance	Linkage between transaction costs and relational governance. Relationalism more suited to deal with opportunism (used Transaction Cost Economics framework).
Gundlach et al. (1995)	Commitment and opportunism	Relational norms (which are part of collaborative governance) regulate the standards of trade and conduct.
Kalawani and Narayandas (1995)	Manufacturer supplier relationships	Long-term relationships between manufacturer and suppliers are beneficial to both and pay off more value to suppliers in the long run, in comparison with value earned by those that follow traditional transactional approaches.

Zaheer and Venkatraman (1995)	Governance	Structure and process dimensions of relational governance and the dynamic link between them. Also suggested the role of sociological (trust) and economic determinants of relational governance.
Frankel et al. (1996)	Contracts and alliances	Pointed out the valuable role of informal contracts in achieving alliance success.
Dyer (1997)	Collaboration and competitive advantage	Linkage between collaboration/governance and competitive advantage.
Dyer and Singh (1998)	Relationship and competitive advantage	Relationships as an important resource for developing competitive advantage.
Zaheer et al. (1998)	Trust and performance	Inter-organisational trust leads to reduced cost of negotiation and level of conflict, thereby improving performance.
Johnson (1999)	Integration and performance	Strategic integration enhances distributor's financial performance.
Brown et al. (2000)	Relational governance and opportunism	Efficacy of relational governance in managing opportunism in marketing channels.
Cannon et al. (2000)	Governance and performance	Concluded that increasing the relational content of a governance structure containing contractual agreements enhances performances when the transactional uncertainty is high.
Love et al. (2002)	IOR and its benefits	Cooperative inter-organisational relationships not only affect the project-specific performance in the construction industry but also cultivate a learning culture and mutual trust.
Wong (2002)	Supplier partnership and customer satisfaction	Supplier partnerships can improve company performance by enhancing customer satisfaction.
Eggert and Helm (2003)	Relationship transparency	Relationship transparency leads to increased customer satisfaction.
Vlachos and Bourlakis (2006)	Trust, collaboration and governance	Effectiveness of inter-organisational governance dependent on trust and collaboration.

Zhang and Li (2006)	Information security and governance	Established risk in inter-organisational relationships and need for governance in these relationships.
Wang and Wei (2007)	Relational governance, control and collaboration	Inter-organisational governance mechanisms emphasise that control and collaboration lead to competitive advantage.
Drake and Schlachter (2008)	Collaboration and trust	Sharing information and coordinating operations contributes to competitive advantage.
Eisman (2008)	Visibility and trust	Sharing business strategy and operational information for mutual benefit.
Chatterjee (2009)	Trust, learning and alliances	Trust, learning and alliances form the foundation of supply chain success.
Mukhtar, Jailani, Abdullah, Yahya and Abdullah (2009)	Collaboration and inter-organisational relationships	Collaboration and power determines coordination mechanisms between supply chain members.
Thomas and Skinner (2010)	Trust and inter-organisational relationships	Strategic effects of trust on collaborative behaviour in supply chain relationships.
Zhu, Gavirneni and Kapuscinski (2010)	Information sharing and decentralisation	Operational change proposed to reduce inefficiencies of decentralisation.

A key objective of this research study is to enhance trust through the appropriate use of IT in order to improve the supply chain's competitiveness. As mentioned before, the link between governance and the establishment of trust is important. This is discussed in detail in section 2.7. The determinants and performance outcomes of supply chain governance provided in Table 2.3 highlight the various positive outcomes of effective governance in inter-organisational relationships. This table also summarises several complementary factors to inter-organisational relationship governance. It is important to highlight that trust and information

sharing, which is central to this study, is mentioned in several of the articles, thus reinforcing the need to investigate these components.

Jain and Dubey (2005) conceptualise inter-organisational governance as a multidimensional phenomenon that is manifested in structure, processes and contracts. These three dimensions are expanded in Table 2.4 (below) and the discussion that follows.

Table 2.4: Inter-organisational Governance and its Dimensions (Jain & Dubey, 2005)

Structure	Processes	Contracts
Transactional vs. Relational Resource Sharing Specific Investment	Routinisation and Documentation	Formal Informal
	Interactions	
	Monitoring and feedback	
	Conflict management	

In terms of structure, Jain and Dubey (2005) classify inter-organisational relationships as transactional or relational based on the level of environmental and transaction uncertainty. The relationship quality, in terms of mutuality, role integrity and restraint of power and opportunism, is also a consideration. Physical or expertise based resources can be shared vertically (from OEM to supplier) or horizontally (pooling of resources across the supply chain). Additionally, relationship-specific investments in infrastructure and systems can be made to facilitate integration.

In terms of processes, Jain and Dubey (2005) acknowledge the importance of managing and organising processes in improving supply chain performance. The key aspects of process management include: documentation and routinisation, organisation of inter-firm interaction, deployment of monitoring and feedback systems, and trouble-shooting and conflict management procedures.

In terms of contracts, Jain and Dubey (2005) acknowledge that contracts have historically been formal, but that the recent trend leans toward informal contracts based on accepted norms. Formal contracts have a specified time frame, limited

transaction and environmental uncertainty and focus solely on the transaction, while informal contracts require flexibility with regards to transaction and timing and are focused on future transaction and learning opportunities as much as the current transaction.

These three dimensions of inter-organisational governance need to be adequately catered for in order to ensure the competitiveness of the supply chain. The role of IT in managing the structure, processes and contracts in these inter-organisational relationships cannot be overlooked and is considered further in Chapter Five. The changing nature of the automotive industry described in section 2.2 has necessitated the consideration of other supply chain governance models.

Peterson (2002) recognises that supply chains have moved beyond the traditional channel master model, where the OEM dominates and specifies the terms of trade across the whole supply chain, to a chain organism model, where there is no dominant organisation and the OEM needs to form strong relationships with all supply chain partners.

In terms of governance, a supply chain can be viewed as either:

1. A business network: in which each organisation is autonomous, that collectively addresses problems in the absence of an overarching authority and in which, therefore, there is a need for inter-organisational governance (Jain & Dubey, 2005).

2. An extended enterprise: in which a local organisation has many stakeholders (including buyers, suppliers, and subcontractors) and thus requires corporate governance to maximise the benefits to the stakeholders (Jain & Dubey, 2005).

The business network model described by Jain and Dubey (2005) can be equated to the chain organism model described by Peterson (2002), while Jain and Dubey's (2005) extended enterprise is similar to Peterson's (2002) Channel Master model.

Decentralising control (as in the business network or chain organism model described above) allows the supply chain to adapt to unforeseen circumstances. Stephen and Coote (2005) confirm that this form of plural governance allows greater flexibility and therefore adaptability. However, decentralised decisions often result in suboptimum outcomes at the supply chain level including an increased level of competition between supply chain partners (Gao & Lee, 2005).

Ryu (2006) considered how a change in the external circumstances of the supply chain affects differing levels of interdependence among supply chain participants. He found that where the organisations have a low level of interdependence, a change in external circumstances prompts the manufacturers to increase the level of monitoring of their suppliers (Ryu, 2006). However, where the organisations have a high level of interdependence, environmental uncertainty has little or no effect on the level of monitoring (Ryu, 2006). Similarly, with the decentralised business network model, a high level of trust will allow the supply chain to operate efficiently and thus compete effectively in the marketplace.

In his book *The Toyota Way,* Liker (2004) describes Toyota's unique supply chain relationships and compares this to other automotive supply chains. This method of governing a supply chain is widely viewed as an ideal which other supply chains aim to emulate. This is discussed further in the next section.

2.5. Toyota's Supply Chain Governance

Ahmadjian and Lincoln (2001) distinguish Toyota's inter-organisational relationships by intense collaboration and the exchange of personnel and technology. Trust and long-term cooperation in these inter-organisational relationships has ensured that this automotive manufacturer and its supply chain are able to respond quickly to demand fluctuations and the market pressures referred to in Section 2.2. Toyota, a leading Japanese automotive manufacturer, sets high standards for their suppliers, but is continuously committed to assisting their suppliers to achieve those standards. This has ensured that Toyota has a

reputation as the best, yet toughest, customer for automotive suppliers (Liker, 2004).

While other automotive manufacturers have attempted to organise suppliers in supplier development centres, they have largely failed to create strong supply chain relationships like that of Toyota (Liker, 2004). Responses from suppliers supplying other automotive OEMs indicate that the supplier development centres were a waste of effort and had no effect on the structure of the supply chain. Toyota on the other hand has developed a strong extended enterprise in Japan and is nearing a world-class supplier network in North America (Liker, 2004). Although Toyota is demanding, suppliers react positively to ensure the supply chain's success. This is testament to the mutual value that can be gained by all supply chain partners when cooperating in the supply chain setting.

Toyota's commitment to and investment in their supply network has ensured that they have been able to effectively implement lean manufacturing (Liker, 2004). Many other automotive manufacturers had to abandon their attempts when faced with a crisis. Liker (2004) provides an example of the ideal self-organising supply chain that distinguishes Toyota. A fire destroyed a brake supplier plant – at this time Toyota's JIT system meant that there was only two days worth of inventory on hand. In other supply chains this could have resulted in a complete shutdown of manufacturing at the OEM. Instead, 200 of Toyota's suppliers reorganised and began production of the part within the two day buffer period.

This example illustrates the strength of the inter-organisational relationships in Toyota's supply chain. As Liker (2004) points out, the power of the supply chain lies in the relationships. In terms of a governance mechanism, Toyota's inter-organisational relationships are built on trust alliances in order to mitigate risk in their relationships (Ahmadjian & Lincoln, 2001). Toyota have proven that the existence of trust in inter-organisational relationships can improve the effectiveness and efficiency of the supply chain's operations. This establishes the importance of trust in the supply chain, which is a central theme of this research project.

Supply chain literature tends to focus on streamlining the supply chain to ensure faster response times, while not concentrating on the complexity of managing the various relationships within the supply chain. Toyota's emphasis is on working together with suppliers towards achieving common goals (Liker, 2004). The supply chain alliances built on trust account for Toyota's close, dedicated supplier relationships which do not require legal contracts in order to ensure mutual benefit (Ahmadjian & Lincoln, 2001). This raises the point of control mechanisms that are mentioned in Section 2.6 and discussed in further detail in the remaining theoretical chapters.

This does not mean that Toyota is not demanding on their suppliers. In fact, Toyota sets their suppliers a series of aggressive targets and challenges. At the same time Toyota assists with the necessary training to achieve these targets (Liker, 2004). It is common practice in the automotive industry to switch to another supplier who is a few percentage points cheaper. Thus, OEMs often govern their supply chains through fear. However, this is not Toyota's approach. As Taiichi Ohno (in Liker 2004, p. 203) said:

> *"Achievement of business performance by the parent company through bullying suppliers is totally alien to the spirit of the Toyota Production System."*

Toyota has established supply chain relationships based on trust built though good governance practices. The establishment of trust in inter-organisational relationships through governance is a key aspect of this research project and is therefore elaborated on in the next section.

2.6. Enhancing Trust Through Governance

The value of trust in automotive supply chains has been illustrated in the description of Toyota's supply chain relationships above. This trust was established through good governance in the inter-organisational relationships. For this reason, the link between trust and governance needs to be considered.

Lewis (1999) defines the purpose of governance in an inter-organisational relationship as providing a framework for guidance and support to all participating supply chain partners. Previous views of inter-organisation relational governance have focused on control mechanisms that enforce trustworthiness. According to Clarke (2004), recent studies suggest that this view has shifted to explore governance in these relationships in terms of social relationships including trust. The absence of trust in inter-organisational relationships is viewed as being destructive to the goals of the supply chain (Clarke, 2004). As such, trust can be built through long-term cooperation and mutual adaptation of routines and systems (Halldorsson, Kotzab, Mikkola, & Skjott-Larson, 2007).

Governance mechanisms such as the formalisation of procedures and standardisation of practices across the supply chain are important in restoring or maintaining trust (Mallalieu, 2005). This draws attention to the relationship between controls and trust which are explored further in the remaining theoretical chapters. Clarke (2004) states that controls serve to focus attention on the supply chain's goals, while trust promotes decision-making and cooperation.

Lewis (1999) promotes the sharing of information as an important governance mechanism to ensure that a trust relationship is maintained in a supply chain. This is confirmed by Tucci, Kaufman, Wood and Theyel (2005) who assert that collaboration establishes well-defined governance structures such as work rules, performance metrics and incentive systems. These mechanisms provide the supply chain member with a means of assessing trustworthiness.

Gulati and Sytch (2007) point out that appropriate governance structures ensure trust formation in the inter-organisational relationship by making it too expensive to engage in opportunistic behaviour that is not mutually beneficial for the supply chain. This is supported by Wang and Wei (2007) who view relational governance as key to regulating opportunism, therefore fostering trust by establishing moral controls, coordination and collaboration.

Ensuring that inter-organisational relationships have trust entrenched in them through appropriate governance mechanisms and routine, creates greater benefits for the supply chain (Hoetker, Swaminathan, & Mitchell, 2007). Once trust is established in these relationships, it ensures lower costs of communication, coordination and governance, thus further providing mutual benefit for supply chain partners. This is supported by Wang and Wei (2007) who define relational governance as the extent to which supply chain partners use mechanisms such as relational norms and joint actions to maintain the relationship for mutual benefit.

Establishing trust though the governance of inter-organisational relationships has considerable benefits for the entire supply chain. In relation to this, the use of IT to enhance trust in inter-organisational relationships is under investigation in this study.

2.7. Conclusion

From the literature survey it has been noted that the automotive industry is important for the South African economy. This highlighted the importance of ensuring the effectiveness and efficiency of automotive supply chains through fostering appropriate levels of trust and information sharing. Improving trust and information sharing can also assist in the successful implementation of lean manufacturing, which enables automotive supply chains to improve competitiveness.

In addition, the literature has shown that the governance model of supply chains has shifted from the traditional channel master model to a chain organism model. This chain organism model requires inter-organisational relational governance in order to maximise benefit for all parties. An example from Toyota's successful implementation of the chain organism model highlighted the importance of ensuring appropriate governance mechanisms are in place.

The literature survey has also revealed the importance of inter-organisational relational governance in promoting trust in supply chain relationships. The value of

collaboration as a governance mechanism to enhance trust was also promoted. The implementation of appropriate governance mechanisms ensures trust is established in the inter-organisational relationship as this makes it costly to engage in opportunistic behaviour. Trust established through governance, therefore, ensures efficient and effective supply chain operations.

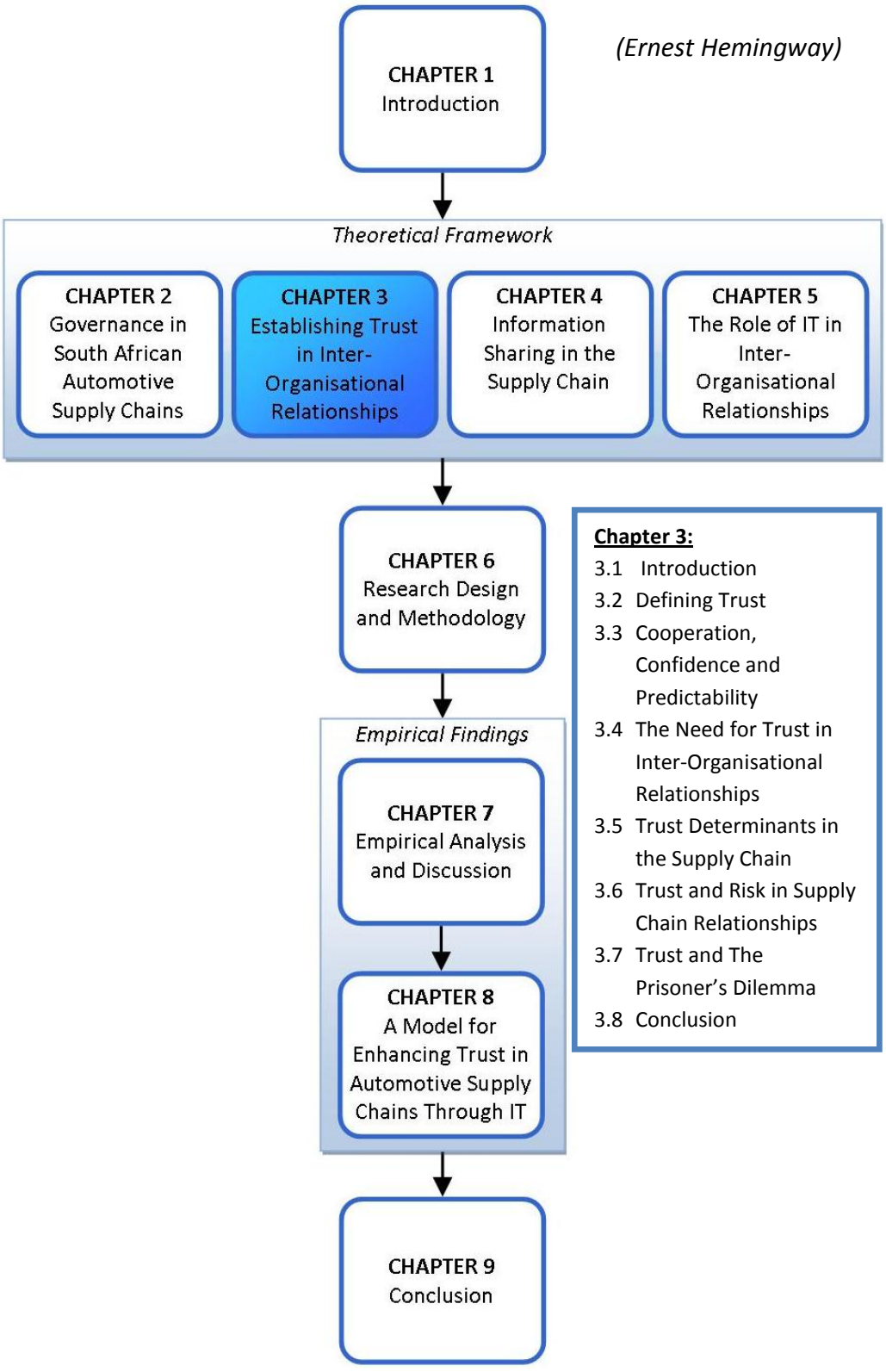
In order to foster effective and efficient inter-organisational relationships, it is important to understand the nature of trust in these relationships. The objective of this study is to study the enhancement of trust in inter-organisational relationships through the appropriate use of IT, and therefore a thorough investigation of trust in this context is necessary. The concepts of trust, its benefits, determinants and Game Theory (in particular the Prisoner's Dilemma) are discussed in the next chapter.

Chapter 3:

Establishing Trust in Inter-Organisational Relationships

"The best way to find out if you trust somebody is to trust them"

(Ernest Hemingway)



3.1. Introduction

As the nature of business evolves, business relationships are becoming increasingly important. In the supply chain context, nurturing external business relationships with supply chain partners is a central concern. Recent years have seen a shift in the research focus in supply chain management from inter-functional to inter-organisational integration and co-ordination (Jain & Dubey, 2005). Furthermore, there has been an increased interest in the role of trust in facilitating supply chain partnerships (Sahay, 2003). This emphasises the importance of this investigation into trust enhancement in automotive supply chains.

Chu and Fang (2006) acknowledge that insufficient trust among supply chain partners leads to inefficient and ineffective performance. Similarly, Covey (2008) emphasises that a sufficient level of trust in an inter-organisational relationship can reduce costs and save time. Thus, trust emerges as an essential element in governing inter-organisational relationships in supply chains (Ghosh & Fedorowicz, 2008). Additionally, Agarwal and Shankar (2003) view the lack of personal interaction and geographic dispersion of supply chain members to be key elements that hinder the development of trust in these inter-organisational relationships.

As trust plays an obvious role in efficient supply chains, it is important to investigate it in more detail. Mayer, Davis and Schoorman (1995) point out that although interest in trust has increased, research has proven difficult for several reasons, including: establishing a definition of trust, and understanding the relationship between trust, its determinants and its outcomes. These issues are examined in this chapter as a thorough understanding of these concerns is necessary for this study of trust in inter-organisational relationships.

This chapter begins by defining the concept of trust and clarifying the differences between trust, cooperation, confidence and predictability. This is followed by a discussion about the need for trust in supply chain relationships. A discussion of the factors that determine trust in a supply chain relationship which critically analyses existing trust models is then provided. This is followed by an outline of

trust and risk in supply chains. The relevance of the Prisoner's Dilemma to this research project concludes this chapter.

3.2. Defining Trust

Agarwal and Shankar (2003) view trust as an important factor in inter-organisational relationships. To better understand trust in an inter-organisational relationship, it must first be defined. Sodano (2002) denotes trust as an elusive notion. It is, however, acknowledged that a few researchers have made tentative attempts at defining trust. These definitions are often based on reputation, trusting opinion or probability (Han, Liu, Sun, & Yu, 2006).

However, as these studies have shown, trust research primarily focuses on an individual level rather than on an inter-organisational level (Saunders, Wu, Li, & Weisfeld, 2004). Han, *et al.* (2006) further acknowledges that although the social sciences have offered definitions and classifications of trust, there is little or no consensus on a definition of trust in a business or supply chain context. The following authors have made attempts at defining inter-organisational trust.

Trust exists in an inter-organisational relationship if one party believes the other to be honest or benevolent (Masuku & Kirsten, 2004). Smeltzer (1997, p. 41) provides a similar definition of trust based on organisational theory and philosophy:

> *"Trust is the expectation by one person, group, or firm of ethically justifiable behaviour – that is, morally correct decisions and actions based upon ethical principles of analysis – on the part of the other person, group or firm in a joint endeavour or economic exchange."*

This definition alludes to supply chain partners acting in a mutually beneficial manner. This assumption is explored further in light of the Prisoner's Dilemma discussion in section 3.7.

Ring and Van de Ven (1994) provide two additional views of trust. The first is based on confidence, or risk, in the predictability of the other party's actions. In this instance the parties hedge themselves against uncertain events through guarantees, insurance or law (Smeltzer, 1997). A popular means of mitigating the risk of the other party's actions is to establish control mechanisms in the inter-organisational relationship. The use of controls is discussed further in section 3.6. Ring and Van de Ven's (1994) second view is based on confidence in the other party's goodwill, which relies on faith in the integrity of the other party. In this instance, complete confidence in a supply chain partner's behaviour does not require control mechanisms to manage the inter-organisational relationship.

Moorman, Deshpande and Zaltman (1993, p. 45) propose a similar view of trust as a *"willingness to rely on an exchange partner in whom one has confidence"*. In their definition, trust is a core attribute in an inter-organisational relationship which exists when one firm (the trustor) has confidence in the other firm's (the trustee's) reliability and integrity. Thus, the trustor believes the trustee will consistently fulfill their obligations in the relationship (Thomas & Skinner, 2010). This notion of consistent, predictable behaviour as a determinant of the extent to which trust exists within the inter-organisational relationship is discussed further in section 3.3.

Saunders, *et al.* (2004) analysed the commonly cited definitions of trust and determined the following common properties of trust definitions:

1. At least two parties are involved in the relationship.
2. The possibility exists that the trustee might act opportunistically.
3. The risk exists that the potential opportunism will negatively affect the trustor.
4. The trustor believes that the trustee will act in the trustor's best interests.
5. The trustor is willing to take a risk.

Although these properties were suggested in terms of interpersonal relationships, they are important for this research project as they can be applied to definitions of trust in inter-organisational relationships. Firstly, there are at least two parties involved in these supply chain relationships. As mentioned previously, automotive supply chains can consist of over 150 members who interact. Secondly, there is a possibility in these complex supply chain networks that one of the parties will act opportunistically. Opportunistic behaviour by any supply chain member can have a negative effect on other supply chain partners. This corresponds to the third property. Additionally, in order to operate effectively and efficiently, each supply chain partner has to believe that the remaining supply chain partners act in their mutual interests. Lastly, each of the supply chain partners must be willing to take the risk of engaging in supply chain activities and exposing themselves to potential opportunistic behaviour by other supply chain members.

Similarly, Huang and Fox (2006, p. 261) provide a summary of existing trust definitions.

> *"Trust is the psychological state comprising (1) **expectancy**: the trustor expects a specific behaviour of the trustee such as providing valid information or effectively performing cooperative actions; (2) **belief**: the trustor believes that expectancy is true, based on evidence of the trustee's competence and goodwill; (3) **willingness to be vulnerable**: the trustor is willing to be vulnerable to that belief in a specific context where the information is used or the actions are applied."*

This summary of definitions can also be expanded to apply to supply chain relationships. An expectancy of mutually beneficial behaviour that supply chain partners should demonstrate exists. It is important to note that Huang and Fox's (2006) definition refers to the sharing of accurate information as expected behaviour, as this is a central theme of this research project which investigates the extent to which information sharing affects trust. Belief in the validity of the abovementioned expectancy can be based on prior interactions with the supply

chain partner. Each supply chain partner needs to willingly accept an element of vulnerability, or risk, based on the beliefs and expectancies they have of their supply chain partners.

Rosseau, Sitkin, Burt and Camerer (1998 in Lazar, 2002, p.5) define trust as *"a psychological state comprising the intention to accept vulnerability based upon a positive expectation of the intentions of behaviour of another."* Based on this definition, Lazar (2002) adopts a "*willingness to be vulnerable*" as a trust definition. Todd (2005) offers a similar view of trust as acceptable uncertainty. This definition is important as it points out that there is always some level of uncertainty in inter-organisational relationships, and an important link between uncertainty and trust exists. The lower the level of uncertainty in the relationship between supply chain partners, the more likely trust is to exist in the relationship.

Agarwal and Shankar (2003) believe trust to be the degree to which the trustor is ready to enter into a partnership with the trustee without any control measures in place. This is expanded on by Mayer, *et al.* (1995, p. 712) who adopted the following definition of trust as the:

> *"willingness of a party to be **vulnerable** to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party."*

This study has adopted the abovementioned definition of trust. Lee and See (2004) acknowledge this as the most widely used and accepted definition of trust. In this definition vulnerability implies that something important can be lost, therefore there is an element of risk-taking in the relationship. Thus, Schoorman, Mayer and Davis (2007, p. 346) concur with Ring and Van de Ven's (1994) first view of trust and define it as the *"willingness to take risk"*.

The Mayer, *et al.* (1995) definition adopted for this study is appropriate as it indicates a level of vulnerability that exists within supply chain relationships despite

prior interactions with the supply chain partner. The definition also refers to a possible lack of monitoring and control of the inter-organisational relationship. This study seeks to investigate the role of Information Technology (IT) in the monitoring and control of the relationship to ensure the enhancement of trust between supply chain partners.

Having defined trust, it can be observed that several terms are often incorrectly used synonymously with trust. The most commonly erroneously used terms are cooperation, confidence and predictability and these are discussed further in the next section.

3.3. Cooperation, Confidence and Predictability

In order to ensure a common understanding of trust, it is necessary to distinguish between commonly confused terms such as cooperation, confidence and predictability. Each of these terms are defined and distinguished from trust in the sections that follow.

3.3.1. Cooperation

Cooperation has often been treated in the literature as tantamount to trust, however, it is important to distinguish between the two terms. Mayer, *et al.* (1995, p. 712) do not provide a clear distinction between trust and cooperation when asserting that trusting someone means:

> *"the probability that he will perform an action that is beneficial or at least not detrimental to us is high enough for us to consider engaging in some form of cooperation with him."*

Ferrin, Bligh and Kohles (2007) make the important observation that in inter-organisational relationships, parties often have conflicting motives to cooperate or to compete. Cooperation is facilitated by trust, which means the trustor accepts the risk that the trustee may be motivated to compete (Ferrin, *et al.*, 2007). Thus,

the success of the supply chain relationship is entirely dependent upon the trustee's choice to cooperate or compete.

It is important to note that while trust can lead to cooperation, it is not a condition for cooperation to occur. This is because cooperation does not necessarily result in a party in the relationship being at risk (Mayer, *et al.*, 1995). One party will cooperate with another party that they do not trust if there are control mechanisms in place to regulate the other party's behaviour or if the situation involves little or no vulnerability (Mayer, *et al.*, 1995).

The relationship between cooperation and controls is important for this research project. As mentioned previously, the more controls in place to manage the inter-organisational relationships, the less effective and efficient the supply chain operations will be. Thus, it is important that cooperation is ensured through enhancing trust between supply chain partners, as this allows for more effective and efficient supply chain operations. The balance between trust and control mechanisms is further explored in section 3.6.

3.3.2. Confidence

The relationship between confidence and trust is not well defined in literature. Some authors refer to trust as having confidence in the other party's ability (Mayer, *et al.*, 1995). This is echoed by Sheng, Brown and Nicholson (2005) who view trust as confidence in the trustee's reliability.

Mayer, *et al.* (1995) distinguish between trust and confidence based on the recognition and acceptance of the existence of risk. Koeszegi (2004) believes that the difference between trust and confidence is the manner of dealing with uncertainty. Trust requires a conscious decision to engage in an inter-organisational relationship despite the possibility of a negative outcome. Confidence on the other hand does not consider the possibility of a negative outcome. Thus, confidence does not allow for uncertainty in an inter-organisational relationship.

The existence of trust in the inter-organisational relationship negates the need for confidence in supply chain partners. Thus, this concept is of little importance for this research project, although it is important to be aware of the difference between trust and confidence.

3.3.3. Predictability

The relationship between trust and predictability is ambiguous, as both are means of reducing uncertainty. Some authors equate predictability and trust, as in Mayer, *et al.*'s (1995, p. 714) definition of trust as *"the extent to which one person can expect predictability in the other's behaviour in terms of what is 'normally' expected of a person acting in good faith".*

It should be obvious that trust extends beyond predictability. In other words, predictability is not sufficient to establish trust in an inter-organisational relationship (Ryu, 2006). If trust and predictability were synonymous, the predictable behaviour of the trustee, even if it is not in the best interests of the entire supply chain, would result in a trusting relationship. In reality, this is not the case; only predictable, mutually beneficial behaviour results in trust in the inter-organisational relationship. This view of trust ignores the aspects of vulnerability and the willingness to take a risk (Mayer, *et al.*, 1995).

Predictability is insufficient to ensure that a party is willing to take a risk. If the trustor routinely and predictably has an adverse reaction to negative news, this does not ensure that the trustee will risk passing on such information in future (Ryu, 2006). Instead this may result in the trustee taking alternative action such as suppressing information (Mayer, *et al.*, 1995). Withholding information in a supply chain context can hamper coordination and therefore be detrimental to efficiency and effectiveness.

Additionally, if predictability is a result of extensive control mechanisms, this can lead to the establishment of trust. Without the controls, the party will be unwilling to be vulnerable and therefore predictability would be insufficient to ensure trust

(Mayer, *et al.*, 1995). Controls have an important role to play in the establishment of trust in inter-organisational relationships and are therefore described in more detail in the remaining literature chapters.

It is important to note that concerns about information sharing and controls have again emerged. The quality of information shared is important in inter-organisational relationships and is discussed in more detail in Chapter Four. The existence of controls in inter-organisational relationships negates the need to establish trust, but is also detrimental to the effective and efficient operation of the supply chain. Thus, it is important to establish trust in inter-organisational relationships in order to improve the supply chain's competitiveness.

Having defined trust and discussed various terms used synonymously for trust; the need for trust in inter-organisational relationships is considered in the following section.

3.4. The Need for Trust in Inter-Organisational Relationships

Trust has been a major concern in organisational research for some time. Evidence of the benefits, for both individual companies and the supply chain as a collective has received some attention (Kramer, 1999). Ghosh and Fedorowicz (2008) explore the key components that support the governance of information sharing and material flow coordination in supply chains, which include: trust, bargaining power and contract. Furthermore, it is argued that trust as a governance mechanism plays a crucial role in sharing information among business partners (Ghosh & Fedorowicz, 2008).

The value of trust in inter-organisational relationships cannot be ignored. As this research project aims to investigate the role of trust in automotive supply chain relationships, the benefits of trust in this context need to be analysed.

Mayer, *et al.* (1995) view the chief importance of trust to be the need to depend on others in order to achieve the organisation's goals. The principal benefits of trust relationships in supply chains have been identified as reducing transaction costs,

improving supply chain performance and sharing information for mutual benefit. These are discussed below.

3.4.1. Reducing Transaction Costs

Transaction costs can be defined as all costs associated with conducting business in an inter-organisational relationship (Dyer & Chu, 2002). These costs include monitoring and enforcement costs which are important to this research project. These monitoring and enforcement costs are associated with control mechanisms. As discussed previously, controls put in place to manage the inter-organisational relationship reduce the efficiency and effectiveness of the supply chain. These control measures also increase transaction costs and thus impact on supply chain competitiveness. Thus, by establishing trust in the inter-organisational relationship, the need for controls can be reduced and consequently transaction costs are lowered.

Dyer and Chu (2002) propose that trust ensures efficient negotiation between supply chain partners and therefore reduces the need to guard against opportunistic behaviour. Thus, trust reduces transaction costs by reducing the time and resources used to monitor the exchange relationship. Kramer (1999) points out that when trust does not exist within an inter-organisational relationship, substitutes need to be established. Such substitutes (which include control measures) often result in inefficiency and additional costs. For this reason, several theorists focus on the role of trust in reducing the cost of inter-organisational transactions. However, Dyer and Chu (2002) state that little or no work confirms the hypothesis that trust reduces transaction costs.

It is, however, acknowledged that the existence of trust in supply chain relationships reduces the need for formal control mechanisms which are costly to implement, monitor and enforce (Dyer & Chu, 2002). Therefore, mutual trust is an effective governance mechanism for reducing transaction costs and reinforcing cooperation (Klein, Rai, & Straub, 2007). This is an important observation as the reduced costs from fewer controls can provide an obvious competitive advantage

for each firm in the supply chain. This competitive advantage is achieved through improved efficiency and effectiveness of supply chain operations. Lowering transaction costs through trust also allows for greater flexibility to respond to events in an unpredictable market (Dyer & Chu, 2002).

As this research project is concerned with the role of trust and IT in managing the inter-organisational relationship, the link between trust, IT and transaction costs is important. Welty and Becerra-Fernandez (2001) state that the relationship between trust and technology reduces transaction costs. The most obvious role of IT in inter-organisational relationships is to allow organisations to interconnect, thus improving information sharing among supply chain partners. Improved information sharing leads to improved trust (as per the Prisoner's Dilemma described in section 3.7), thus reducing the need for controls and consequently lowering transaction costs.

In addition to this, opportunism by any supply chain partner can lead to increased transaction costs, therefore supply chains need to implement mechanisms to counter opportunism and behavioural uncertainty to reduce or maintain transaction costs. IT can assist in reducing transaction costs by mitigating opportunism and streamlining the monitoring of the inter-organisational relationship (Wang & Wei, 2007). Saunders, *et al.* (2004) note that while technology can reduce transaction costs, trust can achieve this faster. Thus, fostering trust in inter-organisational relationships through the use of IT, the focus of this study, provides considerable benefits for the supply chain as a whole.

Evidence of the link between trust and reduced transaction cost can be found in previous studies of automotive supply chains. As evidence of Toyota's leadership in managing inter-organisational relationships, Jain and Dubey (2005) found that General Motor's transaction costs were more than six times that of Toyota. As discussed in Chapter Two, Toyota's efficient and effective supply chain relationships are based on trust, thus trust plays a role in reducing transaction costs. Similarly, Eisman (2008) conducted a survey of over 350 inter-organisational relationships in eight automotive manufacturers in the United States, Japan and

South Korea and found a direct relationship between trust in supply chain partners and transaction costs. The least trusted supply chain partner incurred costs six times that of the most trusted in similar transactions. The additional transactional costs were associated with negotiation and compliance costs.

This research project proposes that insufficient trust between supply chain partners leads to inefficient and ineffective operations in the supply chain. Thus, trust is an essential enabler for supply chain competitiveness. A key benefit of ensuring that trust is established in the supply chain relationship is the reduction of transaction costs through the limited need for controls to manage the supply chain. This benefit of trust in inter-organisational relationships is closely related to improving supply chain performance. This benefit is discussed in the next section.

3.4.2. Improving Supply Chain Performance

Masuku and Kirsten (2004) acknowledge that informal elements are influential in improving supply chain performance. These informal elements include trust, norms and standards that promote effective inter-organisational relationships. This is confirmed by Drake and Schlachter (2008). Naesens, Pintelon and Taillieu (2007) also view successful supply chain performance to be based on trust and commitment. Thus, Masuku and Kirsten (2004) attribute poor supply chain performance to a perceived lack of trust in inter-organisational relationships.

Lazar (2002) confirms that trust leads to reduced conflict and increased satisfaction in inter-organisational relationships. This reduced conflict allows all supply chain partners to participate freely in the inter-organisational relationship and therefore achieve maximum value for the entire supply chain. Thus, the supply chain operates effectively and efficiently and is subsequently competitive.

Increased trust also leads to improved decision making, which in turn improves supply chain performance (Akkermans, Bogerd, & Van Doremalen, 2004). This notion is depicted in Figure 3.1 below:

Figure 3.1: Theoretical Model (Akkermans, *et al.*, 2004)

In this diagram, Akkermans, *et al.* (2004) view trust in a supply chain partner as being determined by previous interactions with the supply chain partner. The establishment of trust leads to improved quality of decision making, which in turn improves supply chain performance. This improved supply chain performance then provides a basis on which future trust can be established. Therefore, it can be seen that improved trust leads to improved supply chain performance.

As this study primarily aims to investigate the role of IT in establishing trust, it is necessary to assess the improved supply chain performance that can be achieved through trusting the IT used in inter-organisational relationships. Inappropriate use of IT is a critical factor that affects inter-organisational cooperation and supply chain performance (Gao & Lee, 2005). Gao and Lee (2005) provide the example of basing decisions on information provided by forecasting systems which may lead to the interpretation by supply chain partners that a company intends to compete. The result of this perceived threat could be a decreased level of trust in the supply chain relationship. Thus, inappropriate use of IT is a factor that affects both trust in inter-organisational relationships and supply chain performance.

Akkermans, *et al.* (2004) pointed out the role of trust in improving supply chain performance through improved decision making. In this context, Gao and Lee (2005) point out that supply chains are a complex network of individual companies

making decisions that have important implications for the supply chain's performance. These decisions are increasingly supported by IT; therefore, the quality of information sharing and interactions with supply chain partners facilitated by IT have a profound effect on supply chain performance (Gao & Lee, 2005). Trust contributes to this information sharing and interaction.

The role of trust in improving supply chain performance which improves the supply chain's competitive advantage is important to this research project. This is confirmed by Covey (2008) who points out that insufficient trust between supply chain partners leads to inefficient and ineffective operations in the supply chain. Thus, trust is a significant factor in the optimal functioning of a supply chain. Information sharing is also disrupted by a lack of trust in supply chain partners, thus affecting decision making and supply chain performance. Therefore, the value of sharing information for mutual benefit is an important benefit of establishing trust in supply chain relationships. This is discussed further in the next section.

3.4.3. Sharing Information for Mutual Benefit

According to Poirier (2003), supply chain professionals have recognised that it is necessary to ensure trust in supply chain relationships. The extent to which either party in an inter-organisational relationship shares information signals good faith to the other party and determines the level of trust between these parties (Sahay, 2003). This sharing of information also establishes trust by indicating a willingness to be vulnerable in the relationship.

These sentiments are echoed by Akkermans, *et al.* (2004) who recognise the importance of sharing information about historical interactions with supply chain partners in establishing a trusting relationship in the supply chain. Sharing information, which establishes trust, is also a determinant of improved supply chain performance (Gao & Lee, 2005). This statement is supported by the discussions in the preceding sections which attributed trust to reduced transaction costs and improved supply chain performance.

However, it is important to note that unless there is evidence that information sharing is equally beneficial to all members of the supply chain, there is no guarantee that all supply chain members will share information (Premkumar, Ramamurthy, & Saunders, 2005). This clearly shows that an important relationship exists between trust and information sharing. Butler (1999) points out that sharing information improves supply chain responsiveness and is therefore beneficial for the entire supply chain.

The importance of information sharing in an inter-organisational relationship is discussed in terms of the Prisoner's Dilemma in section 3.7. Additionally, as this is a central concept for this research project, information sharing is analysed in further detail in Chapter Four. In order to fully understand the role of trust in inter-organisational relationships, it is necessary to understand the determinants of trust which are described in the following section.

3.5. Trust Determinants in the Supply Chain

Several factors have been identified as determinants of the level of trust between supply chain partners, including perceived satisfaction, the reputation of supply chain partners and the level and quality of communication between these supply chain partners (Chu & Fang, 2006). Kwon and Suh (2005) found that the level of trust between supply chain partners was highly reliant upon the level of asset investment and information sharing structures. This statement is important in the context of this research project and thus information sharing as a determinant of trust is discussed in further detail in Chapter Four.

Information sharing is found to play a significant role in reducing uncertainty in the supply chain relationship, thereby improving the level of trust (Kwon & Suh, 2005). Naesens, *et al.* (2007) also describe several determinants that affect the level of trust in supply chain relationships, including:

1. The supplier's performance history which is an indicator of their reliability and competence.

2. Cumulative interactions which are a valuable prediction of the supplier's behaviour.

3. Demonstrations of the supplier's good intentions that create goodwill trust in the relationship.

4. A transference process by which trust is based on other firms' opinions of the supplier's trustworthiness.

In order to investigate the establishment of trust in supply chains, the determinants of trust need to be understood. The components discussed below provide a basis for the creation of a model for enhancing trust in automotive supply chains through the appropriate use of IT which is described in Chapter Eight.

Several key trust models have emerged in literature in recent years. These include Mayer, *et al.*'s (1995) Proposed Model of Trust; McKnight, Choudhury and Kacmar's (2002) Initial Trust Model; Li's (2004) Initial Trust Formation Model; and Han, *et al.*'s (2006) Relationship Among Trust Constructs. Each of these models is outlined below, followed by a comparison of the components suggested by these models.

3.5.1. Mayer, Davis and Schoorman's (1995) Proposed Model of Trust

Rusman, Van Bruggen and Valcke (2009) point out that Mayer, *et al.*'s (1995) model has been predominantly used to research trust. The model was based on literature research and developed within the management domain. The key critique of this model is that the selection of the components for the model was based on a conceptual analysis and common sense approach (Rusman, *et al.*, 2009).

This model is depicted in Figure 3.2 below:

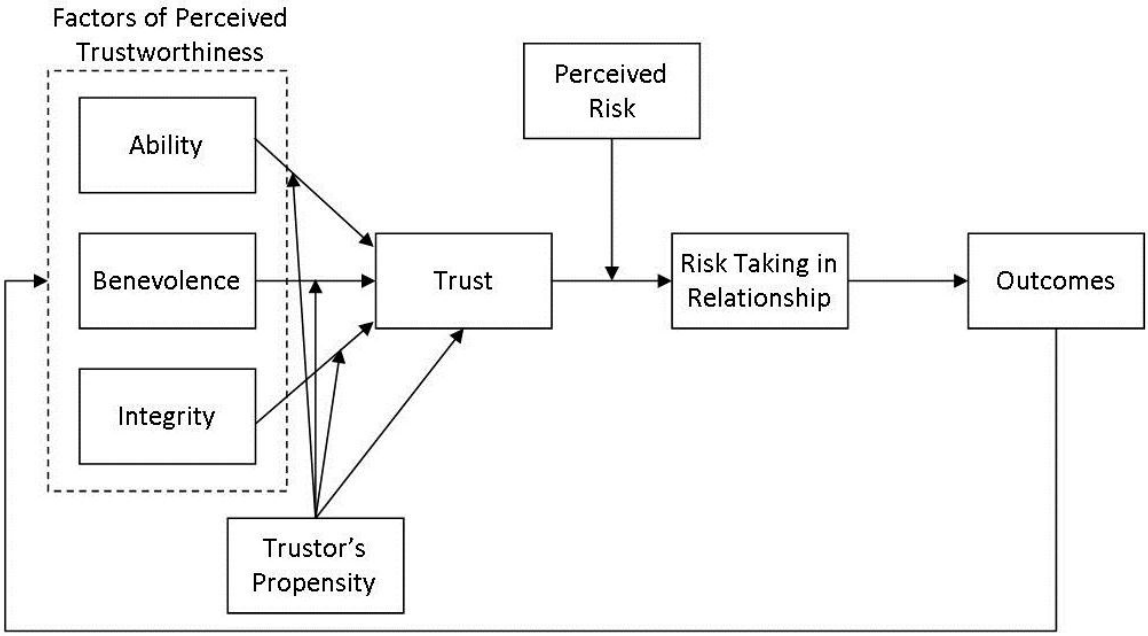


Figure 3.2: Proposed Model of Trust (Mayer, *et al.*, 1995)

In the model, Mayer, *et al.* (1995) distinguish between trustor and trustee characteristics that foster a trusting relationship. These characteristics are discussed in the sections that follow.

3.5.1.1. Trustor Characteristics (Trustor's Propensity)

Mayer, *et al.* (1995) propose that some parties are more likely to be willing to trust than others. Several authors have likened trust to a personality trait (Rotter, 1967; Farris, Senner & Butterfield, 1973; Dasgupta, 1988; Mayer, *et al.*, 1995). This personality trait can lead to a generalised expectation about the other party's trustworthiness. In Mayer, *et al.*'s (1995) Proposed Model of Trust (Figure 3.2 above), this willingness to trust is referred to as the *Trustor's Propensity*.

Every individual's propensity to trust will differ, thus the *Trustor's Propensity* referred to in the model is a general willingness to trust others. This influences how much trust we instill in another party before considering any of the trustees' characteristics. Considering the trustees' characteristics further influences a decision to trust. These trustee characteristics are discussed next.

3.5.1.2. Trustee Characteristics (Trustworthiness)

Ring and Van De Ven (1992) assert that the existence of risk in a relationship results in the trustor considering the trustworthiness of the trustee. A number of authors have considered the various attributes of trustees that indicate trustworthiness. Some authors consider a single attribute while others consider up to ten attributes. Mayer, *et al.* (1995) provide a summary of the literature up to 1995 with regards to trustworthy attributes. This is provided and expanded on in Table 3.1 below.

Table 3.1: Trust Antecedents (Adapted from: Mayer, *et al.*, 1995)

Authors	Antecedent Factors
Hovland, Janis and Kelley (1953)	• Expertise • Motivation to lie
Strickland (1958)	• Benevolence
Deutsch (1960)	• Ability • Intention to produce
Solomon (1960)	• Benevolence
Giffin (1967)	• Expertness • Reliability as information source • Intentions • Dynamism • Personal attraction • Reputation
Boyle and Bonacich (1970)	• Past interactions • Index of caution based on Prisoners' Dilemma outcomes
Kee and Knox (1970)	• Competence • Motives
Farris, *et al.* (1973)	• Openness • Ownership of feelings • Experimentation with new behaviour • Group norms
Jones, James and Bruni (1975)	• Ability • Behaviour is relevant to the individual's needs and desires

Rosen and Jerdee (1977)	• Judgment or competence • Group goals
Frost, Stimpson and Maughan (1978)	• Dependence on trustee • Altruism
Gabarro (1978)	• Openness • Previous outcomes
Cook and Wall (1980)	• Trustworthy intentions • Ability
Larzelere and Huston (1980)	• Benevolence • Honesty
Lieberman (1981)	• Competence • Integrity
Johnson-George and Swap (1982)	• Reliability
Hart, Capps, Cangeni and Caillouet (1986)	• Openness/congruity • Shared values • Autonomy/feedback
Dasgupta (1988)	• Credible threat of punishment • Credibility of promises
Good (1988)	• Ability • Intention • Trustee's claims about how they will behave
Butler (1991)	• Availability • Competence • Consistency • Discreetness • Fairness • Integrity • Loyalty • Openness • Promise fulfillment • Receptivity
Ring and Van de Ven (1992)	• Moral integrity • Goodwill
Sitkin and Roth (1993)	• Ability • Value congruence

Mishra (1996)	• Competence • Openness • Caring • Reliability
Cheung and Lee (2000)	• Integrity • Competence
Callaghan and Shaw (2001)	• Ethics • Bonding • Empathy • Reciprocity
McKnight, *et al.* (2002)	• Competence • Benevolence • Integrity
Ridings, Gefen and Arinze (2002)	• Perceived responsiveness • Information shared • Disposition to trust
Menzies and De Cieri (2003)	• Network relationships • Type of alliance • Communication • Information exchange • Fairness preservation • Inter-firm adaptation
Das and Teng (2004)	• Competence • Goodwill
Li (2004)	• Trusting attitude • Subjective norm • Perceived behavioural control

All of these authors have suggested characteristics on which a determination of trustworthiness can be made. Mayer, *et al.* (1995) propose three characteristics that form a foundation for the development of trust, based on an analysis of the characteristics found in Table 3.1. These characteristics are ability, benevolence and integrity.

1. *Ability:* Ability is defined as the skills, competencies and characteristics that ensure the trustee has influence in the relationship (Mayer, *et al.*, 1995). This ability must be relevant to the relationship. As seen in

Table 3.1, a number of authors have referred to ability or similar concepts such as competence or perceived expertise. As Mallalieu (2005) points out, competence implies credibility, which indicates the ability to perform the functions required efficiently and reliably. In the supply chain context, this would be the supply chain partner's ability to perform the responsibilities assigned to them in a timely and appropriate fashion.

2. *Benevolence:* Benevolence is defined as the extent to which the trustee is believed to want to act in the trustor's best interests (Mayer, *et al.*, 1995). As seen in Table 3.1, a number of researchers have attributed similar characteristics, such as motivation to lie, intentions or motives, altruism and loyalty to a trustworthy party. As Mallalieu (2005) points out, benevolence implies helpfulness, concern and cooperation. In the supply chain context, benevolence is the extent to which a supply chain partner cooperates in order to ensure mutually beneficial gains.

3. *Integrity:* Integrity is defined as a perception that the trustee prescribes to the principles that the trustor finds acceptable (Mayer, *et al.*, 1995). A number of researchers have used similar terms such as value congruence, consistency, fairness, character and openness, as seen in Table 3.1. In the supply chain context, integrity refers to the belief that the supply chain partner will act in the best interests of the entire supply chain.

Mayer, *et al.* (1995) view these three characteristics as being important to trust. Each of these can vary individually, but this does not mean they are not related. Mayer, *et al.* (1995) view trustworthiness as a continuum. The level of ability, benevolence and integrity would determine the trustee's position along the continuum. A perceived deficiency of any of the factors has the potential to undermine trust in a supply chain partner (Mayer, *et al.*, 1995). This continuum is shown in Figure 3.3 below.

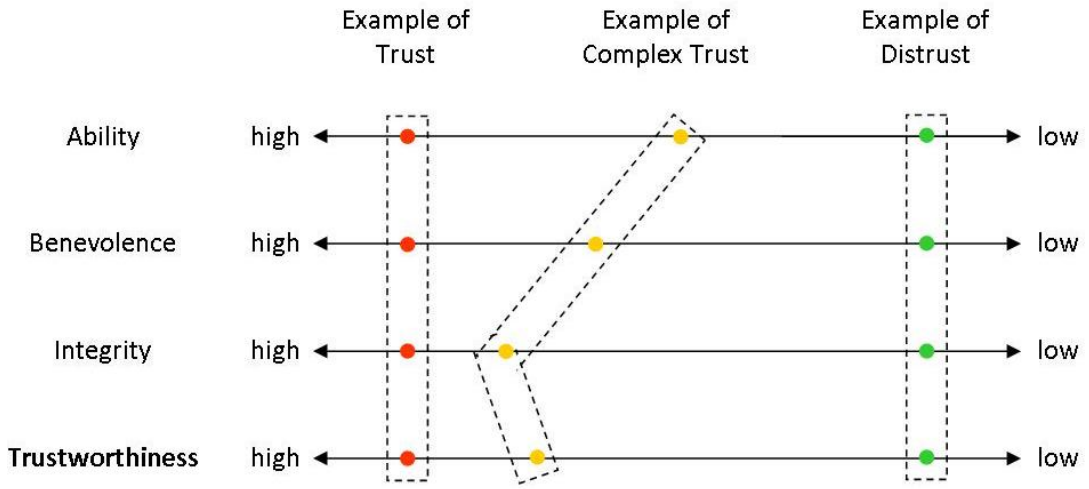


Figure 3.3: Trustworthiness Continuum (Adapted from: Stahl and Sitkin, 2010)

As depicted in Figure 3.3, if the level of ability, benevolence and integrity of the trustee are perceived to be high, the level of perceived trustworthiness will be high, as seen in the example of trust above. If the level of ability, benevolence and integrity are perceived to be low, the level of perceived trustworthiness will be low, as seen in the example of distrust above. If the levels of ability, benevolence and integrity vary along the continuum, the perceived level of trustworthiness can be placed along this continuum, as seen in the example of complex trust above.

Mayer, *et al.*'s (1995) model identifies four key determinants of trust which are important for this research project. The propensity to trust, ability, benevolence and integrity are vital to the establishment of trust in inter-organisational relationships. However, it is important to consider Rusman, *et al.*'s (2009) critique of the model being based only on a literature survey and common sense. However, several researchers have since confirmed these components through empirical findings. A second model of trust, McKnight, *et al.*'s (2002) Initial Trust Model, points to additional trust determinants and is discussed below.

3.5.2. McKnight, Choudhury and Kacmar's (2002) Initial Trust Model

McKnight, *et al.*'s (2002) Initial Trust Model was proposed in an electronic commerce context. This model is appropriate for this research project as it was proposed for an IT-enabled relationship between two parties. The model also

incorporates the concepts of trust from other disciplines, including the Mayer, *et al.* (1995) model. The initial trust referred to is trust in an unfamiliar partner, where the trustor has no prior knowledge of, or interactions with, the trustee (Li, Valacich, & Hess, 2004). Li, *et al.* (2004) believe this model to be one of the most cited models in literature. This model is depicted in Figure 3.4 below.

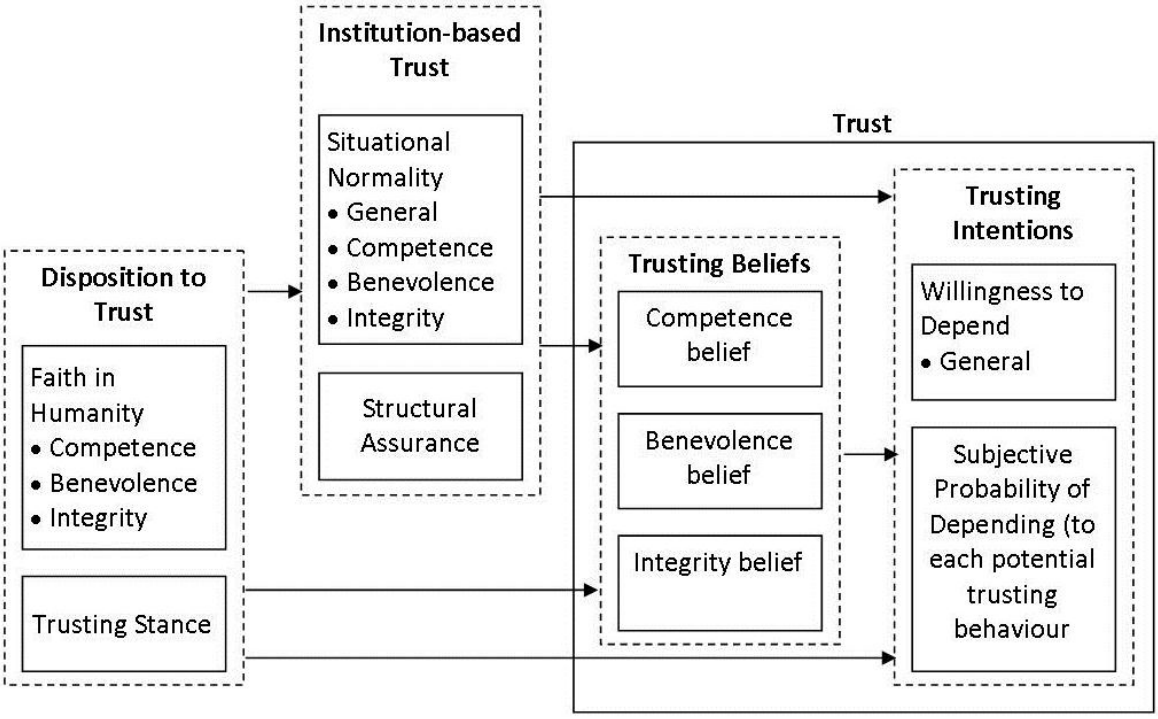


Figure 3.4: Initial Trust Model (McKnight, *et al.*, 2002)

In this model, trust is divided in two components, namely Trusting Beliefs and Trusting Intention:

1. *Trusting Beliefs* refers to the trustor's belief that the trustee has attributes beneficial to the trustor (Li, *et al.*, 2004). These attributes are based on Mayer, *et al.*'s (1995) factors of perceived trustworthiness discussed previously. The three categories of beliefs that constitute Trusting Beliefs are:

    a. *Competence*: The trustee's ability to do what the trustor needs.

    b. *Benevolence*: The trustee's motivation to act in the trustor's interests.

c. *Integrity*: The trustee's honesty.

2. *Trusting Intention*, which is determined by trusting beliefs, is defined as the trustor's willingness to depend on the trustee (Li, *et al.*, 2004). This trusting intention can be equated to Mayer, *et al.*'s (1995) Trustor's Propensity. This is represented by two sub-components:

    a. *Willingness to Depend:* The trustor's willingness to be vulnerable when interacting with the trustee.

    b. *Subjective Probability of Depending:* The perceived likelihood that the trustor will depend on the trustee.

In addition to these two components, McKnight, *et al.* (2002) describe disposition to trust and institution-based trust to be precursors to the trusting beliefs and intentions described above.

1. *Disposition to Trust*: This is the trustor's willingness to depend based upon: (1) *Faith in Humanity*, which is an assumption that each party is honest and dependable; and (2) *Trusting Stance*, which refers to the belief that better outcomes result from dealing with other parties as if they are honest and dependable, regardless of the trustor's perception of the trustee's attributes.

2. *Institution-based Trust*: This is the belief in structural conditions that need to exist to improve the probability of a successful outcome in the relationship, based on: (1) *Structural assurance*, which is a belief that structures such as guarantees, regulations, legal recourse or procedures, promote success in the relationship; and (2) *Situational Normality*, which refers to a belief that the environment in which the interaction occurs is in the necessary state to ensure success, i.e. in a normal state.

In this model, institution-based trust is determined by the disposition to trust. Both of these components are believed to directly influence trusting beliefs and trusting intention. McKnight, *et al.*'s (2002) model identifies additional components relevant to this research project. It is important to note the inclusion of structural assurance which points to the need to achieve a balance between trust and controls. Additionally, components suggested by Mayer, *et al.* (1995) were confirmed by McKnight, *et al.*'s (2002) empirical study. A third model, namely Li's (2004) Initial Trust Formation Model also considers the establishment of trust without considering prior interactions.

3.5.3. Li's (2004) Initial Trust Formation Model

The Initial Trust Formation Model proposed by Li (2004) is based on the Theory of Reasoned Action (TRA) and Theory of Reasoned Behaviour (TRB) (Li, *et al.*, 2004). This model is relevant to this study as it considers trust in inter-organisational relationships, rather than in inter-personal relationships as the previous two models did. Thus, organisational factors are also considered. This model is depicted in Figure 3.5 below.

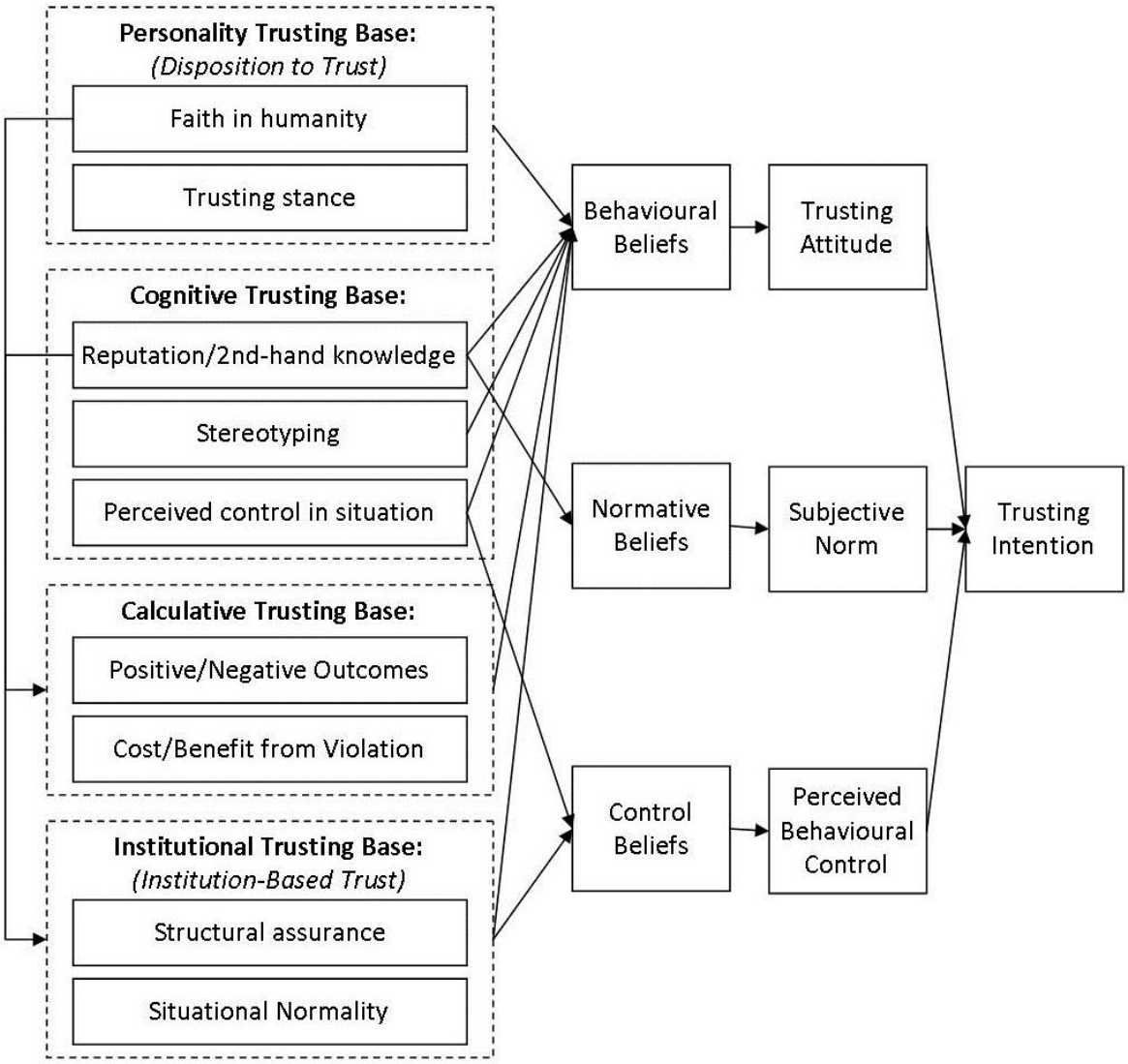


Figure 3.5: Initial Trust Formation Model (Li, 2004)

The TRA states that every construct can be separated into beliefs, attitudes, intentions and behaviours. Thus, Li (2004) provides a composite definition of trust which encompasses different definitions of trust from prior research. This definition establishes trust as having four aspects, namely:

1. *Trusting Behaviour*: The trustor's actions to depend on the trustee, or make the trustor vulnerable to the trustee.

2. *Trusting Intention*: The trustor's willingness to perform trusting behaviour. This aspect is similar to Mayer, *et al.*'s (1995) Trustor's Propensity.

3. *Trusting Attitude*: The trustor's evaluation of the trusting behaviour.

4. *Trusting Belief*: The trustor's perceptions of the trustee based on information available.

As Li's (2004) model was intended to predict initial trust prior to interaction between the two parties, trusting behaviour was excluded from the model. Compliant with the TRA and TRB, the trusting intention is determined by:

1. *Trusting Attitude:* The trustor's evaluation of the trusting behaviour (as described above).

2. *Subjective Norm*: The perceived societal pressure to trust parties in given situations or contexts.

3. *Perceived Behavioural Control:* Perception of internal and external resources and constraints resultant of trusting the party.

These three determinants of trusting intention are in turn determined by a set of trusting beliefs. Trusting belief consists of *behavioural beliefs* about consequences of performing the behaviour and evaluation of these consequences; *normative beliefs* about the likelihood that important people approve or disapprove of the behavior; and *control beliefs* about the presence or absence of required resources or opportunities (Li, *et al.*, 2004).

These trusting beliefs are formed by the external variables shown in Figure 3.5. Four major determinants of trust were identified and integrated into the Initial Trust Formation Model:

1. *Personality Trusting Base*: Li, *et al.* (2004) recognise that this is directly related to disposition to trust in McKnight, *et al.*'s (2002) model. This is based on faith in humanity and the trustor's trusting stance.

2. *Institution Trusting Base*: Li, *et al.* (2004) recognise that this is directly related to institution-based trust in McKnight, *et al.*'s (2002) model.

This is based on situational normality and structural assurance. This requires guarantees, regulations and other control mechanisms to be in place in order to ensure successful interactions. Thus this is an important trust determinant as it recognises the need for controls in order to ensure trust formation in inter-organisational relationships.

3. *Cognitive Trusting Base*: This recognises that initial impressions affect trust formation. The cognitive trusting base consists of two sub-components:

    a. *Categorisation*: The manner in which the trustor categorises the trustee affects the level of trust they have in that trustee (Li, *et al.*, 2004). Two types of categorisation are applicable in the Initial Trust Formation Model: (1) reputation/second-hand knowledge and (2) stereotyping.

    b. *Perceived Control in the Situation*: This sub-construct may moderate the effect of any categorisation (Li, *et al.*, 2004). If the trustor cannot obtain sufficient direct knowledge about the trustee, their perception of their level of control in the relationship will affect their willingness to trust.

4. *Calculative Trusting Base*: This refers to economic principles and calculations that affect trust (Li, *et al.*, 2004). This trusting base refers to a party in the inter-organisational relationship calculating and considering the outcome of entering into a trusting relationship with another supply chain partner. This calculation can be made by considering the Prisoner's Dilemma trade-off discussed previously. This calculative trusting base is based on two sub-components:

    a. *Positive/Negative Outcome*: This trust decision (from the trustor's perspective) can be made based on calculating the strength of the positive and negative motivational

consequences and the probabilities that these consequences would occur.

b. *Cost/Benefit From Violation*: This trust decision (from the trustee's perspective) can be made based on calculating the fear of punishment for violating trust and the rewards of preserving it.

Again components relating to Trustor's Propensity and controls have emerged in this model. Additionally, this model recognises the inter-organisational trust determinants, as well as the need to consider potential outcomes of inter-organisational relationships. These components hold value for this research project. The final model discussed in this chapter is Han, *et al.*'s (2006) Relationship Among Trust Constructs.

3.5.4. Han, Liu, Sun and Yu's (2006) Relationship Among Trust Constructs

This model is based on the definitions of trust adopted by the social sciences. Han, *et al.* (2006) view the determinants of trust in distributed networks to be the offer of incentives for good behaviour, predictions of future behaviour and the detection of selfish and malicious entities. Supply chains are an example of these distributed networks making this model relevant to this study. This model is depicted in Figure 3.6 below.

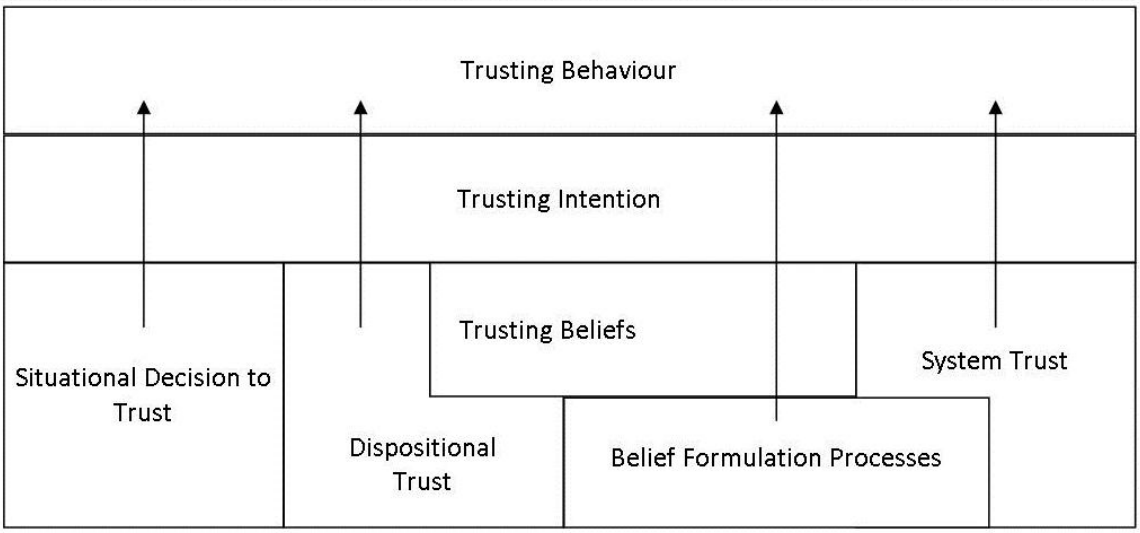


Figure 3.6: Relationship Among Trust Constructs (Han, ***et al.***, 2006)

Han, *et al.*'s (2006) framework is based on six components:

1. *Trusting Behaviour*: This is a voluntary dependence on another person.

2. *Trusting Intention*: This is where one party is willing to depend on the other party. The parties referred to here can be business in the supply chain.

3. *Trusting Belief*: This is the belief that the other person is willing and able to act in the other's best interests

4. *Situational Decision to Trust*: Circumstances where the benefits of trust outweigh the possible negative outcomes of the trusting behaviour.

5. *Dispositional Trust*: This refers to the expectation of trustworthiness that everyone inherently possesses.

6. *System Trust*: This aspect aims to ensure that there are sufficient impersonal structures in place to facilitate the relationship. In particular, it is of great importance to ensure that inter-organisational systems are in place in order for sufficient sharing of information to occur.

The first five components in this model have been established in the previous three models. This model is included as it recognises the importance of system trust in the establishment of trust in inter-organisational relationships. This is important as this research project aims to investigate the establishment of trust in inter-organisational relationships through the appropriate use of IT. The four models discussed in this chapter are compared in the next section.

3.5.5. A Comparison of Trust Components

In order to investigate trust in automotive supply chains, the determinants of trust need to be understood. Four key trust models have emerged in literature in recent years and were discussed in the sections above. These include Mayer, *et al.*'s (1995) Proposed Model of Trust; McKnight, *et al.*'s (2002) Initial Trust Model; Li's (2004) Initial Trust Formation Model; and Han, *et al.*'s (2006) Relationship Among Trust Constructs. This section provides a comparison of the components suggested by these models that are relevant for this study.

The differences and similarities of the four models discussed above can be evaluated in terms of the different trust components which are compared in Table 3.2.

Table 3.2: Comparison of Model Components (Adapted from: Li, *et al.*, 2004)

Mayer, Davis and Schoorman's (1995) Proposed Model of Trust		**McKnight, Choudhury and Kacmar's (2002) Initial Trust Model**		**Li's (2004) Initial Trust Formation Model**		**Han, Liu, Sun and Yu's (2006) Relationship Among Trust Constructs**	
Construct	**Definition**	**Construct**	**Definition**	**Construct**	**Definition**	**Construct**	**Definition**
Trustor's Propensity	General willingness to trust others.	**Trusting Intention**	Trustor is securely willing to depend, or intends to depend on the trustee.	**Trusting Intention**	Trustor's willingness to perform the trusting behaviours.	**Trusting Intention**	The extent to which the trustor is willing to depend on the trustee.
Not included.		*Not included.*		**Trusting Attitude**	Trustor's evaluation of the trusting behaviours.	*Not included.*	
Not included.		*Not included.*		**Subjective Norm**	Trustor's perception of the social pressures put on the trustor to trust or distrust in the particular context.	*Not included.*	
Not included.		*Not included.*		**Perceived Behavioural Control**	Trustor's perception of internal/external resources and constraints of trusting the trustee.	*Not included.*	
Factors of Perceived Trustworthiness • Ability • Benevolence • Integrity	Characteristics that form a foundation for the development of trust.	**Trusting Beliefs** • Behavioural Beliefs ○ Competence ○ Benevolence ○ Integrity	Trustor's perception that the trustee has attributes that are beneficial to the trustor.	**Trusting Beliefs** • Behavioural Beliefs • Normative Beliefs • Control Beliefs	Trustor's information and perceptions of trusting behaviour, social influence, situation, etc.	**Trusting Beliefs**	The belief that the trustee is willing and able to act in the trustor's best interests

Not included.	**Disposition to Trust**	The extent to which the trustor displays a tendency to be willing to depend on others across a broad spectrum of situations and objects.	**Personality Trusting Base**	Trustor's general tendency to trust others.	**Dispositional Trust**	The expectation of trustworthiness that the trustee inherently possesses
Not included.	*Not included.*		**Cognitive Trusting Base**	Trustor's first impressions that affect trust formation.	*Not included.*	
Not included.	*Not included.*		**Calculative Trusting Base**	Trustor's economic principles and calculations that affect trust formation.	**Situational Decision to Trust**	Circumstance where the benefits of trust outweigh the possible negative outcomes of the trusting behaviour.
Not included.	**Institution-Based Trust**	The beliefs that needed structural conditions are present to enhance the probability of achieving a successful outcome in the endeavor.	**Institutional Trusting Base**	The impersonal structures that are inherent in a specific context and facilitate trust building in this context.	**System Trust**	The impersonal structures in place to facilitate the relationship.

Table 3.2 above provides a summary of the key determinants of trust in inter-organisational relationships. These determinants are important in the context of this research, and are used in the formation of the model to enhance trust through IT in automotive supply chains that is described in Chapter Eight.

Mayer, *et al.*'s (1995) model identifies four key determinants of trust which are important for this research project, namely: propensity to trust, ability, benevolence and integrity. This model is primarily concerned with inter-personal relationships, but is still relevant for this research project as several other models are based on the components suggested in this model.

McKnight, *et al.*'s (2002) model identifies additional components relevant to this research project, in particular institution-based trust which is determined by the disposition to trust. Both of these components are believed to directly influence trusting beliefs and trusting intention. Disposition to trust is equivalent to the propensity trust from Mayer, *et al.*'s (1995) model. The model also includes competence, benevolence and integrity as components of the trusting belief which are equivalent to Mayer, *et al.*'s (1995) factors of perceived trustworthiness. This model considers inter-organisational trust relationships by including institution-based trust which provides an appropriate environment for the relationship to succeed. This model also includes structural assurance which refers to the use of controls to manage the inter-organisational relationship. Thus, this model is relevant for this research project.

Li's (2004) Initial Trust Formation Model recognises the determinants of inter-organisational trust, as well as the need to consider potential outcomes of inter-organisational relationships. This model also identifies trusting intention (or propensity to trust) and institution-based trust as in previously discussed models. An additional construct for consideration is the calculative trusting base which refers to a party in the inter-organisational relationship calculating and considering the outcome of entering into a trusting relationship with another supply chain partner. This calculation can be made by considering the discussed Prisoner's Dilemma trade-off which will be described in further detail in section 3.7. This

model also considers inter-organisational trust relationships in the form of institution-based trust making it relevant for this research project.

The final model discussed in this chapter is Han, *et al.*'s (2006) Relationship Among Trust Constructs. This model is included as it recognises the importance of system trust in the establishment of trust in inter-organisational relationships. This is important as this research project aims to investigate the establishment of trust in inter-organisational relationships through the appropriate use of IT.

The use of controls in inter-organisational relationships has emerged in two of the models discussed above. In order to understand the need for controls, it is necessary to analyse the relationship between trust and risk. This is done in the section that follows.

3.6. Trust and Risk in Supply Chain Relationships

The need for trust in a relationship only arises where risk exists. Mayer, *et al.* (1995) and Das and Teng (2004) cite several authors who recognise the importance of risk in understanding trust, but do not agree on the relationship between the two concepts.

Schoorman, *et al.* (2007) view trust as a determinant of risk-taking in a relationship. Thus, the level of trust in a relationship is the amount of risk a company is willing to take (Schoorman, *et al.*, 2007). An alternative method of dealing with risk is the use of control systems. However, trust and controls as means of handling risks cannot be mutually exclusive.

If the level of trust is lower than the risk in the relationship, control systems can bridge the gap and reduce the level of risk to the extent to which trust would be an effective control. This, however, needs to be carefully balanced. If the control system in place is too stringent, it will not foster the development of trust. This is a result of little or no perceived risk in the relationship, hence any trustworthiness is seen as a result of the controls and not the trustee.

Willingness to assume risk and actually assuming the risk distinguishes trust and trusting behaviour respectively. Trust will result in risk taking in a relationship in a manner appropriate to the situation (Mayer, *et al.*, 1995). Mayer, *et al.* (1995) view a perception of risk in a relationship to be separate to the relationship itself.

As mentioned several times already, Game Theory, in particular the Prisoner's Dilemma, is important in this research project as it recognises the relationship between trust and information sharing which is central to this study. This is detailed in the next section.

3.7. Trust and The Prisoner's Dilemma

Game Theory is used to study the choices made when costs and benefits are not fixed, but rather depend on other players (partners) and the shared information available to the players. According to Flowerday and Von Solms (2006), the amount of information that the various players have about each other is a key determinant of behaviour.

This theory is appropriate in a supply chain context which consists of numerous supply chain partners (or players). Each of the supply chain partners need to depend on each other in order to ensure the effective and efficient operation of the supply chain. The amount of information shared between these supply chain partners is important in deciding the extent to which supply chain partners can depend on each other.

Flowerday and Von Solms (2006) examine the classic example of Game Theory, also known as the Prisoner's Dilemma, in which two prisoners in separate cells face the dilemma of whether or not to be police informants. Without further communication, the two players need to trust each other. If neither party informs, both receive light sentences due to insufficient evidence. If both inform, both receive heavy sentences. If one party defects, it is set free, while the other party is convicted based on the informant's evidence. The dilemma of the scenario,

according to Flowerday and Von Solms (2006), highlights the issue of trusting the other player without continuous communication.

Similarly, in a supply chain context where information is shared freely by all members of the supply chain, the benefits to all members is an increased level of trust in the inter-organisational relationship and therefore promotes effective and efficient supply chain operations. If no members of the supply chain reveal information, none can benefit from the improved operations described. If some parties share information while others do not, those who have not shared information can benefit far more than those who have. Thus, the ideal situation would be for supply chain partners to share information freely for the benefit of the entire supply chain.

According to Lewis (1999), this mutual information sharing is likely to occur if all parties will benefit from the relationship in some way, which makes trust an essential prerequisite for information sharing. Poirier (2003) confirms this view by pointing out that trusting those who access information will act responsibly and for the good of the entire supply chain, is crucial to the success of the collaboration.

In this section the crucial relationship between trust and information sharing emerges. This relationship is important in the context of this research. For this reason the vital role of information sharing in inter-organisational relationships is the key focus of the next chapter.

3.8. Conclusion

From the literature survey several definitions of trust were provided. This research project has adopted the Mayer, *et al.* (1995, p. 712) definition of trust as the:

> *"willingness of a party to be **vulnerable** to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party."*

In addition to the trust definition, it was necessary to clearly distinguish trust from cooperation, confidence and predictability which are often mistakenly used as synonyms for trust. The literature survey has also revealed the importance of trust in inter-organisational relationships, namely: the reduction of transaction costs, the improvement of supply chain performance and the sharing of information for mutual benefit.

As this research project aims to investigate trust in automotive supply chains, the determinants of trust need to be understood. Four key trust models were discussed in this chapter, namely: Mayer, *et al.*'s (1995) Proposed Model of Trust; McKnight, *et al.*'s (2002) Initial Trust Model; Li's (2004) Initial Trust Formation Model; and Han, *et al.*'s (2006) Relationship Among Trust Constructs. The components suggested in these models were discussed and compared in this chapter. These components are important for the development of the research model discussed in Chapter Eight.

As risk and controls have emerged in the discussion of trust models, the relationship between trust and risks was analysed. Where trust is lower than risk in an inter-organisational relationship, controls can be used to reduce the gap. This chapter also included a discussion of Prisoner's Dilemma and the importance of information sharing in achieving trust in inter-organisational relationships. From this discussion the relationship between trust and information sharing emerged, which is a key theme of this research project and is further discussed in the next chapter.

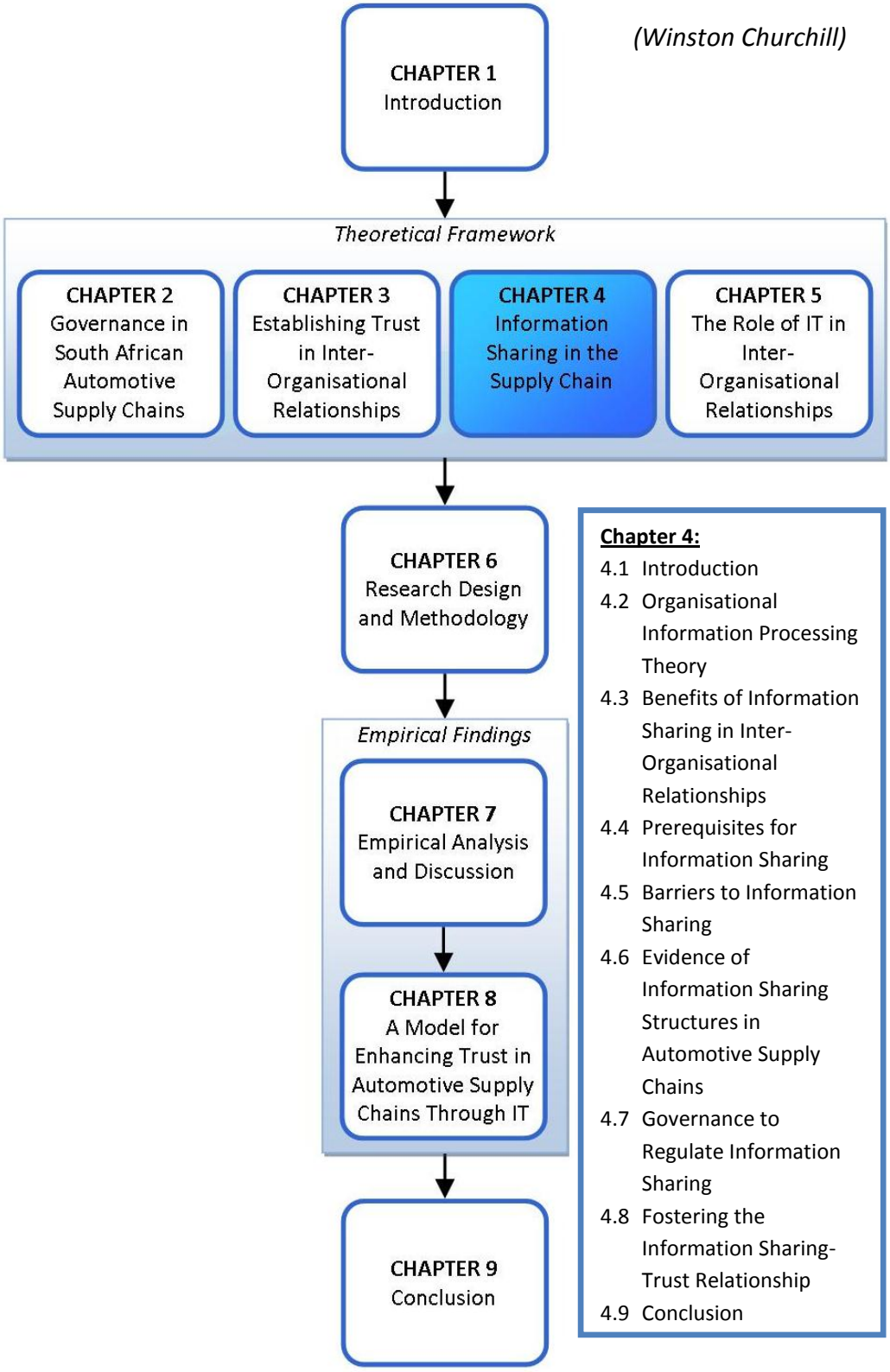
In order to enhance trust in inter-organisational relationship, it is important to understand the nature of information sharing in these relationships. As the objective of this study is to enhance trust in inter-organisational relationships, a thorough investigation of information sharing as a determinant of trust in this context is necessary. Information sharing in the supply chain is explored in Chapter Four.

Chapter 4:

Information Sharing in the Supply Chain

"If we are together, nothing is impossible. If we are divided, all will fail"

(Winston Churchill)



Chapter 4:

4.1. Introduction

Inter-organisational relationships are highly dependent on information sharing (Childerhouse, Hermiz, Mason-Jones, Popp, & Towill, 2003). In large supply chains, such as those found in the automotive industry, it is especially critical to receive information about activities that are controlled by supply chain partners. This information allows organisations in the supply chain to react timeously in order to ensure the continued efficient operation of the supply chain. As part of the problem under investigation in this research project, it is necessary to determine factors that hinder and promote information sharing in inter-organisational relationships.

As stated before, there are large amounts of information available in a supply chain. The difficulty lies in recognising the hidden information therein which has potential for improving supply chain performance (Childerhouse, *et al.*, 2003). Thus, the quantity and quality of information shared is also an important consideration in the supply chain.

As mentioned in Chapter Three, information sharing is important in the establishment of trust in a supply chain. Thus, an investigation of the relationship between trust and information sharing is required. A lowered level of trust leads to ineffective and inefficient operations in the supply chain. This is the result of insufficient information being available to all supply chain partners in order to make effective decisions. Insufficient information sharing can thus be viewed as detrimental to the supply chain's competitiveness.

This chapter begins by introducing the Organisational Information Processing Theory (OIPT), which is concerned with achieving a balance between information needed in the supply chain and the capability the organisation has for sharing information. The benefits of information sharing in the supply chain are then described, in particular benefits relating to coordination, uncertainty reduction and cost reduction. This is followed by a description of the prerequisites for information sharing. The barriers to information sharing are then outlined.

Evidence of information sharing in automotive supply chains is then provided. This is followed by the governance and control measures to regulate information sharing. The chapter concludes with the proposal of a cyclical relationship between trust and information sharing.

4.2. Organisational Information Processing Theory

The Organisational Information Processing Theory (OIPT) identifies information processing needs and capabilities and the need to obtain optimal performance in a supply chain through a balance of these factors. According to Nann, Kumar and Wang (2007), the OIPT is an effective framework for identifying key factors for ensuring efficiency in information-rich activities. This theory was first proposed by Galbraith (1973) and is diagrammatically depicted in Figure 4.1.

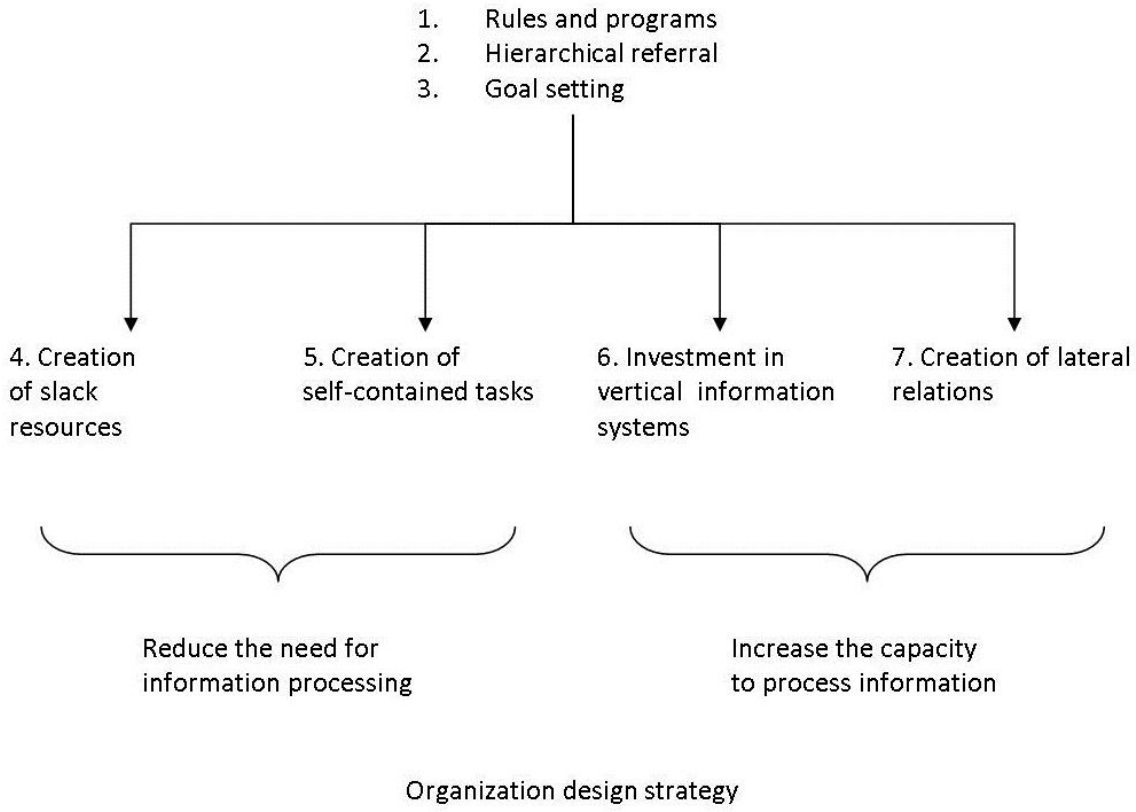


Figure 4.1: Diagrammatic Representation of the Organisational Information Processing Theory (Galbraith, 1973)

The information processing need referred to by the OIPT can be exacerbated by the level of interdependence between organisations within the supply chain (Nann, *et*

al., 2007). In order to optimise the balance between need and capacity, it can become necessary to reduce the need for information processing. Thus, as shown in Figure 4.1, reducing the information processing need can be achieved through allowing for slack resources and implementing self-contained tasks. However, both these options are impractical in a supply chain situation as a key goal for supply chains is to reduce the level of inventory on hand and to promote collaboration among supply chain firms.

The information processing capability is directly related to the collaboration structures in place within the supply chain (Nann, *et al.*, 2007). In order to optimise the balance between need and capacity, it can become necessary to increase the capacity for information processing. Thus, as shown in Figure 4.1, increasing the capacity to process information can be achieved through implementing Information Technology (IT) to assist information flow or establishing lateral relationships in the supply chain. These options are both plausible in a supply chain environment.

Furthermore, the theory views quality information as a requirement in order to handle uncertainty and improve decision making. Similarly, in supply chains, improving information flow between supply chain partners reduces uncertainty in the relationship and thus allows for the enhancement of trust in supply chain partnerships. As described in the previous chapter, improved levels of trust result in optimised supply chain operations. In this regard several benefits of information sharing are recognised. These benefits include coordinating the supply chain and reducing uncertainty in the inter-organisational relationship, and will be discussed in the next section.

4.3. Benefits of Information Sharing in Inter-organisational Relationships

The need for information sharing in inter-organisational relationships has been mentioned several times in the preceding chapters, particularly in relation to

enhancing trust to improve supply chain performance. Information sharing aids in the optimisation of stock levels across the supply chain to allow for the implementation of lean manufacturing principles (which were introduced in Chapter 2.2.4.), which therefore ensures the supply chain profitability and competitiveness (Ghosh & Fedorowicz, 2008).

As the investigation of the relationship between trust and information sharing is an important goal of this study, it is necessary to point out that the benefits that follow can be equated to the benefits of trust in inter-organisational relationships that were discussed in Chapter Three. Further benefits of sharing information with supply chain partners include coordinating the supply chain and reducing uncertainty in the relationship, both of which are instrumental in improving supply chain performance. These are discussed in this section of the chapter.

4.3.1. Coordinating the Supply Chain

The coordination of activities of supply chain members is key to the effective and efficient operation of a supply chain. The need to coordinate the supply chain is obvious due to the large number of suppliers that make up automotive supply chains. As mentioned previously, automotive supply chains are complex networks consisting of over 150 suppliers. Coordinating the activities of all these suppliers is a complicated task. Information sharing plays an essential role in facilitating supply chain coordination.

Ghosh and Fedorowicz (2008) view this coordination as a necessary result of information flow in inter-organisational relationships. Lewis and Talalayevsky (2004) agree that coordination occurs when information is shared between supply chain partners, as decisions are based on this information and hence resources are allocated within the supply chain.

In order to ensure coordination, common governance mechanisms need to be adopted by all members of the supply chains. Ghosh and Fedorowicz (2008) state

that these governance mechanisms are typically trust, bargaining power and contracts. These governance mechanisms are elaborated on in section 4.7.

Lewis and Talalayevsky (2004) also point out that IT facilitates coordination and promotes the formation of new coordination structures. This highlights the need to ensure appropriate IT structures are in place within a supply chain in order to support information flow. The use of IT in facilitating inter-organisational relationships is elaborated on in Chapter Five. Another benefit of information sharing is the reduction of uncertainty in inter-organisational relationships. This is discussed in the section that follows.

4.3.2. Reducing Uncertainty in Inter-organisational Relationships

Yu, Yan and Chang (2001) attribute uncertainty in inter-organisational relationships to the quality and quantity of information available. Although each company has the required information about their own operations upon which to base decisions, they cannot be certain about information they obtain about their supply chain partners. The information can be incomplete or withheld by supply chain partners. This means that decision-making may not be effective as it is based on inadequate information.

Particularly in the decentralised, chain organism supply chain model preferred in Chapter Two, there is a need to reduce uncertainty through shared information. This type of supply chain will not be able to function effectively without the free flow of information between supply chain partners. Without a dominant firm or Channel Master (as described in Chapter Two) which sets the terms of trade for the supply chain, the sharing of information will assist in the successful operation of the supply chain.

The notion of the Prisoner's Dilemma discussed in Chapter Three has relevance here too. The more information each company shares with the supply chain, the more they trust the supply chain partners and thus the more information they are

willing to share. Thus, the importance of information sharing in generating trust in inter-organisational relationships is again confirmed.

In order to investigate trust in inter-organisational relationships, it is necessary to look into the effect of a lack of information sharing on the effective and efficient operation of the supply chain. If information is shared adequately among supply chain partners, the benefits mentioned above can be achieved and therefore the supply chain operates effectively and efficiently. In order to gain maximum benefit from shared information, certain prerequisites need to be met, and these are discussed in the next section.

4.4. Prerequisites for Information Sharing

One of the most important prerequisites for information sharing is the existence of appropriate IT tools in the inter-organisational relationship (Ghosh & Fedorowicz, 2008). As established in Chapter Three, trust can be established through an appropriate level of information sharing. Thus, a link between trust and IT can be established in so far as IT facilitates the sharing of information, which can lead to the establishment of trust in the inter-organisational relationship. As this is a key element of this research project, the role of IT in inter-organisational relationships is discussed in-depth in Chapter Five.

Simatupang and Sridharan (2002) identify four prerequisites that need to be in place in order to ensure adequate information sharing occurs within a supply chain.

1. *Mutual Objectives*: The entire supply chain needs to establish a set of mutual objectives for information sharing. A common understanding of the information that needs to be shared and the expected manner and timing of information sharing ensures that these efforts create mutual value and competitive advantage.

2. *Integrated Policies*: Individual companies need to change internal policies and processes to align with the mutual objectives mentioned

in the previous prerequisite. This is required to ensure that all members of the supply chain share information in the same manner.

3. *Appropriate Performance Measures*: Participating members in the supply chain need to agree on an effective performance measurement system to determine if those organisations are adhering to the objectives of the supply chain. This provides a means of determining which supply chain partners can be trusted to share appropriate information.

4. *Incentive Alignment*: Incentives can be used to encourage commitment to information sharing by participating members. This focuses efforts and attention on joint problem-solving within the supply chain.

As mentioned before, Yu, *et al.* (2001) promote the quality and quantity of information available in an inter-organisational relationship as prerequisites for information sharing. In order to add value to the supply chain the information shared should meet certain requirements. The attributes needed in the shared information will depend on the goals of the supply chain and the manner in which the information is used (Ghosh & Fedorowicz, 2008).

Ghosh and Fedorowicz (2008) suggest the following key attributes for shared information:

1. *Accuracy*: Without accurate information decision-making in the supply chain is ineffective. Inaccurate information will have a negative effect upon supply chain performance and on the trusting relationship between supply chain partners.

2. *Understandability*: Information shared in a manner that is not understood by all supply chain partners is likely to be misinterpreted, and could therefore lead to incorrect decisions being enforced. This can negatively impact supply chain performance or lead to suspicions of uncooperative behaviour of a supply chain partner.

3. *Relevance*: Irrelevant information shared can waste resources used in processing this type of information. This impacts on supply chain performance.

4. *Timeliness*: Supply chains require information to be shared in a timely fashion. In particular, information related to inventory requirements is critically time-sensitive. Failure to share inventory requirements on time can cause delays in production which affects the Original Equipment Manufacturer (OEM) and the rest of the supply chain. This can impact both supply chain performance and trust in the inter-organisational relationships.

5. *Accessibility*: Without access to information, supply chain partners are not able to act on it and make use of it to aid decision making. This can be detrimental to supply chain performance.

6. *Completeness*: As with understandability, incomplete information can result in incorrect decisions being enforced. This can lead to suspicions of deliberate withholding of information by supply chain partners and thus negatively affect the level of trust in the inter-organisational relationship.

7. *Appropriate Amount*: As with relevance, if too much information is shared it can waste resources used in processing and thus impacts on supply chain performance. Like completeness, too little information can result in poor decision making and thus affect trust in the inter-organisational relationship.

8. *Reliability*: Reliability in information shared is built up over a period of time and is closely linked to the level of trust in the inter-organisational relationship. The more reliable the information is deemed to be, the higher the level of trust in the relationship.

9. *Ease of Use*: Information shared should be easily interpreted so that immediate and effective action can be taken based on this information. If the information is not easily interpreted, this can lead to poor decision making.

The prerequisites for information sharing are only able to assist in information flow if the barriers to information sharing are overcome. As this research is concerned with achieving the optimal level of information sharing in order to enhance trust in the inter-organisational relationship, both prerequisites and barriers need to be considered when attempting to optimise information flow in an inter-organisational relationship. The barriers are discussed in the next section.

4.5. Barriers to Information Sharing

Childerhouse, *et al.* (2003) provide an illustration of barriers affecting information sharing in supply chains. This is depicted in Figure 4.2 on the following page.

As established previously, the level of trust in the inter-organisational relationship can be enhanced through improving the flow of information in the relationship (among other factors). However, in the complicated supply chain networks, various barriers exist to the effective sharing of information. It is important to understand these barriers in order to address them and ensure free flow of information in the supply chain.

These barriers can be grouped into four categories, namely technological, cultural, financial and organisational and are discussed below. An additional barrier to information sharing is recognised in the literature, namely the risk of information sharing and is also included in this section.

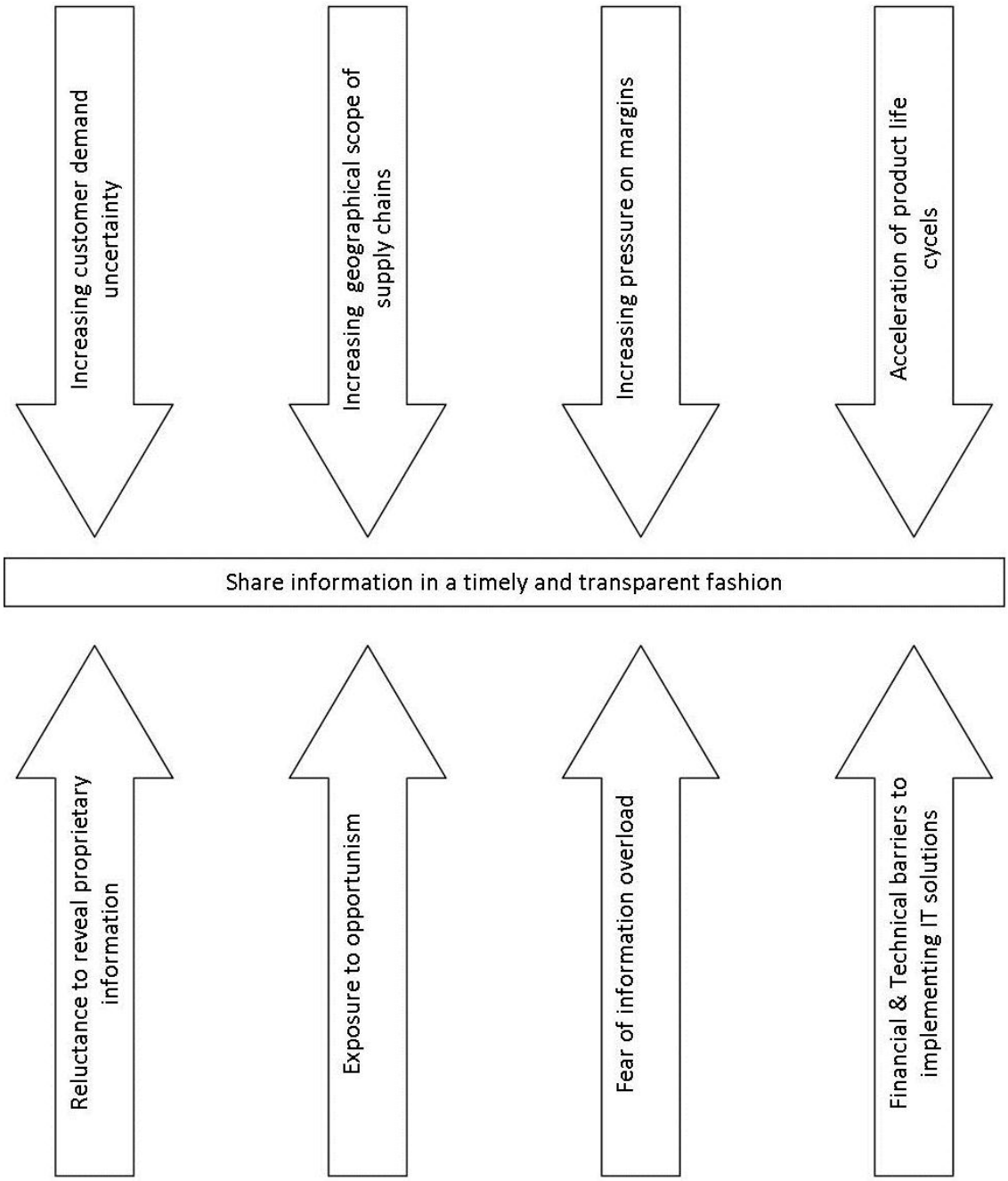


Figure 4.2: Summary of Pressures for and against Information Sharing in Supply Chains (Childerhouse, *et al.*, 2003)

4.5.1. Technological Barriers

Although it would seem obvious that technological barriers are no longer a concern in this information age, this is often not the case. The most common technological barrier in supply chain relationships is systems incompatibility. Fawcett, Magnan and McCarter (2008) state that systems incompatibility aggravates the cost of

connectivity and is therefore a major stumbling block to ensuring the flow of information between supply chain partners.

As shown in Figure 4.2, financial and technical barriers to implementing IT solutions correspond to this category. Other technological barriers fall into cost and implementation categories and are discussed in more detail in Chapter Five which deals with the IT-enablement of inter-organisational relationships. Another category of barriers is cultural barriers, which is discussed next.

4.5.2. Cultural Barriers

Eighty percent of information flow problems arise due to people rather than the technology used to transfer the information (Childerhouse, *et al.*, 2003). Cultural barriers can be related to trust in inter-organisational relationships, and Childerhouse, *et al.* (2003) observe that parties are only willing to share information if they perceive that the benefits of sharing information offset the risks involved.

An additional point is raised by Fachinelli, Ueltschy and Ueltschy (2007) who consider that although trust is a prerequisite to supply chain success, this trust and its importance are found to be considerably different across different cultures. The authors made use of a sample of United States manufacturing companies and their Brazilian suppliers to investigate the importance of trust, personal contact and long-term commitment in global supply chain relationships in differing cultures. In this case the Brazilian suppliers placed more value in long-term commitment and trust than their United States counterparts and preferred more personal, but not necessarily more frequent, interaction (Fachinelli, *et al.*, 2007). This highlights the role of cultural influences on information flow and trust development.

As shown in Figure 4.2, the reluctance to reveal proprietary information and fear of information overload correspond to this category. The next category of barriers is financial barriers, which is discussed below.

4.5.3. Financial Barriers

This is the visible cost of enabling information flow in the supply chain and is chiefly related to the costs associated with the IT necessary to share information in the supply chain. As mentioned previously in connection with technological barriers, the chief costs in enabling information flow are related to establishing compatible IT systems across the supply chain that allows the free flow of information (Fawcett, *et al.*, 2008).

In traditional supply chains the OEM holds the power in deciding the systems that are to be implemented for information sharing purposes. The suppliers to the OEM therefore are required to implement these systems in order to streamline information flow. The price of failure to adapt to these systems is high as it could result in loss of business with the OEM. These financial barriers are explored further in Chapter Five.

Childerhouse, *et al.* (2003) recognise four major sources of cost relating to information flow:

1. Costs associated with feasibility studies and system design.
2. Cost of the hardware necessary to implement the information sharing structures.
3. Cost of software implemented in the supply chain.
4. Cost of managing and ensuring software and hardware are operational.

The burden of cost falls chiefly upon the suppliers; however, a shift of attitude by OEMs is advocated. In particular, the shift toward a chain organism model of the supply chain (as discussed in Chapter 2) would require the OEM to work together with suppliers toward maximising benefit from implemented technologies. By enforcing power over the supply chain, OEMs may in fact inhibit the advantage of the technology implemented to manage information flow (Fawcett, *et al.*, 2008).

In Figure 4.2, increasing pressure on margins and financial and technical barriers to implementing IT solutions correspond to this category. The next category of barriers is organisational barriers, which is discussed in the following section.

4.5.4. Organisational Barriers

The nature of supply chains which consist of independent companies, with their own goals, processes and information needs, give rise to costs associated to transactions, coordination issues and governance concerns (Childerhouse, *et al.*, 2003).

Among the costs associated with this barrier are those related to controls established to manage the inter-organisational relationship. These controls are used to reduce the risk associated with sharing information (which is discussed in section 4.5.5 below). Although costly to implement, controls reduce the likelihood of supply chain partners acting contrary to the supply chains' best interests.

From Childerhouse, *et al.*'s (2003) illustration of the barriers in Figure 4.2, increasing customer demand uncertainty, increasing geographical scope of supply chains, and acceleration of product life cycles correspond to this category. An additional barrier to information sharing is the existence of risk when information is shared. This barrier is discussed next.

4.5.5. The Risk of Sharing Information

Sharing information with other organisations encompasses inherent risk. Ghosh and Fedorowicz (2008) provide the example of the risks of information leakage which can result in reluctance to share sensitive production data. Information shared within the supply chain is expected to be used for the supply chains' benefit. If this information is distributed outside of the supply chain, this can be detrimental to the supply chain's competitive advantage as well as the trust level between supply chain partners. This is important in the context of the competitive nature of the automotive industry where supply chains are competing against each other for market share.

According to Mishra, Raghunathan and Yue (2007), many supply chain studies assume that information shared in supply chains is always truthful and often do not consider the possibility that one party distorts information. In truth, each company has an incentive to distort information if they are relying solely upon their own information. This relates to previous discussions of the Prisoner's Dilemma – without knowing anything about the supply chain partners, the organisation does not know what the outcome of sharing information with the rest of the supply chain will be. Thus, the more information is shared in the supply chain, the less likely information is to be distorted.

There exists a risk for individual companies in the supply chain of losing control of their valuable information, while receiving poor quality information in return from supply chain partners (Ghosh & Fedorowicz, 2008). This risk of sharing information is important in the context of this research project. This risk can appear to be detrimental to the establishment of trust in inter-organisational relationships. Despite the potential barriers to information sharing detailed above, several automotive supply chains have succeeded in implementing information sharing structures. These examples are discussed in the next section.

4.6. Evidence of Information Sharing Structures in Automotive Supply Chains

Most automotive OEMs have made some attempt at information sharing with the entire supply chain. These attempts were used to improve efficiency and effectiveness of supply chain relationships and operations. This section details efforts by six of the automotive OEMs with South African-based facilities, namely: BMW, Ford, General Motors, Mercedes-Benz, Toyota and Volkswagen.

BMW make use of a web-based document management system that allows easy, secure access to information worldwide (Kappe, 2001). This is of particular importance in the global setting of multinational automotive suppliers. Furthermore, BMW encourage the use of a "yellow pages" application to locate

experts (Piderit, Flowerday, & Von Solms, 2011). This is the most important (and easy to establish) tool for information sharing in multinational automotive supply chains.

Ford's web-based knowledge base is an important tool for dealing with daily problem-solving activities (Coughlan & Rukstad, 2001; Jenkins & Tallman, 2010). These portals and intranet sites ensure that relationships are formed between the necessary people for problem-solving to occur, as well as allowing information access within the supply chain (Piderit, *et al.*, 2011). This is necessary for globally dispersed employees in a multinational automotive supply chain.

General Motors' efforts include the establishment of centres of excellence in key business areas (Coughlan & Rukstad, 2001; Jenkins & Tallman, 2010). Even more important is the documentation of lessons learned and discussions of best practices that is encouraged amongst all the supply chain stakeholders (Piderit, *et al.*, 2011).

Mercedes-Benz's efforts have an interesting history. Initiatives embarked upon include information resource mapping and Communities of Practice (CoPs) that focus on particular situations (Piderit, *et al.*, 2011). Furthermore, the company has identified knowledge areas that require support by the existing CoPs (Coughlan & Rukstad, 2001; Jenkins & Tallman, 2010). Mercedes-Benz's initiatives hold value for the multinational automotive supplier in terms of bringing geographically dispersed employees and suppliers together to solve problems and ensuring the free flow of information within their supply chain.

The success of Toyota's information management initiatives highlight the relevance of information sharing in the automotive sector. These information sharing practices have allowed Toyota to ensure collaboration and realise significant benefits for the entire supply chain (Liker, 2004). Furthermore, their know-how database allows employees to explore previous problem-solving attempts (Piderit, *et al.*, 2011). This central repository is an important source of information for their entire supply chain network.

Volkswagen has also made use of a web-based knowledge base for handling queries (Hyperwave, 2007). Volkswagen's efforts focus on the distribution of the necessary information and solutions to problems throughout the organisation and supply chain (Volkswagen, 2007). Similar to BMW, Volkswagen has implemented a "*yellow pages*" application, which, together with expert "*rooms*", encourages collaboration for problem-solving activities (Piderit, *et al.*, 2011).

Although this literature points to a free flow of information from the OEM to suppliers, little or no mention is made of information flowing from or among suppliers. In fact, Toyota appears to be the only automotive manufacturer to have information flowing freely within the supply chain – their continued dominance of the market might be attributed to this (Liker, 2004). Examples of how Toyota achieves this information flow through the chain organism governance model were discussed in Chapter Two.

As Toyota's governance approach is attributed to the success of the information sharing approach which builds trust in inter-organisational relationships, it is acknowledged that governance mechanisms are required in order to control information sharing and ensure the benefits of appropriate information sharing is experienced by all supply chain members. Thus, governance mechanisms that can be used to regulate information sharing are discussed in the next section.

4.7. Governance to Regulate Information Sharing

Employing governance mechanisms to managing the inter-organisational relationship has previously been discussed in Chapter Two. In this chapter a discussion of governance mechanisms used to regulate information sharing is necessary.

Ghosh and Fedorowicz (2008) promote the use of trust, bargaining power and contract as governance mechanisms to aid inter-organisational information sharing. The quality of information (as discussed in section 4.4) and the

mechanisms for sharing information (for example inter-organisation systems which will be discussed in Chapter Five) are additional factors to be considered.

Figure 4.3 below illustrates the link between these governance mechanisms and information sharing. Establishing the governance mechanisms depicted in Figure 4.3 and discussed thereafter, aids in the establishment and control of information sharing across the entire supply chain. This regulated information sharing environment provides the basis for establishing trust in the inter-organisational relationship. It is important to note that the model (Figure 4.3) points out the value of information sharing in coordinating the supply chain.

As discussed earlier in this chapter, coordination of supply chain members allows for the effective and efficient operation of the supply chain and therefore improves the supply chain's competitiveness. The two factors vital to this coordination (supported by information sharing) are the quality of information shared and the means of sharing the information. Both these factors have been discussed previously as being important factors in the establishment of trusting relationships within supply chains.

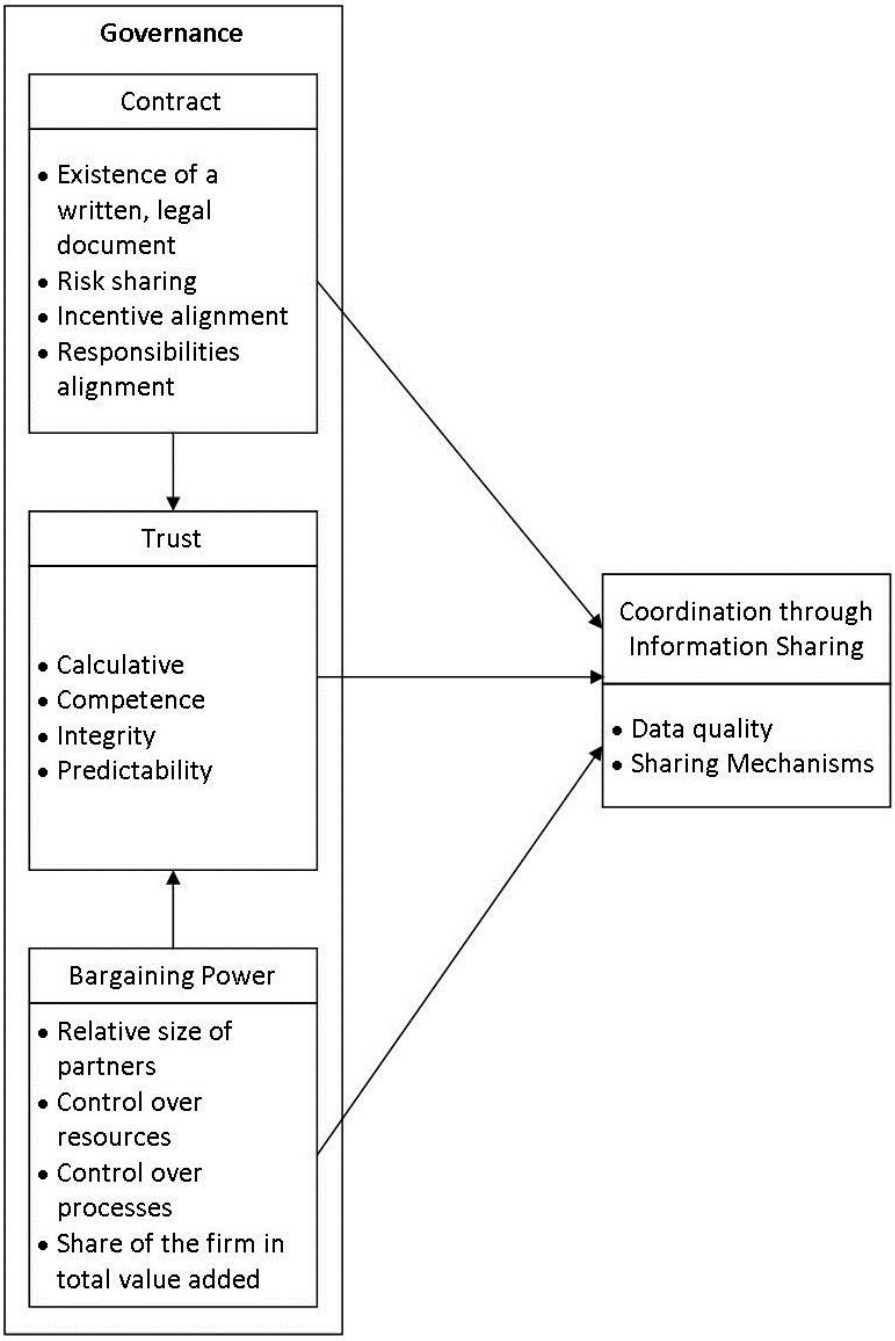


Figure 4.3: Framework for the Role of Governance in Supply Chain Information Sharing (Ghosh & Fedorowicz, 2008)

The three governance mechanisms proposed by Ghosh and Fedorowicz (2008), namely: trust, bargaining power and contracts are discussed in further detail in the sections that follow.

4.7.1. Trust Governing Information Flow

Trust in inter-organisational relationships has been discussed extensively in the previous chapter, but it is necessary to recap the concept as it relates to regulating information sharing in supply chains. Ghosh and Fedorowicz (2008) view trust as key in ensuring information flows freely in the supply chain. Trust is a key governance mechanism, which, in conjunction with bargaining power and contracts, determines the extent to which information sharing benefits the entire supply chain.

Ghosh and Fedorowicz (2008) advocate four types of trust relevant in this context.

1. *Calculative Trust*: This form of trust can be equated to the *Benevolence* construct in Mayer, Davis and Schoorman's (1995) model. This type of trust is defined as the trustee's expected cooperation in the relationship (Ghosh & Fedorowicz, 2008). This type of trust is developed during the initial formation of an inter-organisational relationship.

2. *Competence Trust*: This form of trust can be equated to the *Ability* construct in Mayer, *et al.*'s (1995) model. This type of trust is the ability of the trustee to perform required tasks (Ghosh & Fedorowicz, 2008) and is developed when interactions between the companies occur.

3. *Trust in Integrity:* This is the *Integrity* construct in Mayer, *et al.*'s (1995) model. This type of trust is based upon the experience of prior interactions with the trustee (Ghosh & Fedorowicz, 2008) and thus is focused on past behaviour. The importance of integrity is highlighted by the number of members in a supply chain that need to be coordinated.

4. *Trust in Predictability*: This type of trust requires the trustor to be able to reliably predict the outcomes of interactions with the trustee (Ghosh & Fedorowicz, 2008).

In summary, the amount of trust in the supply chain affects the extent of the information sharing between supply chain partners. This is consistent with the Prisoner's Dilemma which is an underlying theory for this study. In the Prisoner's Dilemma, trust is an important prerequisite for information sharing which leads to mutual information sharing. This information sharing occurs when all supply chain partners will benefit from the relationship in some way.

4.7.2. Bargaining Power

Bargaining power arises where one firm in the supply chain controls key resources or processes (Ghosh & Fedorowicz, 2008). This power base is expected to shift from the OEM to the suppliers if information flows easily in the supply chain. This is consistent with the shift from the channel master to chain organism model described in Chapter Two. Thus, bargaining power affects the extent of information sharing between supply chain partners. The final contributing governance mechanism discussed in this section is contracts which is detailed below.

4.7.3. Contracts

Contracts are important in allocating authority in supply chains and sharing risk between members, by providing a means of enforced coordination (Ghosh & Fedorowicz, 2008). Contracts provide a formal means of structuring the amount and method of information sharing. Contracts, such as Service Level Agreements (SLAs), provide a control mechanism to regulate the inter-organisational relationship. The use of controls is discussed in more detail in Chapter Five.

Based on the literature surveyed in Chapter Three and Chapter Four, the relationship between trust and information sharing can appear to be complicated. Thus, the next section proposes an information sharing-trust relationship for a

competitive supply chain. This is then related to the Organisational Information Processing Theory (OIPT) and previously discussed Prisoner's Dilemma.

4.8. Fostering the Information Sharing-Trust Relationship

As Jain and Dubey (2005) and Peterson (2002) point out, the modern supply chain needs to be collectively competitive. In the chain organism supply chain model mentioned previously (Peterson, 2002), the existence of trust in the inter-organisational relationship is paramount to the competitiveness of the supply chain.

Where trust exists in the inter-organisational relationship, information sharing among supply chain partners is maximised. With increased information sharing, transaction costs are reduced and therefore efficiency is improved, thereby allowing the supply chain to compete effectively.

The relationship between trust and information sharing is important in the context of this research. Several works have highlighted benefits and concerns regarding sharing information among supply chain partners, at the same time noting a relationship between trust and information sharing in a singular direction:

1. Premkumar, Ramamurthy and Saunders (2005) recognise that information flow is restricted due to the competitive nature of the automotive industry and propose that in order to enhance trust in the supply chain relationships, information flow should be enhanced.

2. Kwon and Suh (2005) found that the level of trust between supply chain partners was highly reliant upon the level of asset investment and information sharing structures. Information sharing, in particular, was found to play a role in reducing uncertainty in the supply chain relationship and thereby improving the level of trust.

3. Chu and Fang (2006) identify information sharing as one of the determinants of the level of trust between supply chain partners.

4. Ghosh and Fedorowicz (2008) see trust as a governance mechanism that plays a crucial role in sharing information among business partners.

In order to have a sufficient level of trust in a relationship, a significant level of information sharing is required. Better decision making can occur if there is sufficient information, and the resultant improved operational performance experienced results in improved trust in the supply chain partners that have shared the information. Conversely, the sharing of information will only occur if there is a sufficient level of trust among supply chain partners. If there is insufficient trust in supply chain partners, there will be unwillingness to share information. Thus, the relationship between trust and information sharing is cyclical – it is not a relationship that occurs in a single direction only (as established by the existing literature).

Having established previously the role IT has in facilitating information sharing (and thereby enhancing trust), this vital component cannot be ignored. Jharkharia and Shankar (2004) view information sharing as a basic enabler for the effective management of a supply chain which needs to be facilitated by IT.

The cyclical relationship between trust and information sharing and the underlying supporting role of IT is represented in the diagram below (Figure 4.4). This proposed cyclical relationship is the basis of the model for establishing trust in automotive supply chain through IT which is the primary objective of this research project. This view is confirmed by the Organisational Information Processing Theory (OIPT) discussed in section 4.2, whereby uncertainty in the relationship can be reduced by increasing access to information (Premkumar, *et al.*, 2005). This allows the supply chain to improve decision making and operations.

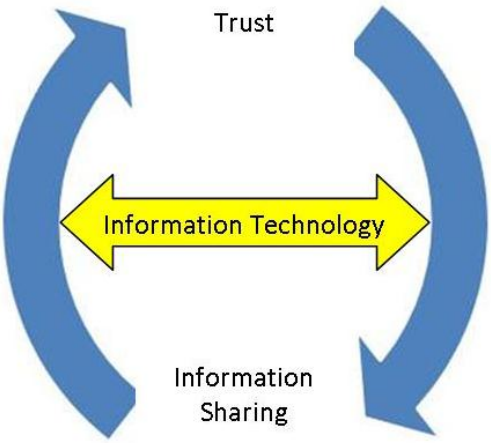


Figure 4.4: Trust-Information Sharing Relationship (Piderit, *et al.*, 2011)

In light of the Prisoner's Dilemma discussed in Chapter Three, the supplier's choice to co-operate and willingly supply information is directly related to the amount of information available and therefore the level of trust that each of the supply chain partners places in the others. This choice is depicted in Figure 4.5 below.

		Player 1	
		Cooperate	**Defect**
Player 2	**Cooperate**	Both rewarded due to mutual cooperation.	Player 1 rewarded while Player 2 punished.
	Defect	Player 2 rewarded while Player 1 punished.	Both punished due to mutual defection.

Figure 4.5: Game Theory Reward Versus Punishment (Based on: Andreoni, Harbaugh, & Vesterlund, 2003)

As shown in the top left quadrant of Figure 4.5 above, if both supplier chain partners (referred to as Player 1 and Player 2) cooperate and share information for mutual benefit, both are rewarded (Andreoni, *et al.*, 2003). In the context of the supply chain, the reward is effective and efficient supply chain operations which allow the entire supply chain to compete effectively, and therefore benefits all

supply chain partners. This scenario involves a high trust level between supply chain partners.

Conversely, as shown in the bottom right quadrant of Figure 4.5, if both supply chain partners defect and withhold information, both are punished (Andreoni, *et al.*, 2003). In the context of the supply chain, the punishment is poor supply chain performance which is detrimental to all supply chain partners. In this scenario there are low levels of trust between the supply chain partners.

In either of the remaining quadrants, if one supply chain partner cooperates and shares information while the other defects and withholds information, the defecting partner is rewarded while the cooperating partner does not gain from the sharing of information (Andreoni, *et al.*, 2003). Thus, it is important that all supply chain partners share information freely in order to achieve maximum benefit for all supply chain partners and the supply chain as a whole.

4.9. Conclusion

In this chapter the Organisational Information Processing Theory (OIPT), which is a supporting theory for this research project, was described. The OIPT identifies a trade-off required between information processing needs and capabilities. This is relevant in the supply chain context as it points to the need to balance information shared and the support structures (usually IT) to share this information.

From the literature survey it has been noted that there are several benefits of information sharing in supply chains which positively impact on the performance of the entire supply chain. Information sharing is beneficial with regards to coordinating the supply chain and reducing uncertainty. These benefits can be equated to the benefits of trust in inter-organisational relationships discussed in Chapter Three.

In addition, the literature has shown that certain requirements need to be met in order for information sharing to occur. Prerequisites identified include mutual objectives, integrated policies, appropriate performance measures and incentive

alignment. Achieving an appropriate level of quality in the information shared is also necessary. These prerequisites need to be considered in conjunction with barriers that exist with regard to information sharing in supply chains. Barriers that need to be considered and overcome are technological, cultural, financial and organisational. An additional barrier is the existence of risk that the organisation is exposed to when information is shared.

The literature survey has also provided examples of information sharing structures in place at automotive manufacturers. With the barriers and prerequisites in mind, information sharing needs to be regulated through appropriate governance mechanisms. These governance mechanisms include trust, bargaining power and contracts. This chapter then proposed a cyclical relationship between trust and information sharing in the supply chain. This cyclical relationship is a foundation for the model of enhancing trust in automotive supply chains through IT which is proposed in Chapter Eight.

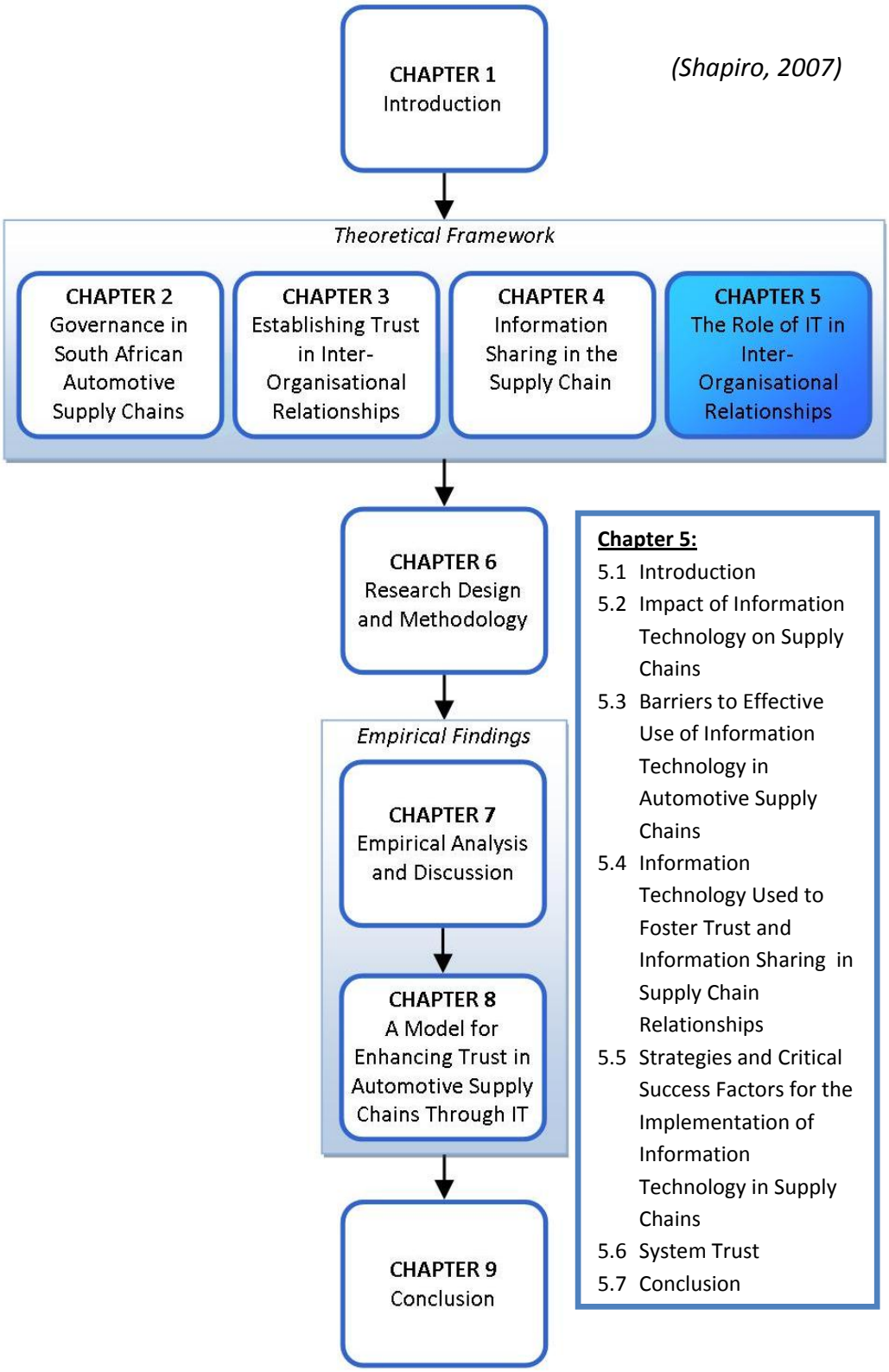
As IT is instrumental in facilitating inter-organisational relationships, in particular information sharing, it is appropriate to ensure that IT is leveraged for maximum benefit. The objective of this study is to study the enhancement of trust in inter-organisational relationships through the appropriate use of IT and therefore a thorough investigation of IT in this context is necessary. The role of IT in fostering a trust-information sharing relationship is discussed in the next chapter.

Chapter 5:

The Role of Information Technology in Inter-Organisational Relationships

"Effective supply chain management requires the acquisition and application of analytical IT tools"

(Shapiro, 2007)



Chapter 5:

5.1 Introduction
5.2 Impact of Information Technology on Supply Chains
5.3 Barriers to Effective Use of Information Technology in Automotive Supply Chains
5.4 Information Technology Used to Foster Trust and Information Sharing in Supply Chain Relationships
5.5 Strategies and Critical Success Factors for the Implementation of Information Technology in Supply Chains
5.6 System Trust
5.7 Conclusion

5.1. Introduction

The value of Information Technology (IT) in inter-organisational relationships, particularly with regard to enhancing trust and information sharing, is rarely addressed in the literature. A cyclical relationship between trust and information sharing in inter-organisational relationships was proposed in Chapter Four. In the complex network of automotive supply chains, IT is required to facilitate and enhance information sharing and trust in the supply chain relationship.

As IT is instrumental in facilitating inter-organisational relationships, in particular information sharing, it is appropriate to ensure that IT is leveraged for maximum benefit. As previously discussed, inefficiencies in inter-organisational relationships threaten the competitiveness of the entire supply chain. Thus, Original Equipment Manufacturers (OEMs) have begun to adopt inter-organisational systems to assist in the efficient and effective operation of the supply chain (Lauer, 2000).

This chapter is important for this research project as the focus of this study is on using IT to enhance trust in inter-organisational relationships. Thus, it is necessary to investigate the types of IT used to manage inter-organisational relationships and their effect on trust and information sharing.

This chapter first considers the impact IT has on the supply chain. This is followed by a discussion of barriers to the effective use of IT in supply chain relationships. An overview of the types of inter-organisational systems used to foster trust and information sharing in automotive supply chains is then provided. A framework for the successful implementation of IT in supply chains is then discussed. The dimensions of system trust are then outlined to conclude this chapter.

5.2. Impact of Information Technology on Supply Chains

The role of IT in the supply chain has been discussed by many authors. The most relevant impact of IT in the supply chain for this research project is making real time information available among supply chain partners. This information is

important as it allows supply chain partners to make appropriate decisions based on the information available. Optimised decision making is key to effective and efficient supply chain operations (as established in previous chapters). Making information available throughout the supply chain allows supply chain members to establish trusting relationships as per the Prisoner's Dilemma discussed in Chapter Three.

Widespread IT support is essential to capture and communicate information across the supply chain. A supply chain partner's willingness to share information would be higher if appropriate IT support is available. This is confirmed by Fawcett, Magnan and McCarter (2008) who recognise that a high level of information sharing is related to the level of IT investment in the supply chain. This willingness to share information is an indicator of the amount of trust that can be placed in the supply chain partner.

IT is essential to ensure that the organisation is able to obtain the necessary information required in order to improve supply chain performance (Cheng, Lai, & Singh, 2007). The quality of information exchanged is enhanced if supply chain partners trust each other and there is no conflict between these parties (Cheng, *et al.*, 2007). As per the Prisoner's Dilemma, supply chain partners may be more willing to share information with their fellow suppliers if trust exists, however, this information would need to be shared via appropriate IT systems.

The objectives of IT in Supply Chain Management according to Simchi-Levi, Kaminsky and Simchi-Levi (2003) are:

1. Providing information availability and visibility.
2. Enabling single point of contact data.
3. Allowing decisions based on total supply chain information.
4. Enabling collaboration with other supply chain partners.

These objectives are all relevant for this research project as they establish the importance of information sharing through IT. Reducing the friction in transactions between supply chain partners through cost-effective information flow is the most distinctive impact of IT in supply chains. IT also has a role in supporting the collaboration and coordination of supply chains through information sharing (Amiri, 2006). This corresponds to the coordination benefits of information sharing mentioned in Chapter Four.

As discussed above, the primary impact IT has on the supply chain is providing a means whereby information can be shared. As established in earlier chapters with regards to the Prisoner's Dilemma, sharing information leads to trust in supply chain partners. Thus, this impact of IT is of value to this research project as this study aims to enhance trust in supply chain relationships through the use of IT. Several barriers to the effective use of IT for information sharing are established in the literature and are discussed in the next section.

5.3. Barriers to Effective Use of Information Technology in Automotive Supply Chains

IT tools such as Electronic Data Interchange (EDI) have enabled manufacturers to share information such as demand and inventory information with their supply chain partners. This enables organisations to reduce lead time, improve logistics management and improve forecasting (Mishra, Raghunathan, & Yue, 2007). As described in the previous section, IT facilitates coordination and information flow in the supply chain. This includes demand, capacity, inventory and scheduling information in the supply chain. However, IT may have little value unless supply chain partners capitalise on the use of IT to share information among supply chain partners.

There are several barriers to the effective use of IT which hamper the flow of information in a supply chain. Jharkharia and Shankar (2004) provide a

classification of the barriers that may significantly affect the IT-enablement of a supply chain. This is depicted in Figure 5.1 below.

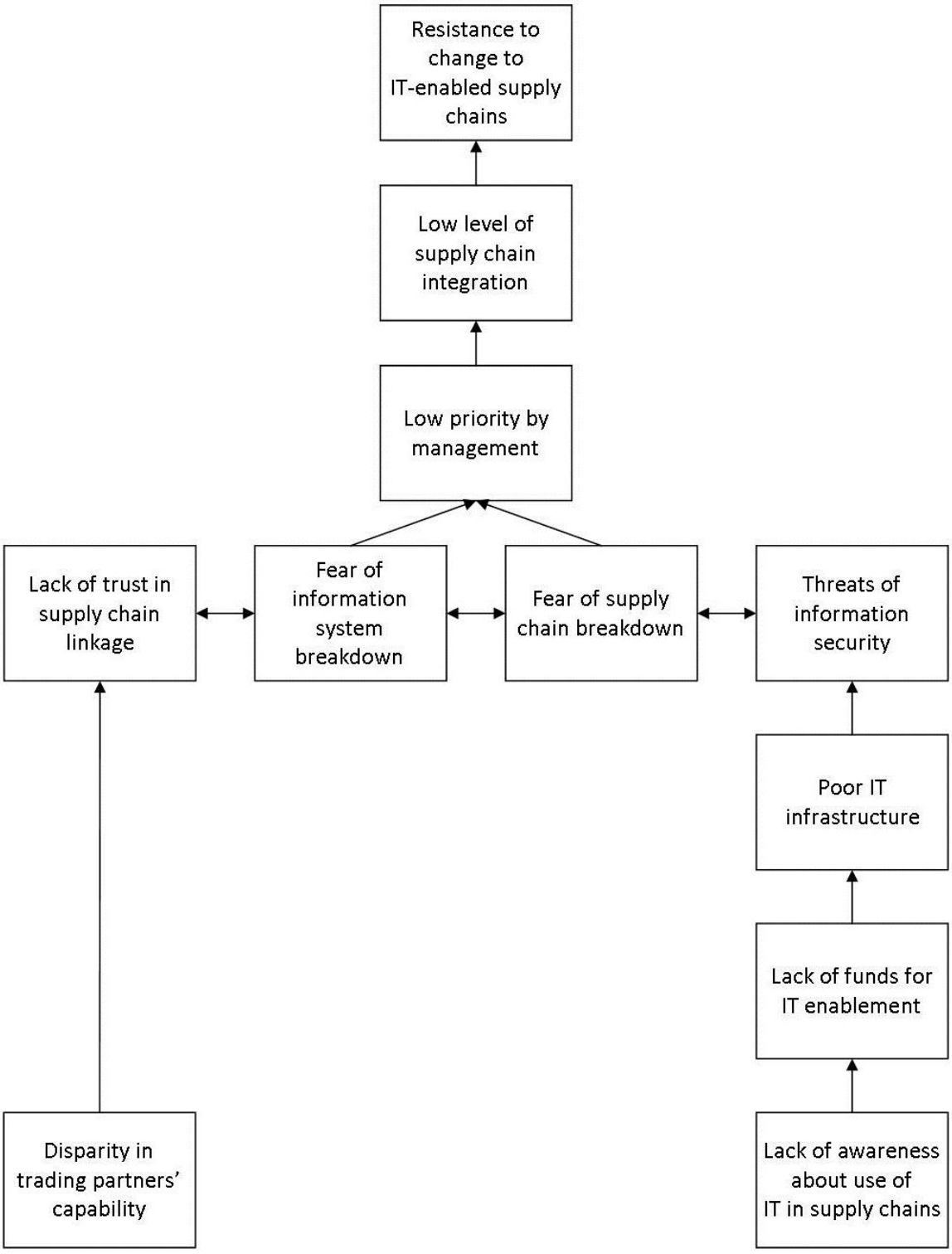


Figure 5.1: Barriers to the Information Technology-enablement of a Supply Chain
(Jharkharia & Shankar, 2004)

The most significant barriers represented in Figure 5.1 can be classified into five categories, namely: cost of implementation, redesigning business processes, security and access to information and willingness to participate and share information. These barriers have an effect on the establishment of trust in supply chain relationships as this is reliant upon IT to facilitate sharing of information. These barriers are discussed in the sections that follow.

5.3.1. Cost of Implementation

Implementing systems across organisational boundaries, as would need to be done in supply chains, involve cost, time and risk (Jharkharia & Shankar, 2004). In Figure 5.1 the lack of funds for IT-enablement is a corresponding barrier. The most common technological barrier in supply chain relationships is systems incompatibility. Fawcett, *et al.* (2008) state that systems incompatibility aggravates the cost of ensuring supply chain partners are connected and is therefore detrimental to the flow of information between supply chain partners.

If suppliers' systems are incompatible, there is a substantial cost involved in ensuring existing systems can integrate or alternatively implement new systems that are compatible. The cost of implementation are traditionally stipulated by the OEM who specifies the IT systems to be used across the supply chain for coordination. However, if automotive supply chains adopt the chain organism model, the costs of implementation could be agreed upon by all supply chain partners and the impact of this barrier would be reduced. Thus, the choice of governance model (as discussed in Chapter Two) for the supply chain can affect the cost of implementation.

In addition to costs relating to compatibility, there are also costs associated with redesigning business processes, which are elaborated on in the following section.

5.3.2. Redesigning Business Processes

To achieve an IT-enabled supply chain requires business processes in each supply chain partner to be redesigned in order to adapt to the processes supported by the

system implemented (Jharkharia & Shankar, 2004). This barrier also corresponds to the lack of funds for IT-enablement in Figure 5.1. Failure to adapt business processes is generally considered a major contribution to the ineffective operation of the supply chain.

If the supply chain partners do not adapt business processes to fit the IT systems implemented, then the information provided by the supply chain systems is likely to be inadequate. This would hinder the establishment of trust in the inter-organisational relationship.

This barrier is important as the required changes to the business processes are often met with resistance. This corresponds to Jharkharia and Shankar's (2004) resistance to change to IT-enabled supply chains in Figure 5.1. This resistance is a result of alterations to work culture and the nature of work that will need to be carried out. This employee resistance needs to be managed in order to optimise use of IT in the supply chain. Once use of the IT system is optimised, information sharing among supply chain partners is improved and trust enhanced.

5.3.3. Security and Access to Information

Security and access privileges are important barriers in the use of intranet and extranet technologies in supply chains (Jharkharia & Shankar, 2004). The threat of competitors accessing and tampering with information is another important concern represented in Figure 5.1. Concerns about the possibility of information being available outside of the supply chain will significantly affect the amount of information shared. The consequences of information reaching unintended recipients could include the exposure of planning or production information that could be used by competitors to gain a competitive advantage.

If a supply chain member does not trust the rest of the supply chain to safeguard information shared, this can result in information being withheld and therefore the use of the IT system will not be implemented. This, therefore, is a barrier that needs to be addressed in order to ensure that trust and information sharing is

enhanced within the supply chain. This is related to the next barrier which is concerned about the willingness of supply chain partners to participate and share information.

5.3.4. Willingness to Participate and Share Information

Regardless of IT implementation, if organisations are not willing to participate and share information across the supply chain for mutual benefit, the venture would not succeed (Jharkharia & Shankar, 2004). This reluctance is a major barrier to IT enablement of supply chains (and the focus of this study).

In Chapter Three the willingness of a supply chain partner to share information within the supply chain was noted as a factor in the establishment of trust in inter-organisational relationships. This barrier is related to the Prisoner's Dilemma – if the supply chain partner does not trust the rest of the supply chain and is therefore not willing to share information, supply chain partners do not gain from the supply chain partnership. If a supply chain partner is not willing to share information they effectively do not trust the supply chain partners. Thus, regardless of IT implemented, the supply chain relationships will not be effective.

Consideration of the various IT used in supply chain relationships is discussed next. While several other IT are available for use in the supply chain, the discussion is limited to those who have an impact on the formation of trust or the facilitation of information sharing in inter-organisational relationships.

5.4. Information Technology Used to Foster Trust and Information Sharing in Supply Chain Relationships

The numerous inter-organisational relationships in automotive supply chains require IT to manage the integration between supply chain partners (Muller & Seuring, 2007). As referred to before, information sharing is key to the effective operation of a supply chain, in particular so far as it enables the establishment of trust in inter-organisational relationships. Inter-organisational systems increase

the efficiency and effectiveness of business transactions by improving the information flow between supply chain partners (Ibrahim, 2004).

If the information shared through the IT systems described in this section is not available to all supply chain members for decision making, this can adversely affect supply chain operations. This can be related to the Prisoner's Dilemma which states that if any supply chain members withhold information due to insufficient trust in the inter-organisational relationship, the implementation of IT to manage the supply chain will be insufficient to improve supply chain operations.

The use of IT in supply chains has proliferated in the past decade. Motwani, Madan and Gunasekaran (2000) point out there are many IT options available for supply chains and several newer options have been developed in recent years. Deciding which IT tool to use in order to maximise competitive advantage for a supply chain is a difficult task. Competitive advantage in the supply chain cannot simply be achieved through faster and cheaper communication, as access to masses of transactional data does not lead to better decision making. As Shapiro (2007, p. 35) points out:

> *"To effectively apply IT in managing its supply chain, a company must distinguish between the form and function of transactional IT and analytical IT."*

The transactional IT referred to in this statement acquires, manages and communicates raw data within the supply chain, while analytical IT evaluates supply chain transactional data in order to prepare demand forecasts and capacity planning (Shapiro, 2007). For this study, transactional IT systems are important in so far as they facilitate the sharing of information between supply chain partners. Analytical IT systems are also relevant as they facilitate the decision making required to optimise supply chain operations. A comparison of analytical and transactional IT in terms of six aspects is depicted in Table 5.2 below.

Table 5.1: Comparison of Analytical and Transactional Information Technology (Shapiro, 2007)

	Transactional IT	**Analytical IT**
Time Frame Addressed	Past and present	Future
Purpose	Communication	Forecasting and decision making
Business Scope	Myopic	Hierarchical
Nature of Databases	Raw and lightly transformed objective data	Raw, moderately transformed, and heavily transformed data that are both objective and judgmental
Response time for queries	Real time	Real time and batch processing
Implications for business process change	Substitute for or eliminate inefficient human effort	Coordinate overlapping managerial decisions

As can be seen from Table 5.2 above, the transactional IT systems are important for the coordination of supply chain efforts. However, analytical IT systems are also required to improve decision making across the entire supply chain.

In this section, supply chain systems such as: Enterprise Resource Planning (ERP), Distribution Requirements Planning (DRP), Material Requirements Planning (MRP), EDI and the Automotive Network Exchange are discussed in terms of their use in the sharing of information between supply chain partners.

5.4.1. Enterprise Resource Planning Systems

ERP systems include software and hardware that facilitate the flow of transactional data in a supply chain relating to manufacturing, logistics, finance, sales and human resources (Shapiro, 2007). In principle, ERP systems integrate all business applications to provide a central system for decision making. ERP systems are essential in supply chains as they are responsible for sharing both transactional data as well as supporting decision making (Vollmann, Berry, Whybark, & Jacobs, 2005). There is a human element to this decision making; therefore, ERP systems

cannot eliminate trust issues in the supply chain entirely. Thus, the use of ERPs is insufficient to establish trust in inter-organisational relationships and therefore controls will need to be established. The use of controls is described in section 5.6.4.

ERP implementations have not been as successful as was intended. Shapiro (2007) highlights the limitations of ERP in a supply chain context:

1. *Imposed Conformity*: ERP systems have rigid requirements that inhibit the way a company operates its business. This may require a change of business processes, which is an important barrier to implementing IT in supply chains (as discussed above).

2. *Hidden Costs*: These costs include training, integration, testing, customisation, data conversion and consulting support. These costs are a significant barrier for implementation by smaller suppliers in the supply chain.

3. *Inability to Employ Software from Multiple Vendors*: Modules from multiple vendors cannot be integrated. Thus, the entire supply chain is required to buy into to a single vendor.

4. *Incompatibility of ERP Systems Across the Supply Chain*: The OEMS cannot easily integrate supply chain databases with supply chain partners, especially where cost is a barrier to smaller companies.

These limitations to ERP implementation are significantly similar to the barriers for IT implementation in supply chains previously discussed. These ERP systems are effective at sharing information across the supply chain provided that the barriers to implementation are overcome. Thus, if compatible ERP systems are implemented across the supply chain and are appropriately used by all supply chain members, information sharing and trust can be enhanced in the supply chain.

5.4.2. Distribution Requirements-Planning System

A DRP system forecasts production requirements across the supply chain based on demand order information (Shapiro, 2007). Data from this system is used to schedule shipments across the network to ensure just-in-time (JIT) arrival of components for production (Vollmann, *et al.*, 2005). Thus, the effective use of a DRP system is essential for the success of lean manufacturing initiatives which ensure efficiency across the supply chain.

Information relating to the planning of production needs to be shared with all supply chain partners in order to optimise supply chain operations. Thus a DRP is an important system for the enhancement of information sharing in the supply chain. The information shared by a DRP is closely related to the information available from a MRP, which is discussed in the next section.

5.4.3. Materials Requirement-Planning System

A MRP system develops the requirements for raw materials to be used in production for the day (Shapiro, 2007). The information from this system is important for production scheduling throughout the supply chain. Similar to a DRP, this data is necessary to ensure JIT and lean manufacturing standards are met. As mentioned previously, lean manufacturing improves the effectiveness and efficiency of the supply chain and hence improves the supply chain's competitiveness.

Uncertainty in information shared between supply chain partners leads to inefficient materials requirement planning (Vollmann, *et al.*, 2005). If uncertainty in this type of information exists, supply chains hold buffer stock which hinders efficiency of the supply chain. Thus, there is a requirement that supply chain partners trust the information received from this system in order to effectively act on it.

Again, the concepts raised in earlier discussions of the Prisoner's Dilemma are relevant in this context. If all parties are sharing the required information for the

MRP and not withholding information, then uncertainty is reduced and trust enhanced. However, if a supply chain partner withholds information and acts opportunistically, trust is diminished in the inter-organisational relationship.

The use of EDI has been well-established in supply chains. Although EDIs have largely been replaced in automotive supply chains, there are still some supply chains relying on this form of inter-organisational system to manage the supply chain. This is discussed in the next section.

5.4.4. Electronic Data Interchange

EDI has proven to improve coordination and integration of inter-organisational relationships. Hill and Scudder (2002, p. 376) define EDI as *"computer-to-computer transmission of standardised business transactions"*. This is largely transactional data that is required in order to analyse and make decisions for supply chain operations.

Chrysler, Ford and General Motors have historically prescribed the use of EDI in their supply chains. However, the promised benefits of EDI adoption cannot be realised if the suppliers' business processes are dysfunctional. Implementing EDI across the supply chain can require significant business process reengineering in the weaker supply chain partners. Again, this coincides with the barriers to the effective use of IT previously discussed.

Benefits expected from EDI adoption include:

1. Increased inventory turns.
2. Increased on-time shipments.
3. Reduced premium freight costs.
4. Reduced error rates.
5. Reduced costs for unplanned changeovers.

6. Reduced labour for order fulfillment.

Thus, increasing information sharing between supply chain partners through the use of EDI can lead to reduced uncertainty and consequently improve the performance of the supply chain as a whole. However, Childerhouse, Hermiz, Mason-Jones, Popp and Towill (2003) believe that the information flow from EDI is far from ideal. The potential implementation concerns are listed below:

1. *Multiple Standards*: There are multiple industry-specific standards so a company with multiple business interests (for example supplying products to multiple supply chains) has to face dealing with multiple standards.

2. *Inflexibility*: EDI is designed on a one-size-fits-all basis and it may not meet the exact needs of any particular supply chain.

3. *Limited Function*: EDI is primarily designed around transaction processing. It may not cope with other kinds of information sharing such as databases, barcodes and images.

4. *Fixed Operating Mode*: EDI is batch-operated and works only in operational windows.

5. *Cost*: There is a high financial and resource cost to installing EDI which discourages participation by small and medium-sized companies. These costs are further exacerbated by the costs of reengineering business processes to match the requirements of the system implemented.

The implementation concerns associated with EDI outweigh the costs and issues associated with implementing newer supply chain technologies. For this reason, EDI is still widely used to manage supply chain relationships. This can be largely attributed to the high cost of migration to a newer system which would affect all members of the supply chain.

However, these implementation issues are likely to be a hindrance to the effective flow of information between supply chain partners, thus effective and efficient supply chain relationships are not realised through the use of EDI. Additionally if competing supply chains have migrated to the use of newer IT systems, EDI will be a significant barrier to supply chain competitiveness. The final IT system described in the section below is the Automotive Network Exchange.

5.4.5. Automotive Network Exchange

A new trend to emerge in supply chain management is the formation of online business communities. Some automotive manufacturers have made an attempt in the form of the automotive network exchange (Jharkharia & Shankar, 2004). The OEMs intend the automotive network exchange to become the standard method for suppliers to communicate and obtain order information.

Ford and General Motors were the first OEMs to insist on suppliers connecting to this network (Shapiro, 2007). However, these attempts have largely failed as organisations are skeptical about the security of information shared in this manner. Additionally, as not all supply chain members committed to this information sharing forum, the Prisoner's Dilemma trade-off was evident.

Having considered the various IT options for facilitating supply chain information flows, it is important to consider the strategies and critical success factors for the implementation of IT in supply chains.

5.5. Strategies and Critical Success Factors for the Implementation of Information Technology in Supply Chains

Gunasekaran and Ngai (2004) proposed a framework based on a literature survey on IT in supply chain management. This literature pointed to the major strategies, enabling technologies and critical success factors for implementing IT for supply chain management. In order for IT to be used effectively in the supply chain and to ensure that information sharing is optimised between supply chain partners the six

concepts in this diagram (Figure 5.2) need to be catered for by the organisation (or supply chain) to enhance trust.

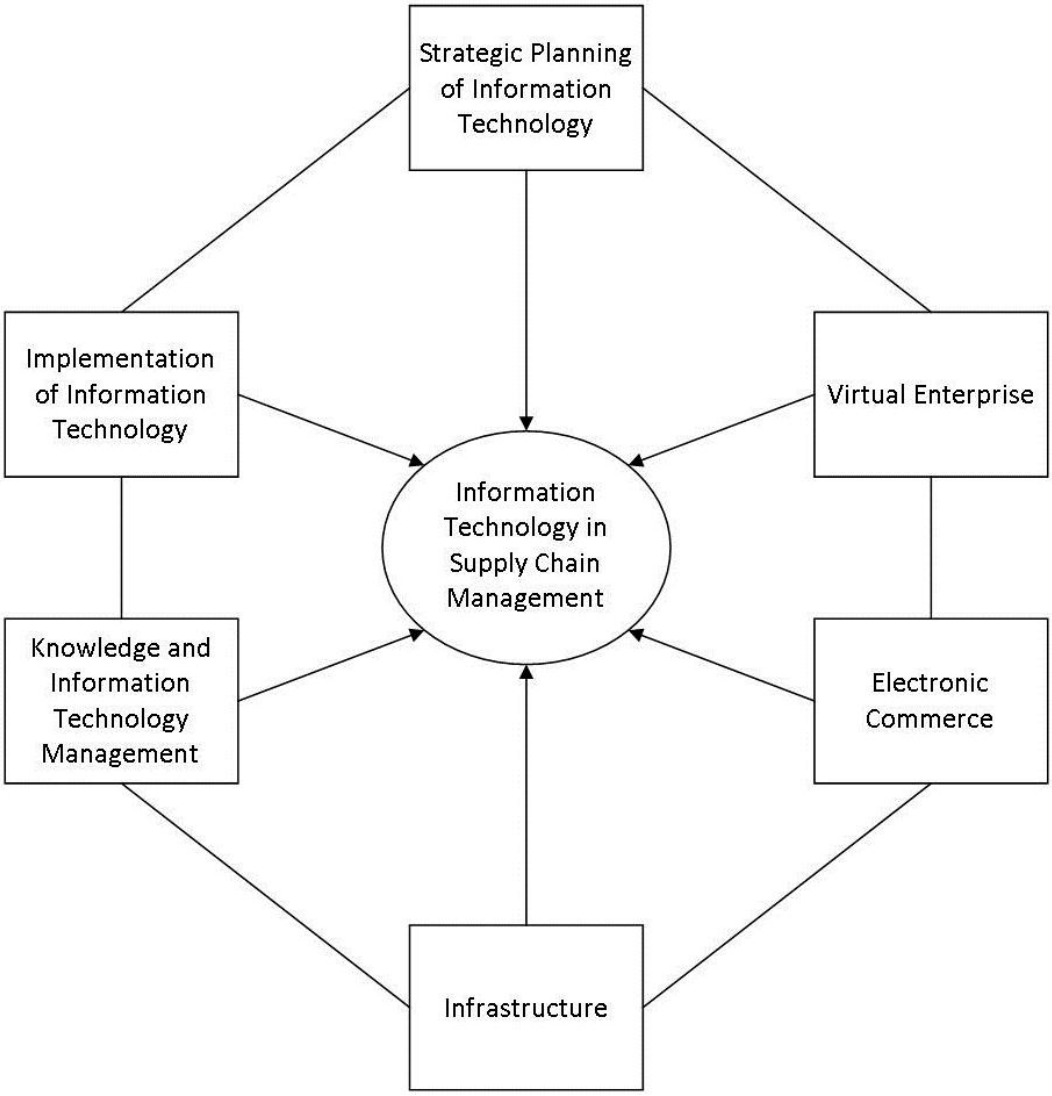


Figure 5.2: A Framework for the Development of Information Technology for Effective Supply Chain Management (Gunasekaran & Ngai, 2004)

As described in the previous section, in order to ensure information flow in the supply chain is optimised so that trust is enhanced among supply chain partners, the successful implementation of IT in the supply chain is necessary. The framework in Figure 5.2 addresses the major elements that need to be addressed to optimise the use of IT in supply chain management, namely: strategic planning of IT, virtual enterprise, e-commerce, infrastructure, knowledge and IT management, and implementation of IT. These are discussed in the sections that follow.

5.5.1. Strategic Planning

The objective of this component of the framework is the long-term decision making in terms of selecting and implementing appropriate IT for the supply chain (Gunasekaran & Ngai, 2004). Determining and then implementing the appropriate IT in the supply chain ensures an effective and well-connected supply chain, which shares sufficient information and therefore enhances trust.

Top management participation is important in this decision making process as the implementation of IT may require changes to business processes. In this regard, decisions about implementing IT can either be dictated by the OEM (in the channel master approach) or decided on by the entire supply chain (in the chain organism approach). Thus, again choice of governance approach in the supply chain is important.

Gunasekaran and Ngai (2004) provide the following examples of strategic planning for IT in supply chain management:

1. Implementing an IT system aids effectiveness and allows the supply chain to compete in a market that values speed of delivery and quality.

2. Supply chains and the individual supply chain members compete along several performance objectives. This requires cost reduction which can be achieved through an Internet-enabled supply chain management system which optimises information sharing and thereby enhances trust.

3. Companies have to restructure business processes to achieve lean manufacturing by implementing IT that eliminates non-value-adding activities in the supply chain.

Some supply chains overlook the need to ensure IT compliance throughout the supply chain for long-term benefit (Shapiro, 2007). Within a few years the supply chain could lose its competitive edge if certain members of the supply chain have

not implemented the chosen IT system. Supply chains need to leverage their strategic alliances in order to develop their strategy for implementing IT.

These concerns about ensuring the IT systems have been implemented and are used appropriately by all supply chain members have already been raised as barriers to the effective implementation of IT in a supply chain environment. The next factor is the virtual enterprise which makes use of IT to optimise the agility of the supply chain.

5.5.2. Virtual Enterprise and Supply Chain Management

The virtual enterprise is an important strategic application of IT to improve agility of the supply chain. Gunasekaran and Ngai (2004) believe that partner selection in a virtual enterprise environment is crucial to effective operation of the supply chain. The criteria for selection of these partners bears resemblance to the determinants of trust between supply chain partners (as discussed in Chapter Three), for example: past performance, strategic objectives, infrastructure, IT systems and skills. These criteria are comparable to Mayer, Davis and Schoorman's (1995) ability, benevolence and integrity.

Virtual logistics within the supply chain can be done through the implementation of ERP systems such as SAP, BAAN, JD Edwards and ORACLE. The successful development of a virtual enterprise is reliant upon sufficient skills in JAVA, XML and web development (Shapiro, 2007). Gunasekaran and Ngai (2004) advocate this virtual enterprise approach for large, complicated supply chains such as those found in the automotive industry. In order to be successful in this type of initiative, each company needs to evaluate the IT systems that support their integration with their supply chain partners. Thus, the choice of IT system for the supply chain is relevant.

The use of ERP systems in managing inter-organisational relationships was discussed in the previous section. These ERP systems are effective at sharing information across the supply chain provided that the barriers to implementation

are overcome. E-commerce is the next factor in the model; however, this has limited use in the automotive supply chain. This is briefly described in the following section.

5.5.3. E-commerce and Supply Chain Management

E-commerce facilitates communication and collaboration in inter-organisational relationships. The benefits of this include reduced cycle times and the opportunity to expand markets (Gunasekaran & Ngai, 2004). However, the use of e-commerce is promoted for use in smaller, less complicated supply chains and is thus not relevant for use in the large, complicated network of automotive suppliers. Infrastructure questions for implementation have been crucial in the determination of the successful application of IT in supply chains and are discussed in the next section.

5.5.4. Infrastructure for Information Technology in Supply Chain Management

As established in Chapter Four, the sharing of information in the supply chain is an important consideration for this research project. This study seeks to ensure that trust is enhanced in the supply chain through the use of IT, and information sharing has been established as a contributing factor to achieving this. In respect to information sharing, there exists a trade-off between the quantity and quality of the information shared and the speed of access to this information, thus the use of IT is important to facilitate real-time access to quality information. Strategic alliances or the appointment of an IT firm that oversees all technology-related issues in the supply chain may aid in this (Gunasekaran & Ngai, 2004).

Typically, failure occurs when companies do not recognise their short comings in terms of aligning business processes to the IT systems they are required to implement (Shapiro, 2007). Additionally, the adoption and specifications of the system to be implemented may not be agreed upon by all the organisations within the supply chain. Poor IT infrastructure can be blamed on a lack of funds in smaller

supply chain partners, or a lack of top management support in more powerful organisations (Jharkharia & Shankar, 2005). These shortcomings have previously been described as barriers to IT implementation.

Compatibility of the systems is an important related issue (which has been also been discussed previously). Disparities between supply chain organisations in terms of size and policies are also important factors in incompatibility (Jharkharia & Shankar, 2005). As discussed previously, this is largely a governance issue and can have significant consequences for the supply chain.

The use of IT to manage supply chain knowledge about expectations is also of importance, thus it is discussed in the next section.

5.5.5. Knowledge and Information Technology Management

The most appropriate application of this aspect is to manage the required knowledge about market and supply chain expectations (Gunasekaran & Ngai, 2004). Web-based information systems are appropriate for this application. Data mining and warehousing techniques are required in order to ensure the right information is available at the right time in order to facilitate effective decision making.

This knowledge needs to be shared within the supply chain in order to optimise supply chain operations. Sharing this kind of information with supply chain partners signals commitment and thus enhances the level of trust between supply chain partners. Thus, this is an important factor for this research project and highlights the importance of sharing information with supply chain partners to enhance trust, improve decision making and ultimately enhance supply chain efficiency and effectiveness.

In order to ensure IT systems are used effectively in the supply chain, implementation issues need to be considered and dealt with. The final component considers implementation issues and is detailed below.

5.5.6. Implementation Issues of Information Technology in Supply Chain Management

A well-documented plan for the implementation of IT across the supply chain is key to success. This is especially needed when the implementation of IT requires changes to business processes (Gunasekaran & Ngai, 2004). As described previously, changes to business processes can be a significant stumbling block to successful implementation of IT. Thus, interventions at a supply chain level are necessary to ensure these are overcome.

Agreement needs to be reached to allow IT implementation in all supply chain organisations. This section is similar to the discussion in section 5.3. These implementation issues were considered to be barriers to the successful use of IT in supply chain relationships.

As the IT facilitates the flow of information which in turn helps in the enhancement of trust, it is necessary for supply chain partners to trust the IT used to transmit the information. The components of System Trust and the technologies that have been shown to undermine trust are discussed in the next section.

5.6. System Trust

Cripps, Salo and Standing (2009) define System Trust as:

> *"The subjective probability by which organisations believe that the underlying technology infrastructure is capable of facilitating transactions according to their confident expectations."*

Kleist (2004) refers to electronic trust as being the application of technology to build trust by controlling rational errors in the system. Important aspects of System Trust are authentication, verification, non-repudiation and reliability.

1. *Authentication* is the mechanism that identifies the participant in the exchange.

2. *Verification* establishes that the party to the information exchange is indeed the intended participant.

3. *Non-repudiation* allows tracking of information exchanges in order to ensure accountability for the information exchanged.

4. *Reliability* refers to the accuracy of the information exchanged.

These aspects of System Trust are significant for enhancing trust in the inter-organisational relationship. If these aspects are satisfied, a supply chain partner is more likely to be willing to share information through the IT system. This in turn leads to the formation of a trusting relationship with supply chain partners. This is confirmed by the Prisoner's Dilemma discussions in previous chapters.

Trust in the inter-organisational systems is seen to be an important factor in the optimal use of these systems in creating supply chain competitive advantage (Cripps, *et al.*, 2009). However, it also needs to be considered that using IT in inter-organisational relationships also impersonalises the relationship, which can have a resultant negative affect on trust in the relationship.

A balance between trust and IT-enablement of the supply chain is needed (Lee & See, 2004). This is depicted in Figure 5.3. This emphasises that when trust exceeds the capabilities of the system, this leads to overtrust and misuse. Conversely, where trust falls short of the capabilities of the system, this leads to distrust and disuse. Where trust and the system capabilities match, this is referred to as calibrated trust and appropriate use of the IT systems in place.

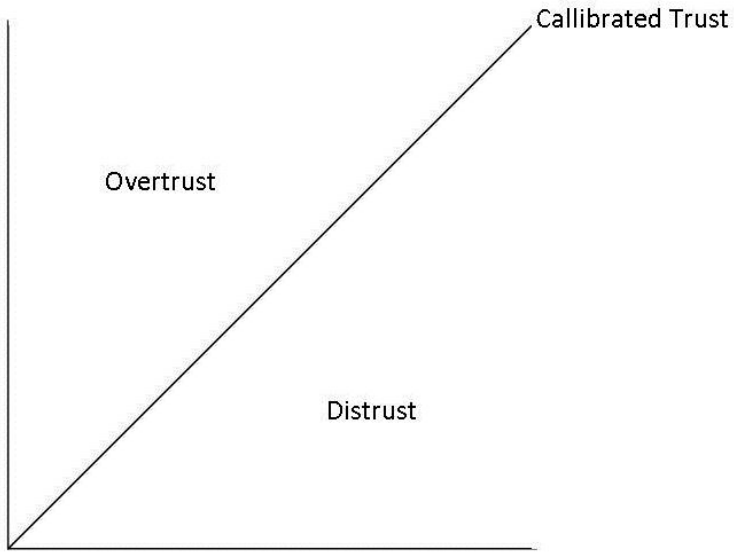


Figure 5.3: The Relationship Between Trust and Information Technology (Lee & See, 2004)

Gao and Lee (2005) summarise the key components of System Trust in supply chain technology that is expected to result in more appropriate reliance and avoid unintended competitive behaviour caused by inappropriate use of technology. These are purpose, performance and process. This is comparable to the three components proposed by Cheng, *et al.* (2007), namely: nature of use (performance), nature of processes (process), and Nature of IT (purpose).

In addition to these components of System Trust, the use of controls to manage the use of IT in a supply chain relationship has been advocated in the preceding chapters. This, therefore, is also discussed in relation to System Trust. All these components are important in the creation of the model for enhancing IT in supply chains through IT which is described in Chapter Eight.

5.6.1. Purpose

The purpose of the IT used can often be misunderstood, thus all supply chain partners need to ensure a common understanding of the purpose and intended use of the technology managing the relationship (Gao & Lee, 2005). If the purpose is not understood by all supply chain partners, this can lead to poor decision making based on information provided by the IT system. Thus, communicating the purpose

of the IT system and the information provided by it is essential to efficient and effective supply chain operations.

5.6.2. Performance

Feedback regarding the performance of the IT managing the relationship can promote appropriate reliance (Gao & Lee, 2005). This element of System Trust is related to the competence construct studied in Chapter Three. All supply chain partners need to be confident in the performance of the IT system and the information shared by it. This assists in establishing trust in the inter-organisational relationship.

5.6.3. Process

The process that needs to be followed in using the technology needs to be communicated and adhered to by all supply chain members (Gao & Lee, 2005). This requires business processes to be adjusted according to those required by IT systems and has been discussed previously in section 5.3.2.

5.6.4. Controls

As establishing trust in inter-organisational relationships using IT systems can be complicated by the lack of personal contact, an element of risk in the relationship is established. Controls can be used to manage the level of risk in the supply chain relationship. Although costly to implement, controls reduce the likelihood of supply chain partners acting contrary to the supply chain's best interests, despite the lack of inter-personal contact in the supply chain.

Kramer (1999) points out that when trust does not exist within an inter-organisational relationship, substitutes need to be established. However, such substitutes, which include control measures, often result in inefficiency and additional costs. It is, however, acknowledged that the existence of trust in supply chain relationships reduces the need for formal control mechanisms which are costly to implement, monitor and enforce (Dyer & Chu, 2002).

In relation to controls, there has been much enthusiasm exhibited in the use of IT to remedy existing trust-related issues in inter-organisational relationships. Evidence of this, provided by Kramer (1999), include electronic monitoring of supplier activities. Adopting such technologies is advocated in order to ensure compliance with regulations and deter misbehaviour. However, some authors have found that these technologies may actually serve to hinder trust rather than promote it.

Thus, where System Trust is not established in an inter-organisational relationship, control mechanisms need to be implemented to mitigate the risk in the relationship. This, however, does not result in effective and efficient supply chain operations, thus for optimal supply chain performance a balance between System Trust and controls needs to be established. This is discussed in the context of the model for enhancing trust through the use of IT in Chapter Eight.

5.7. Conclusion

From the literature survey it has been noted that the most important impact IT has in the supply chain is related to the sharing of information which enhances decision making. This is an important observation for this research project which is investigating the enhancement of trust in inter-organisational relationships. As described in Chapter Four, information sharing is important in the establishment of trust and thus the use of IT in this regard is significant.

In addition, the literature has shown that there are considerable barriers to IT implementation in supply chains. These are exacerbated in large supply chains such as those found in the automotive industry. These barriers need to be overcome in order to optimise the use of inter-organisational systems. The barriers that have been suggested by literature include the cost of implementing an inter-organisational system, the resistance and cost related to redesigning business processes, concerns regarding the security of information shared, and the requirement of willingness by supply chain partners to participate in the supply chain relationship by sharing information.

The literature points to several possible intra-organisational systems that can be implemented in order to ensure optimal information flow in the supply chain. Several of these systems were described in this chapter. Information sharing is beneficial with regards to coordinating the supply chain and reducing uncertainty in the supply chain. Strategies and critical success factors for the implementation of IT were also outlined. These need to be considered in order to promote sufficient information flow in the supply chain

The literature survey has also provided an analysis of the concept of System Trust. Without establishing System Trust, any IT system implemented in the inter-organisational relationship will not be sufficient to promote information sharing, and thereby enhance trust. The dimensions of System Trust: purpose, performance and process, need to be considered in order to ensure trust in systems and therefore optimal information flow. In addition, control mechanisms as an alternative to establishing System Trust also need to be considered.

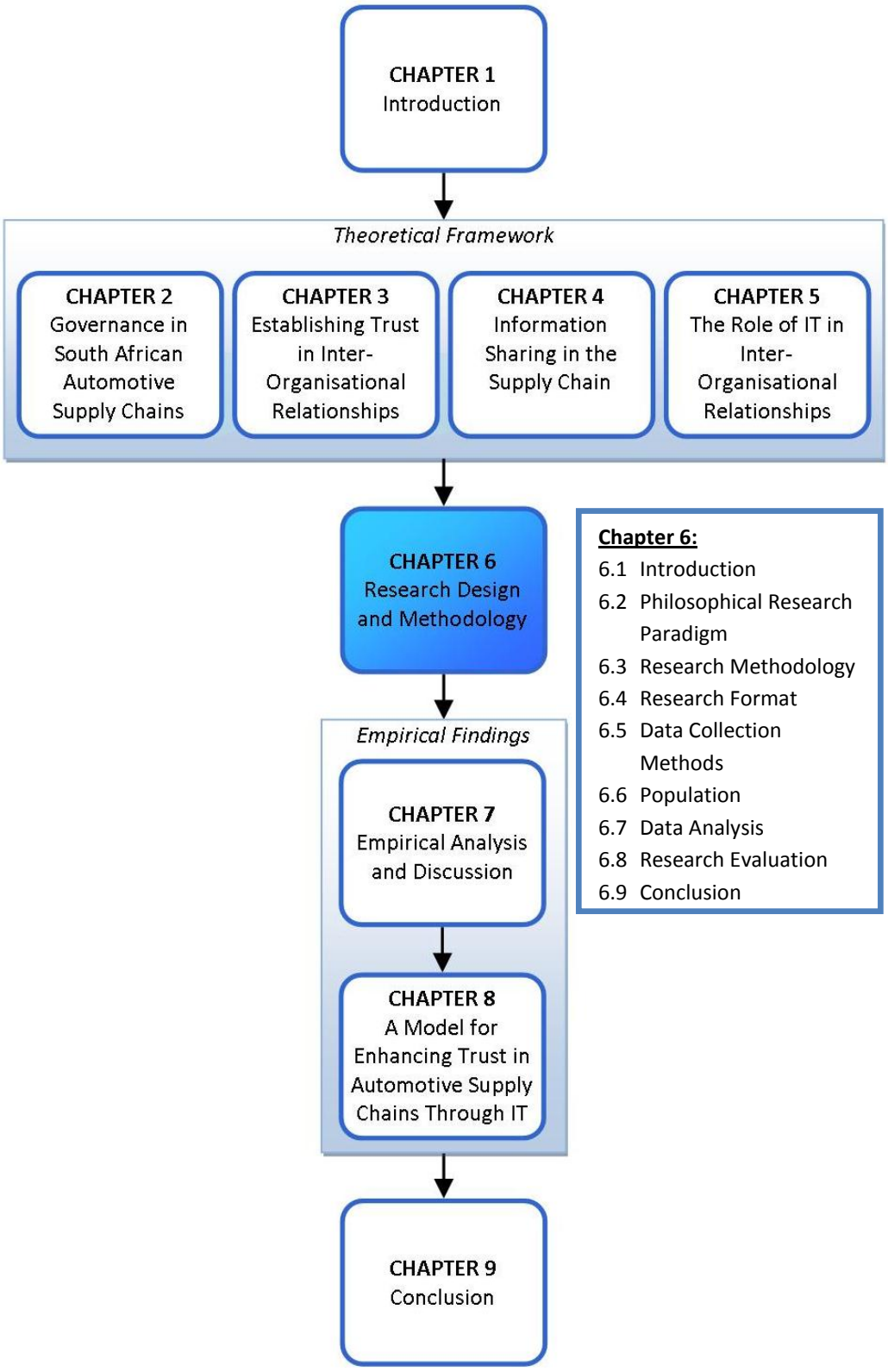
Having established a theoretical base for this study in the preceding chapters, the research design and methodology need to be described. The preceding chapters have dealt with the relevant elements of this research project, namely governance of supply chain relationships, the philosophical issue of trusting supply chain partners, sharing information as a means of promoting trust and the use of IT to manage the inter-organisational relationship. With this theoretical base as a starting point, empirical work needs to be conducted to investigate the use of IT to enhance trust in automotive supply chains. The approach to conducting this empirical work is described in the next chapter.

Chapter 6:

Research Design and Methodology

"Several issues that are problematic in more conventional research can be largely overcome with more creative methodologies and considered preparation."

(Ayling and Mewse, 2009)



6.1. Introduction

As argued in Chapter One, information sharing can be disrupted through insufficient trust amongst supply chain partners, which leads to ineffective and inefficient operations in the supply chain. This is attributed to ineffective decision making when insufficient information is available to all supply chain partners. Thus, both insufficient trust and information sharing are viewed as contributing factors to the ineffectiveness and inefficiency of a supply chain's operations and the resultant negative effect on competitive advantage.

As Information Technology (IT) is instrumental in facilitating inter-organisational relationships, in particular information sharing, it is appropriate to ensure that IT is leveraged for maximum benefit. Thus, the objective of this research project is to formulate a model that can be used to enhance inter-organisational trust in automotive supply chains through the effective use of IT. The theoretical aspects of this research problem have been explored in the preceding chapters.

The research method applied was influenced by the research project's objectives (stated above). By describing the theoretical aspects of the chosen method, the aim of this chapter is to illustrate how the study was conducted and how the results were derived. This chapter is important to show the link between the chosen method and how it enables the research objectives to be addressed.

This study is conducted within an interpretivist paradigm and follows the qualitative approach consistent with this paradigm. The Design Science Methodology, which aims to create and evaluate IT artifacts, is followed in this research project. In this study the artifact is a model to enhance trust in automotive supply chains through IT. As the Design Science Methodology is characterised by an iterative approach, the Delphi technique is used to evaluate the artifact developed. The methods used to collect the empirical data for this research project were case study, web-based questionnaires and expert reviews.

This chapter details the selected research methodology for this study. First, the philosophical research paradigm is described. Next the chosen research methodology is outlined and the research format discussed. Following which a discussion of the primary and secondary data collection methods, the population of the study and data analysis methods are provided. This chapter concludes with a discussion of how the credibility of the study can be evaluated.

6.2. Philosophical Research Paradigm

Any research will have an underlying research paradigm that guides how the research should be conducted (Collis & Hussey, 2009). There are several paradigms that exist which can be distinguished by the philosophical assumptions on which they are based. This section discusses the research paradigm appropriate for this study.

A research paradigm can be defined as a way of viewing the research material on hand (De Vos, Strydom, Fouche, & Delport, 2005). Similarly, Oates (2006) defines a research paradigm as a pattern, model or shared way of thinking that underlies any research undertaking. Additionally, a paradigm refers to a set of general philosophical assumptions about the nature of the world (referred to as ontology) and how we understand it (referred to as epistemology) which is shared by researchers working in that area (Maxwell, 2005).

Often in IT disciplines, researchers concentrate on creating IT artifacts and do not consider the underlying research philosophy (Oates, 2006). This is problematic as the research methodology is underpinned by a particular research philosophy. The researcher therefore needs to decide within which paradigm the research project will be conducted in order to determine the correct methodology to embrace.

Maxwell (2005) makes four important points about selecting research paradigms, notably:

1. It is important to select an appropriate research paradigm to guide research design decisions and to justify these decisions.

2. Using an established paradigm allows the researcher to use an appropriate approach to research of this nature.

3. It is possible and often necessary to adopt aspects of different paradigms.

4. Choosing a paradigm involves assessing which paradigm best fits the researcher's assumptions and methodological preferences.

As De Vos, *et al.* (2005) point out, each discipline accommodates a variety of competing paradigms. The important point here is that all scientific research is conducted within a paradigm, the choice of which is determined by the paradigms appropriate to that discipline and the nature of the research undertaken.

Oates (2006) recognises three philosophical paradigms in IT research, namely: positivism, interpretivism and critical research. Meanwhile, Collis and Hussey (2009) limit the discussion of paradigms to positivism and interpretivism. In addition, Vaishnavi and Kuechler (2008) motivate the inclusion of Design Science as an emerging research paradigm in IT research. Thus, the sections below outline the positivist, interpretivist, critical and Design Science research paradigms. This is followed by a comparison of the fundamental differences between the paradigms and a motivation for the selection of the appropriate research paradigm for this study.

6.2.1. Positivism

The positivist paradigm is considered the oldest research paradigm. It is the traditional approach for scientific studies (De Vos, *et al.*, 2005). However, as Collis and Hussey (2009) acknowledge, it is an approach still widely accepted in social science studies (including IT research that considers environmental and behavioural aspects). According to Oates (2006), the positivist approach is based on two assumptions:

1. The world is ordered and regular, not random.

2. The world can be investigated objectively.

Thus, social reality is singular and objective and is not affected by the act of investigating it (Collis & Hussey, 2009). The positivist approach usually relies upon experiments to look for evidence of cause and effect (Oates, 2006). Developed hypotheses and collected evidence from these experiments is used to confirm or refute the initial hypotheses.

Positivistic studies can be characterised by the following (Oates, 2006):

1. *The World Exists Independently of Humans*: There is a physical and social world that exists to be studied, captured and measured.

2. *Measurement and Modeling*: This world is observed and measured and models, hypotheses or theories of how it works are produced.

3. *Objectivity*: The researcher acts as an impartial observer and the facts are discovered independently of the researcher's personal values and beliefs.

4. *Hypothesis Testing*: The research is based on empirical testing of hypotheses which are either confirmed or refuted.

5. *Quantitative Data Analysis*: Mathematical modeling and statistical analysis provide a logical and objective means of analysing observations and results.

6. *Universal Laws*: Positivist researchers aim to produce generalisations that are shown to be true regardless of the researcher and occasion.

As positivist research is objective and therefore not influenced by the researcher, results achieved can be repeated by a second researcher who undertakes the study (Olivier, 2004). This is contrasted by the interpretivist paradigm which is subjective and relies upon the researcher's social context. This paradigm is described next.

6.2.2. Interpretivism

According to Collis and Hussey (2009), the interpretivist paradigm emerged in response to criticisms of positivism. The interpretivist paradigm can be traced to German sociologist Max Weber and German philosopher Wilhelm Dilthey (De Vos, *et al.*, 2005). This paradigm aims to understand IT as a practice constructed and developed by humans (Oates, 2006). Thus, interpretivism seeks to understand the social context of IT.

Interpretivism does not aim to prove or disprove hypotheses as is done in positivist research, but rather to identify, explore and explain how the factors in a social setting are related and interdependent (Oates, 2006). In the context of this study, the social setting is the inter-organisational relationships in an automotive supply chain. Therefore, factors relating to the effective and efficient operation of these inter-organisational relationships are studied in this research project. Thus, interpretivist studies aim to create a rich understanding of a unique context, such as the automotive supply chain.

Interpretivist studies can be characterised by the following (Oates, 2006):

1. *Multiple Subjective Realities*: There is no single version of the truth as each person perceives the world in a different way.

2. *Dynamic, Socially Constructed Meaning*: Language and shared meanings are used to transmit the understanding of reality and these differ across groups and time.

3. *Researcher Reflexivity*: The assumptions, beliefs, values and actions of the researcher inevitably affect the research process. Researchers therefore need to acknowledge their influence on the research.

4. *Study of People in their Natural Social Settings*: People are studied in their natural setting and not an artificial environment. Additionally,

the researcher's previous understanding or expectations must not be imposed upon the participants of the study.

5. *Qualitative Data Analysis*: There is a strong preference in this paradigm for generating and analysing qualitative data.

6. *Multiple Interpretations*: Researchers usually arrive at more than one explanation of their study, but discuss and motivate the explanation that appears most relevant.

As interpretivist research is relatively subjective in comparison to positivism, it can be influenced by the researcher's beliefs, values and actions (Olivier, 2004). This is contrasted by critical theory which is reliant upon economic, political and cultural influences. Critical theory is defined in the next section.

6.2.3. Critical Theory

Critical theory seeks not only to study and understand society, but to critique and change society (De Vos, *et al.*, 2005). This paradigm was influenced by Marxism and informed by the presumption of class conflict. Thus, De Vos, *et al.* (2005) define critical theory as providing a framework for approaching research as political.

Critical research goes beyond merely understanding IT practice, to challenge the power structures and assumptions about the development and implementation of IT artifacts (Oates, 2006). Researchers in this paradigm also view social reality as created by people with the addition of economic, political and cultural influences that shape this view of reality.

Critical research studies can be characterised by the following (Oates, 2006):

1. *Emancipation*: Critical researchers do not just aim to understand and explain, but also to empower people.

2. *Critique of Tradition*: Critical researchers do not accept the status quo, but rather challenge existing patterns of power and taken-for-granted assumptions.

3. *Non-performative Intent*: Critical researchers focus on maximising profits and enhancing manager's power and control.

4. *Critique of Technological Determinism*: Critical researchers reject the notion that people need to adapt to technology, but rather argue that people and society should shape the way technology is created.

5. *Reflexivity*: As with interpretivist research, critical researchers acknowledge the influence their own values, beliefs and actions have on the research.

Critical researchers criticise interpretive research for failing to analyse the patterns of power and control that regulate views of reality (Oates, 2006). Design Science is increasingly adopted as a complementary research paradigm in IT research. This emerging paradigm is outlined in the next section.

6.2.4. Design Science Paradigm

Vaishnavi and Kuechler (2008) motivate the inclusion of Design Science as an emerging research paradigm in IT disciplines. According to Hevner, March, Park and Ram (2004), there are two paradigms relevant to IT research, namely Behavioural Science and Design Science. The Design Science paradigm has also been referred to as the socio-technologist paradigm (Vaishnavi & Kuechler, 2008).

Behavioural Science develops and verifies theories that explain and predict human or organisational behaviour, while Design Science extends human and organisational capabilities through the creation of artifacts (Hevner, *et al.*, 2004). Thus, this paradigm is important for IT research which inherently incorporates people, organisations and technology.

Design Science is fundamentally a problem-solving paradigm which ensures that knowledge and understanding of a problem domain are achieved through the building and application of an artifact (Hevner *et al.*, 2004). Having defined each of the most relevant research paradigms, the following section compares them and justifies the selection of the interpretivist and Design Science paradigms for this research study.

6.2.5. Selecting an Appropriate Research Paradigm

The positivist approach was historically recognised as the norm for IT research (Oates, 2006). For this reason, interpretive and critical approaches are often judged harshly. However, interpretive research has been adopted more frequently in recent years, with Design Science emerging recently as a dominant paradigm in many research areas. Critical research is less well-known and accepted than the other philosophical paradigms within IT research.

When comparing the paradigms previously defined, it is necessary to consider the philosophical assumptions that underpin these paradigms, namely:

1. *Ontology*: This assumption describes the nature of reality.

2. *Epistemology*: This assumption explores the nature of knowledge and what constitutes valid knowledge.

3. *Axiology*: This assumption studies the role of values.

Table 6.1 (below) provides a summary of the contrasting assumptions in the positivist, interpretivist and Design Science paradigms.

Table 6.1: Assumptions of the Main Paradigms (Vaishnavi & Kuechler, 2008)

Philosophical assumption	Positivism	Interpretivism	Design
Ontological assumption	A single reality, knowable, probabilistic	Multiple realities, socially constructed	Multiple, contextually situated alternative world-states, socio-technologically enabled
Epistemological assumption	Objective, dispassionate, detached observer of truth	Subjective (i.e. values and knowledge emerge from the researcher-participant interaction)	Knowing through making (objectively constrained construction with a context), iterative circumspection reveals meaning
Axiological assumption	Truth, universal and beautiful, prediction	Understanding, situated and description	Control, creation, progress (i.e. improvement), understanding
Methodological assumption	Observation, quantitative, statistical	Participation, qualitative, hermeneutical, dialectical	Developmental, measure artifactual impacts on the composite system

It is important in multi-paradigmatic disciplines, such as IT, to consider the fundamental assumptions that form the base of the research paradigms (as is shown in Table 6.1). Before embarking on research, Collis and Hussey (2009) believe that the ontological, epistemological, axiological and methodological assumptions need to be considered in order to make an appropriate decision for the underlying philosophy of the research project.

The paradigm adopted for a study is influenced by the dominant paradigm in the research area and the nature of the problem under investigation. Collis and Hussey

(2009) identify the key features of the positivist and interpretivist paradigms in order to distinguish between them. Positivism tends to: use large samples; have an artificial location; be concerned with hypothesis testing; produce precise, objective, quantitative data; produce results with high reliability but low validity; and allow results to be generalised from the sample to the population. Interpretivism, on the other hand, tends to: use small samples; have a natural location; be concerned with generating theories; produce 'rich', subjective, qualitative data; produce findings with low reliability but high validity; and allow findings to be generalised from one setting to another similar setting.

Collis and Hussey (2009) provide a way of viewing the various views of reality held by researchers. This is shown in Figure 6.1 (below).

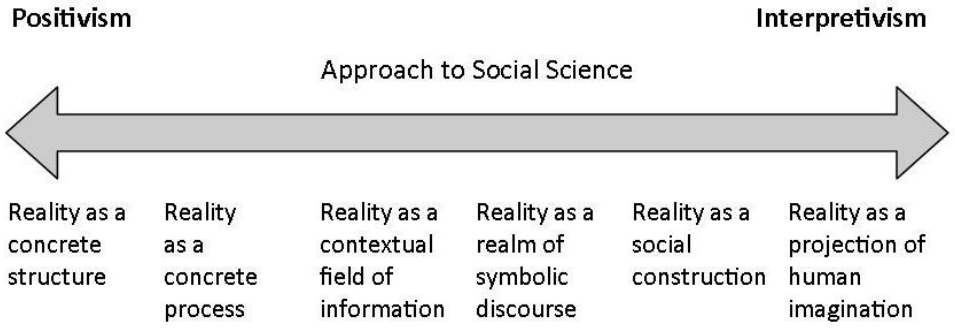


Figure 6.1: Typology of Assumptions on a Continuum of Paradigms (Collis & Hussey, 2009)

As illustrated in Figure 6.1, the positivistic and interpretivist approaches are two extreme research paradigms, with several research paradigms combining elements from these two extremes. Collis and Hussey (2009) explain that few people operate purely within any of these forms of research. Using a combination of the elements allows one to take a broader and often complementary view of the research problem or issue (Collis & Hussey, 2009).

This research project will focus on the means of enhancing inter-organisational trust through IT in automotive supply chains. Due to the subjective nature of the case studies that will be used in this study, an interpretivist influence will emerge in this study in line with the third stage (reality as a contextual field of information) of

the continuum represented in Figure 6.1. Additionally, the Design Science paradigm is influential in this research project as the study aims to create and evaluate an artifact.

The following section will discuss the research methodology chosen and the reason for its implementation in this study.

6.3. Research Methodology

The purpose of this study is to develop a model that can be used to enhance inter-organisational trust in automotive supply chains through the effective use of IT. For this purpose the Design Science Methodology is used in order to produce and evaluate an artifact (the model). Collis and Hussey (2009) point out that the researcher needs to choose a methodology that reflects the philosophical assumptions of the chosen paradigm. A research methodology is an approach to the process of research and encompasses a body of methods.

The chief distinction to be made between research approaches is that between quantitative and qualitative research methods. A quantitative approach is likely to use post-positivist claims to develop knowledge, for example: cause and effect thinking, hypotheses, measurement and observation and testing theories (Creswell, 2003). In comparison, a qualitative approach studies things in a social setting in order to interpret a phenomenon (Denzin & Lincoln, 2000).

Qualitative research methods are ideally suited to *"study social and cultural phenomena*" (Myers, 1997, p. 241) in the social sciences, however, due to the increasing importance of management and organisational issues (above traditional technology issues) in IT research, qualitative research methods are being used more frequently (Myers, 1997). These management and organisational issues are an important aspect of this study of the inter-organisational relationships in automotive supply chains.

The increased use of qualitative methods can be attributed to the value of an individual's natural ability to talk and provide insight into the social and cultural

context that is not considered in quantitative methods (Myers, 1997). This research project therefore uses qualitative research methods to gather the empirical data. This is in line with the interpretive paradigm selected for this research project.

As described in the previous section, this study aligns with both the interpretivist and Design Science paradigms. Thus, the selection of a qualitative approach and the Design Science Methodology is appropriate. Additionally, the Design Science approach is characterised as iterative and thus this study also draws on elements of the Delphi technique in order to evaluate the model created. Both the Design Science Methodology and Delphi technique are discussed in the sections that follow.

6.3.1. Design Science Methodology

As described previously, the goal of Design Science research is to create and evaluate IT artifacts in order to solve identified organisational problems (Hevner, *et al.*, 2004). Such artifacts generally take the form of constructs, models, methods or instantiations. As the purpose of this study is to develop a model that can be used to enhance inter-organisational trust in automotive supply chains through the effective use of IT, the Design Science Methodology is an appropriate research methodology.

The creation of the artifact, a model in the case of the research project, allows for understanding of the problem addressed and confirms the feasibility of the solution (Hevner, *et al.*, 2004). Carlsson, Henningson, Hratinski and Keller (2011) acknowledge the importance of Design Science research in producing novel IT design, as well as practical knowledge for IT governance and management. The four categories of artifacts can be described as follows (Hevner, *et al.*, 2004):

1. *Constructs* provide the language in which problems and solutions are defined and communicated.

2. *Models* are used to represent the real-world situation while aiding understanding of the problem and solution.

3. *Methods* define processes and provide guidance to solve problems.

4. *Instantiations* show that construct, models or methods can be implemented in a working system.

Figure 6.2 (below) represents Hevner, *et al.*'s (2004) conceptual framework for IT research that combines Design Science and Behavioural Science.

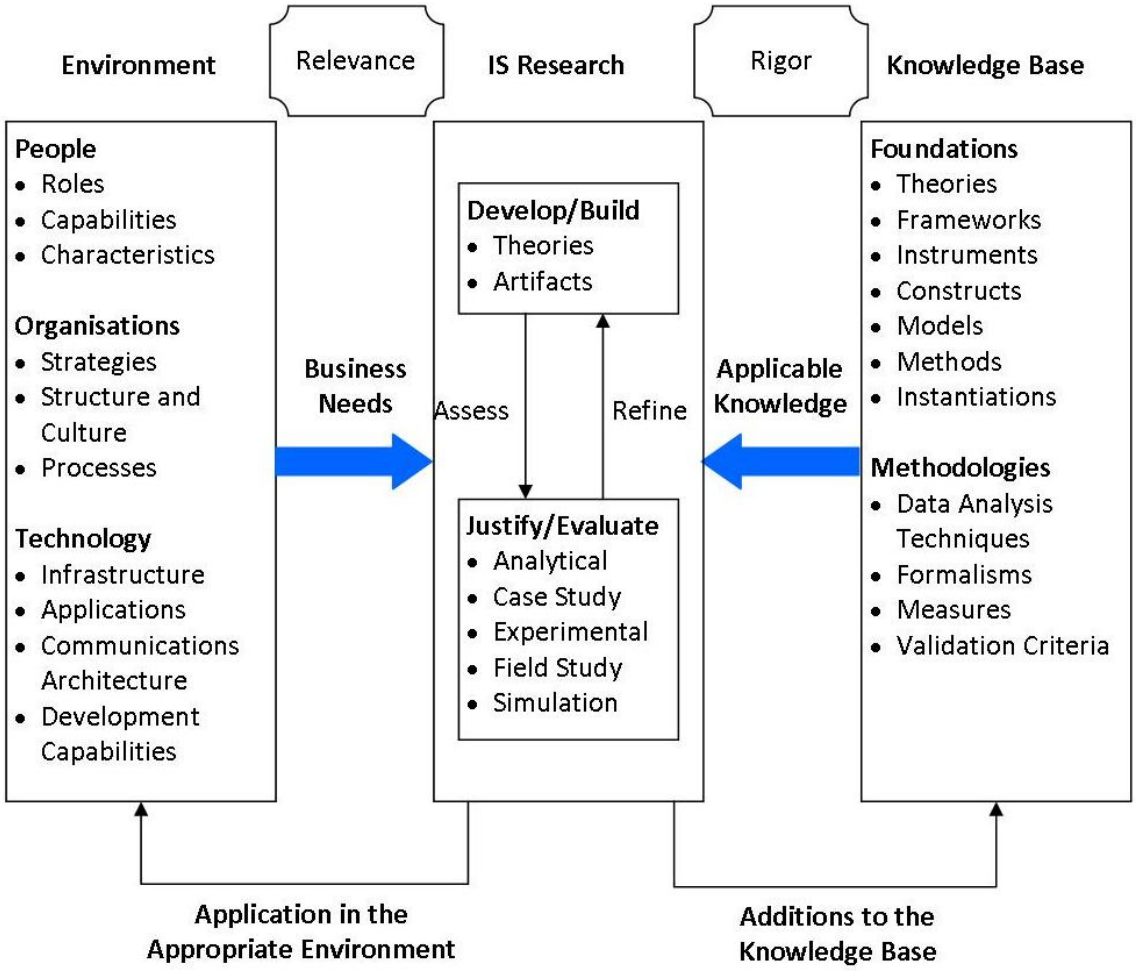


Figure 6.2: Information Systems Research Framework (Hevner, *et al.*, 2004)

In their research framework, Hevner, *et al.* (2004) recognise the impact of the environment and existing knowledge base on IT research. The environment refers to the context of the research, in this case the automotive supply chain. This environment is comprised of people, organisations and technology which together

define the business problem (depicted as business need in Figure 6.2). The knowledge base is composed of existing theories and methodologies that are used in the development of the research artifact. Considering the business need (environment side) and the existing theories and methodologies (knowledge base side), IT research is conducted in two stages, namely build and evaluate (Hevner, *et al.*, 2004).

There are different approaches to conducting Design Science research, each with a unique number of steps and method of conducting the research. In a recent study, Carlsson, *et al.* (2011) propose a simplified set of steps, namely: identify problem situations and desired outcomes; review extant theories, knowledge and data; propose or refine design theory and knowledge; and test design theory and knowledge. This approach to Design Science highlights the iterative nature of the testing of the artifact, as shown in Figure 6.3.

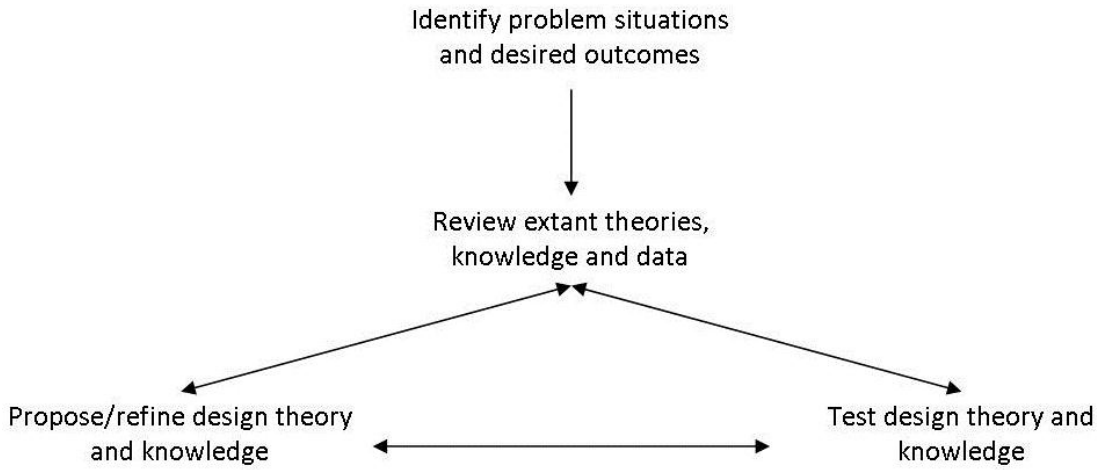


Figure 6.3: Socio-technical Design Theory Development (Carlsson, *et al.*, 2011)

Ahmad, Guy and Wasana (2011) provide a summary of the different steps used in Design Science studies conducted to this point. As is evident from this summary (provided in Table 6.2), a variety of options exist for a researcher operating within the Design Science arena.

Table 6.2: Design Science Activities/Steps/Tasks Proposed by Previous Studies (Ahmad, *et al.*, 2011)

Author	Steps	Design Science Activities/Steps/Tasks proposed						
Nunamaker, Chen and Purdin, 1991	5	Construct a conceptual framework	Develop a system architecture	Analyse and design the system	Build the (prototype) system	Observe and evaluate the system		
Walls, et al, 1992	7	Design Product				Design Process		
		Meta-requirements	Meta-design	Kernel theories	Testable design product hypotheses	Design method	Kernel theories	Testable design process hypotheses
March and Smith, 1995	2	Build				Evaluate		
Rossi and Sein, 2003	5	Identify a need	Build	Evaluate	Learn	Theorise		
Hevner, et al, 2004	7	Design as an artifact	Problem relevance	Design evaluation	Research contributions	Research Rigor	Design as a Search Process	Communication of Research
Vaishnavi and Kuechler, 2004	5	Awareness of a problem	Suggestion	Development	Evaluation	Conclusion		
Aken, 2004	4	Choosing a case	Planning and implementing interventions	Reflecting on the results	Developing design knowledge to be tested and refined in subsequent cases			
Cole, Purao, Rossi and Sein, 2005	4	Problem definition	Intervention	Evaluation	Reflection and Learning			
Venable, 2006	4	Solution technology inception	Theory building	Artificial evaluation	Naturalistic evaluation			
Peffers, Tuuanen, Rothenberger and Chatterjee, 2007	6	Problem identification and motivation	Define the objectives for a solution	Design and development	Demonstration	Evaluation	Communication	

Gregor and Jones, 2007	8	Compulsory						Optional	
		The purpose and scope	Constructs	Principles of form and function	Artifact mutability	Testable propositions	Justificatory knowledge	Principles of implementation	Expository instantiation
March and Storey, 2008	6	Identification and clear description of a relevant organisational IT problem	Demonstration that no adequate solutions exist in the extant knowledge-base	Development and presentation of a novel IT artifact that addresses the problem	Rigorous evaluation of the IT artifact enabling the assessment of its utility	Articulation of the value added to the knowledge-base and to practice	Explanation of the implications for IT management and practice		
Pries-Heje et al, 2008a	4	Risk Evaluation in Design Science research							
		Risk identification		Risk analysing		Risk treatment		Risk monitoring	
Pries-Heje et al, 2008b	8	Evaluation activity							
		Ex ante naturalistic design process	Ex ante naturalistic design product	Ex ante artificial design process	Ex ante artificial design product	Ex post naturalistic design process	Ex post naturalistic design product	Ex ante post design process	Ex ante post design product
Baskerville, Pries-Heje and Venable, 2009	7	A specific problem is identified and delineated	This problem must then be expressed as a specific set of requirements	The specific problem are systematically abstracted and translated into a general problem	General; solution design (a class of solutions) for the general problem	General design requirements are compared with the specific problem for fit	A declarative search is then made for the specific components that will provide a workable instance of a solution to the general requirements	An instance of the specific solution is constructed and deployed into the social system	

Having considered the various options for approaching Design Science research, this study adopts Hevner, *et al.*'s (2004) seven guidelines. This is the most widely cited set of guidelines for Design Science research and is thus relevant in this study. As pointed out by Hevner, *et al.* (2004), these guidelines provide a base point for conducting Design Science research. None of the guidelines are viewed as mandatory steps and it is up to each researcher to decide when, where and how to apply each of the guidelines to a specific research project. These guidelines, a description and their application in this research project are described in Table 6.3.

Table 6.3: Design Science Research Guidelines (Hevner, *et al.*, 2004)

Guideline	Description	Application
1. Design as an Artifact	Design Science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.	This study produces a model to enhance inter-organisational trust in automotive supply chains through the effective use of IT.
2. Problem Relevance	The objective of Design Science research is to develop technology-based solutions to important and relevant business problems.	In this study, the problem under investigation is that insufficient trust and insufficient information sharing contribute to the ineffectiveness and inefficiency of a supply chain's operations. A solution is sought in terms of the use of IT in this context.
3. Design Evaluation	The utility, quality and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.	The research model is evaluated through applicable data gathering and analysis techniques (as discussed in section 6.5 below).

4. Research Contributions	Effective Design Science research must provide clear and verifiable contributions in the areas of the design artifact, design foundation, and/or design methodologies.	The contribution of this study is the research model, which is considered a foundation contribution as it extends the knowledge base of the field.
5. Research Rigor	Design Science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.	In terms of rigor, the research project employed valid data gathering and analysis techniques, and the model was evaluated using expert review.
6. Design as a Search Process	The search for an effective artifact requires utilising available means to reach desired ends while satisfying laws in the problem environment.	This guideline was satisfied through the use of case studies to ensure applicability to the problem domain. Additionally, the iterative nature of the search process is achieved through the use of the Delphi technique.
7. Communication of Research	Design Science research must be presented effectively both to technology-oriented as well as management-oriented audiences.	This guideline is satisfied by the publishing of the journal article included as Appendix A. Another research paper outlining the contribution of this research project will be written.

In order to accommodate the iterative nature of the Design Science Methodology, the Delphi technique is used in the evaluation of the research artifact (model). Thus, the Delphi technique is described in the section that follows.

6.3.2. Delphi Technique

Several proponents of Design Science research stress the need for rigorous evaluation of the artifact produced in the research project. Generally this is shown

to be an iterative process, and thus the Delphi technique was adopted in this study in order to ensure the credibility of the research model.

Collis and Hussey (2009) define the aim of the Delphi technique as gathering opinions from carefully selected experts. The experts are sent questionnaires and responses are sent back to the researcher, who then collates the responses and seeks further feedback on the results. The process stops when the research question is answered, a consensus is reached or sufficient information has been exchanged (Skulmoski, Hartman, & Krahn, 2007). In order to understand the applicability of the Delphi technique to this study, it is necessary to consider the origins of the method.

The original Delphi method was developed in the 1950s. The original method is characterised by four key features (Skulmoski, *et al.*, 2007):

1. *Anonymity of Delphi Participant*s: Allowing for the free expression of opinions and responses to be assessed on merit.

2. *Iteration*: Allows for the refinement of results over a number of rounds.

3. *Controlled Feedback*: Allows for the opportunity to clarify responses received.

4. *Statistical Aggregation of Group Response*: Allows for quantitative analysis and interpretation of data.

Skulmoski, *et al.* (2007) identify ten factors that should be considered when employing the Delphi technique:

1. *Methodological Choices*: The classical Delphi technique is typically used as a quantitative technique, however, in modern methods the Delphi technique is often applied to interpretive, qualitative studies. This study is interpretive by nature.

2. *Initial Question – Broad or Narrow*: Typically the questions sent to participants are initially broad, open-ended questions, with subsequent rounds using focused, specific questions. This approach was used in this study.

3. *Expertise Criteria*: The participants in a Delphi study should meet four criteria: (i) knowledge and experience relevant to the research; (ii) capacity and willingness to participate; (iii) sufficient time to participate; and (iv) effective communication skills. These four criteria have been met by the experts engaged in for the evaluation of the research model.

4. *Number of Participants*: The number of participants in the Delphi study is dependent upon the goal of the study. This study made use of a sample of seventeen experts in the field.

5. *Number of Rounds*: The number of rounds is also dependent upon the nature of the study. This study made use of four rounds of review.

6. *Mode of Interaction*: The classic Delphi technique made use of pen and paper and was delivered through the mail. Electronic means has provided much improvement and was thus the mode of interaction chosen for this study.

7. *Methodological Rigor*: This factor is satisfied when the researcher follows a particular research process and provides sufficient motivation for the process followed. This is described in this chapter.

8. *Results*: Analysis techniques appropriate for the type of data collected must be used. The data analysis techniques are discussed in section 6.7.

9. *Further Verification*: Most researchers recommend further study to refine and verify results. However, in this study the Delphi technique is used to verify results from other techniques used.

10. *Publication*: Results of the Delphi technique should be adequately discussed and incorporated into the research. This is done in Chapter Eight.

The most important consideration (from the above factors) is the selection of respondents for a Delphi study. Hsu and Sandford (2007) acknowledge that participants must be experts in the field of study. Additionally, it is noted that the majority of Delphi studies make use of a sample size of between 15 and 20 respondents (Hsu & Sandford, 2007). However, smaller sample sizes are expected where a research area is characterised by a few specific experts.

The Delphi technique employed in this study took the form of an expert review to evaluate the research artifact. Hartman and Baldwin (1995) also made use of the Delphi technique to validate the research outcome. Thus, this is a valid means of evaluating the research artifact. In this study, a sample size of seventeen experts was used to review the research model over four rounds. This is consistent with Hsu and Sanford's (2007) guideline. The next section describes the research format for this study.

6.4. Research Format

Five research formats are identified by literature, namely: descriptive, explanatory, evaluative, predictive and explorative. The following distinctions can be made between these formats:

1. *Descriptive*: Descriptive research provides a detailed analysis of a phenomenon and the context (Oates, 2006). This type of research presents evidence of interesting and significant patterns in the data (Mouton, 2001).

2. *Explanatory*: Explanatory research seeks to explain why outcomes occurred (Oates, 2006). This type of study generally arises where a researcher encounters a known problem, but seeks more information on this problem (De Vos, *et al.*, 2005).

3. *Evaluative*: Evaluative research provides evidence for the impact of certain interventions (Mouton, 2001).

4. *Predictive*: Predictive research aims to generalise by predicting phenomena on the basis of hypothesised, general relationships (Collis & Hussey, 2009). Thus, the solution to a problem in one study can be generalised for similar studies.

5. *Exploratory*: Exploratory research is used to help a researcher understand a research problem where there is little literature about the topic (Oates, 2006). The need for this type of study is generally used in a new area of research (De Vos, *et al.*, 2005).

Since this study examines existing literature as secondary data and data obtained from case studies, questionnaires and expert reviews as primary data, the descriptive approach is most applicable.

The logic of research can be classified as either inductive or deductive. Deductive research involves the development of a theoretical structure that is then tested empirically (Collis & Hussey, 2009). This form of reasoning involves the deduction of particular instances from general inferences. Inductive reasoning involves the development of recommendations from empirical observations, where generalised conclusions are achieved (Collis & Hussey, 2009).

The approach in this research project will be based on inductive reasoning. In this case, the researcher begins with specific observations, or formulated research questions, from which patterns are identified. This leads to general conclusions. For this study the conclusions will be recommendations based on a model for the

selection and use of IT to enhance inter-organisational trust in the South African automotive supply chain.

Having discussed the research purpose and logic, the data collection methods employed to gather primary and secondary data for this research project will be discussed in the next section.

6.5. Data Collection Methods

There are numerous data and information collection techniques relevant to researchers. There are different sources of data to choose from when conducting research, namely primary and secondary data. Most research projects require some combination of both in order to answer the research question and to meet the research objectives.

Myers (1997) makes a clear distinction between primary and secondary data. Primary data refers to data that is unpublished and which the researcher has gathered from the participants or organisation directly. Secondary data is any previously published materials such as books, articles and completed studies. This study makes use of case studies, web-based questionnaires and expert reviews as primary data, and literature survey as secondary data. The approach to using these data collection techniques is depicted in Figure 6.4.

As shown in Figure 6.4, the literature survey was used to form the theoretical base for this study. This theoretical base and the findings from the case studies influenced the creation of the questionnaire used to gather empirical data. These empirical findings, combined with the secondary data, led to the creation of the research artifact (the model for enhancing trust in automotive supply chains through IT). This model was then evaluated using the expert reviews as part of a Delphi technique, thus an iterative set of reviews was undertaken.

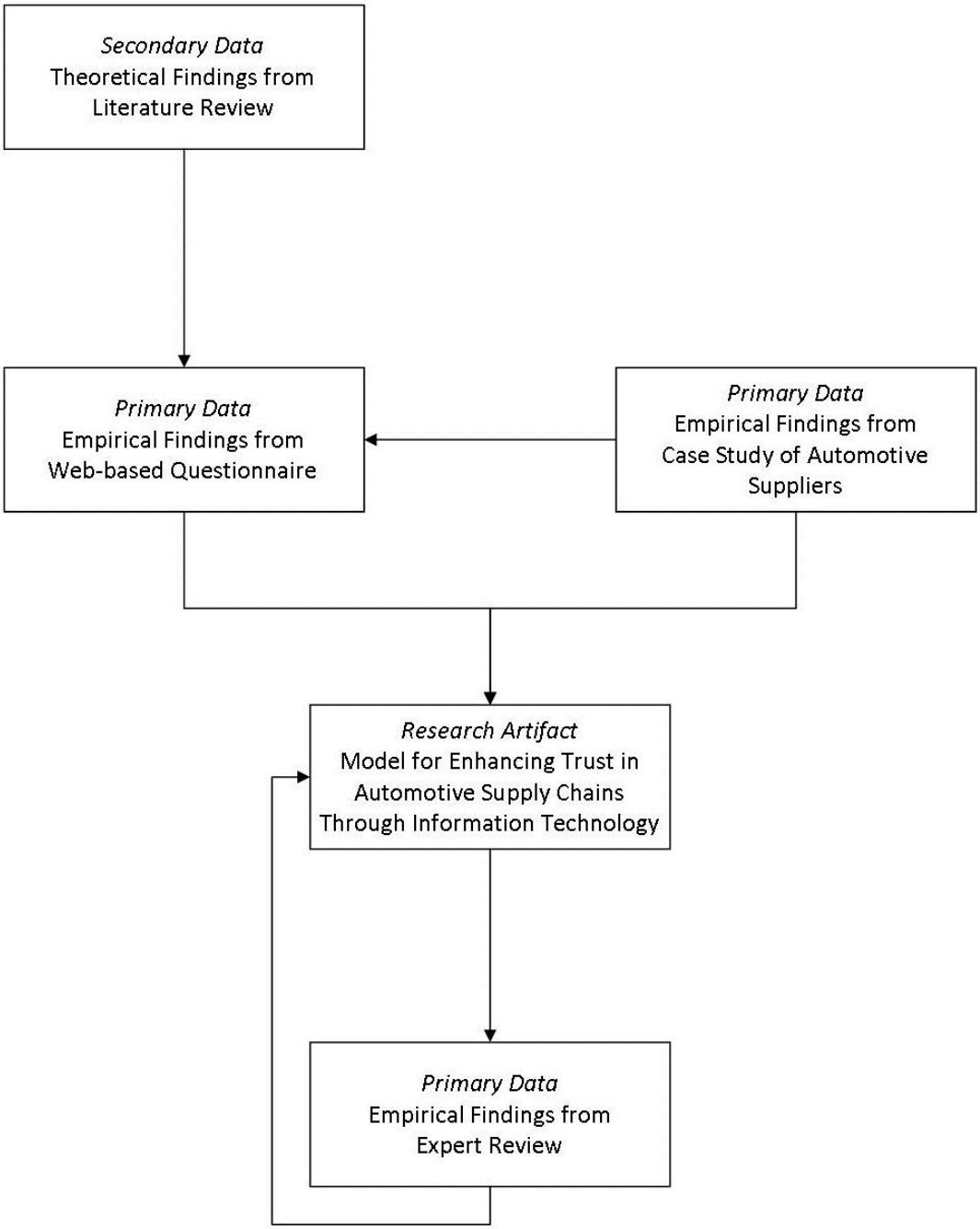


Figure 6.4: Data Collection Process

The primary and secondary data collection techniques employed by this study are discussed in the following sections.

6.5.1. Primary Data Collection Methods

The primary data sources for this research project are case study, web-based questionnaire and expert review. These are detailed below.

6.5.1.1. Case Study of Automotive Suppliers

A very important benefit of using case study research is the ability to use multiple data collection techniques (Yin, 2003). This approach allows the researcher to thoroughly explore historical, attitudinal and behavioural issues (Yin, 2003). Yin (2003) provides a useful comparison of advantages and disadvantages of the six major sources of evidence traditionally used in case study research in Table 6.4 (below).

Table 6.4: Six Sources of Evidence: Strengths and Weaknesses (Yin, 2003)

Source of Evidence	Strengths	Weaknesses
Documentation	• Stable – can be reviewed repeatedly • Unobtrusive – not created as a result of the case study • Exact – contains exact names, references and details of an event • Broad coverage – long span of time, many events, and many settings	• Retrievability – can be low • Biased selectivity, if collection is incomplete • Reporting bias – reflects (unknown) bias of author • Access – may be deliberately blocked
Archival Records	• Stable – can be reviewed repeatedly • Unobtrusive – not created as a result of the case study • Exact – contains exact names, references and details of an event • Broad coverage – long span of time, many events, and many settings • Precise and quantitative	• Retrievability – can be low • Biased selectivity, if collection is incomplete • Reporting bias – reflects (unknown) bias of author • Access – may be deliberately blocked due to privacy reasons

Interviews	• Targeted – focuses directly on case study topic • Insightful – provides perceived causal inferences	• Bias due to poorly constructed questions • Response bias • Inaccuracies due to poor recall • Reflexivity – interviewee gives what interviewer wants to hear
Direct Observations	• Reality – covers events in real-time • Contextual – covers context of event	• Time-consuming • Selectivity – unless broad coverage • Reflexivity – event may proceed differently because it is being observed • Cost – hours needed by human observers
Participant Observation	• Reality – covers events in real-time • Contextual – covers context of event • Insightful into interpersonal behaviour and motives	• Time-consuming • Selectivity – unless broad coverage • Reflexivity – event may proceed differently because it is being observed • Cost – hours needed by human observers • Bias due to investigator's manipulation of events
Physical Artifacts	• Insightful into cultural features • Insightful into technical operations	• Selectivity • Availability

The data collection methods employed in this case study aimed to obtain empirical data about information sharing activities and trust establishment in inter-organisational relationships. Participant observations and informal interviews were the key techniques used for these case studies.

In participant observations the researcher is involved with the participants and the phenomena being researched (Collis & Hussey, 2009). The aim is to provide a detailed understanding of the problem domain. Advantages of this method

include: providing a comprehensive perspective on the problem; allowing for in-depth, qualitative investigation of the problem; and data is gathered directly not retrospectively (De Vos, *et al.*, 2005). Disadvantages are: the presence of the researcher may cause the community to alter their behaviour; data gathered is usually unable to be quantified; and validity and reliability issues may arise (De Vos, *et al.*, 2005).

For this study, the case studies were two East London-based automotive component suppliers to both local and international automotive Original Equipment Manufacturers (OEMs). The suppliers were selected because of the researcher's involvement in the Programme for Industrial Manufacturing Excellence (PRIME), which gave initial access to the organisation. Subsequent involvement with the suppliers was, however, independent of this programme.

In a case study, the data gathering takes the form of field notes detailing everything seen and heard during the participant observations (De Vos, *et al.*, 2005). This includes notes made during informal interviews with the community involved. These interviews were conducted at the end of the six week observation period.

These suppliers are considered to be representative of issues faced in similar component suppliers (based on involvement in PRIME). Thus, as pointed out by Cooper and Schindler (2003), the selection of this supplier can lead to conclusions being drawn about the entire population. The findings of the case studies are described in detail in Chapter Seven.

6.5.1.2. Web-based Questionnaire

Oates (2006) states that a questionnaire is a pre-defined set of questions assembled in a pre-determined order, which respondents are then required to answer, thereby providing the researcher with data that can be analysed and interpreted. The aim of a questionnaire is to elicit the respondent's opinion in order to address the research problem (Collis & Hussey, 2009).

The advantages of this method include: low cost, a high degree of freedom for respondents in completing the questionnaire and the ability to reach a large number of respondents (De Vos, *et al.*, 2005). Limitations include: a potentially high non-response rate, answers left out or questions incorrectly interpreted (De Vos, *et al.*, 2005). For this reason it is important to ensure the questionnaire is carefully structured.

There are many different ways of designing question and response formats. The questionnaire constructed for this study made use of both open-ended and closed-ended questions (in the form of a Likert scale). Information gathered from open-ended questions allows the researcher to explore certain aspects of the research problem, while the closed-ended questions can be easily analysed (De Vos, *et al.*, 2005).

For this study, questionnaires were sent to 70 supply chain participants in automotive suppliers in the Eastern Cape. A link to the web-based questionnaire was emailed to the participants with detailed instructions for completion of the questions. 50 responses were received. Prior to this, a pilot study was conducted to test the suitability of the research instrument. The findings of the questionnaire are described in detail in Chapter Seven.

6.5.1.3. Expert Review

In order to evaluate the research model, expert reviews were conducted. This took the form of a Delphi technique whereby respondents were asked to comment on the model created as an outcome of this research project. Thus, an iterative means of refining the research model was undertaken. The research model was sent to a total of seventeen experts over four rounds in order to refine the model.

The use of the Delphi technique for expert review was discussed in detail in section 6.3.2. In addition to the primary data collection techniques described above, secondary data was used as a theoretical basis for this research project. The use of secondary data is described in the next section.

6.5.2. Secondary Data Collection Methods

Data collected by another person is termed secondary data. The secondary data collected for this study involved an extensive and thorough literature survey of internet sources, frameworks, methodologies, journal articles, past research, reports and books.

Secondary data was used throughout the research process, including the creation of the research instrument, writing of the theoretical chapters and contributed to the formation of the research model. All efforts were made to ensure that the content of the research remained as current as possible.

The population of the respondents used for the case studies, questionnaires and expert reviews is described in the next section.

6.6. Population

The participants for the case studies were chosen according to convenience sampling. A convenience sample is simply *"an easy to get sample*" (Wuensch, 2003, p.3). The researcher was selected for PRIME, a programme run under the auspices of the Advance Manufacturing Technology Strategy and backed by the Department of Science and Technology. Thus, the researcher was placed on a six week internship at the company used for observations. These internships provided adequate opportunity for data collection for this study. Approval for the use of data obtained during the internships was, however, obtained from management of the companies independent of the programme which organised the internship.

In terms of the web-based questionnaire, 70 suppliers were invited to participate in the questionnaire. Of these 70 suppliers, 50 responses were received. Again, convenience sampling was used. The response rate and the population used for the web-based questionnaire is described in further detail in Chapter Seven.

As the population of experts in the field of study is unknown, the sample size of experts used for the expert review is relatively small. Seventeen experts

responded to the requests for participation and provided feedback on the research model over four rounds of review. Although this appears to be a small number of experts to use for the expert review, this was described in section 6.3.2 as an acceptable number of respondents for the Delphi technique.

Having described the methods that were used for data collection and the population that were studied to elicit this data, the means of analysing the collected data needs to be described. This is done in the next section.

6.7. Data Analysis

Data from the questionnaire was used in order to inform the creation of the research model distributed for expert review. The qualitative data from the experts was summarised and changes were made according to their feedback and as a further stage of refining the proposed solution. Their feedback either supported or opposed the proposed solution and this added to the integrity of the project.

The analysis of the data from the web-based questionnaire is provided in Chapter Seven and the analysis of the findings from the expert review is described in Chapter Eight. Once a research project is completed it is necessary to establish the credibility of the research. The means of evaluating the research project are described in the next section.

6.8. Research Evaluation

Research evaluation is a necessary step in order to ensure the credibility and integrity of the research project. Oates (2006) provides a set of equivalent criteria for positivist and interpretivist research. These are shown in Table 6.5.

Table 6.5: Quality in Positivist and Interpretivist Research (Oates, 2006)

Positivism	Interpretivism
Validity	Trustworthiness
Objectivity	Confirmability
Reliability	Dependability
Internal validity	Credibility
External validity	Transferability

The interpretivist criteria apply to this research as follows:

1. *Trustworthiness*: With respect to the Delphi technique employed, the trustworthiness of the experts used to refine the research model was evaluated.

2. *Confirmability*: This criterion has been met through the use of multiple data collection techniques culminating in the expert review in order to confirm the outcome of the research.

3. *Dependability*: Dependability is established through the use of literature from recognised authors and the contribution from experts in the field of study.

4. *Credibility*: Credibility has been achieved through the use of multiple data collection techniques and the use of expert review.

5. *Transferability*: Transferability has been achieved as the research model can be applied to other inter-organisational settings with similar characteristics.

Through the application of these five criteria, the research project can therefore be considered credible. As this research project follows a Design Science approach, the evaluation methods for Design Science Projects are also applicable (as described in Table 6.6.)

Table 6.6: Design Evaluation Methods (Hevner, *et al.*, 2004)

1. Observational	Case Study: Study artifact in depth in business environment
	Field Study: Monitor use of artifact in multiple projects
2. Analytical	Static Analysis: Examine structure of artifact for static qualities (e.g., complexity)
	Architecture Analysis: Study fit of artifact into technical IS architecture
	Optimization: Demonstrate inherent optimal properties of artifact or provide optimality bounds on artifact behavior
	Dynamic Analysis: Study artifact in use for dynamic qualities (e.g., performance)
3. Experimental	Controlled Experiment: Study artifact in controlled environment for qualities (e.g., usability)
	Simulation . Execute artifact with artificial data
4. Testing	Functional (Black Box) Testing: Execute artifact interfaces to discover failures and identify defects
	Structural (White Box) Testing: Perform coverage testing of some metric (e.g., execution paths) in the artifact implementation
5. Descriptive	Informed Argument: Use information from the knowledge base (e.g., relevant research) to build a convincing argument for the artifact.s utility
	Scenarios: Construct detailed scenarios around the artifact to demonstrate its utility

These criteria are described and evaluated in Chapter Nine in order to establish the credibility of this research project.

6.9. Conclusion

This chapter detailed the research methodology employed for this research project. A discussion of the key research paradigms applicable to IT research was provided. This study was conducted within an interpretivist paradigm with an important influence from the Design Science paradigm.

The research methodology applicable was described, namely the qualitative approach as this is consistent with the interpretivist paradigm adopted for the study. The Design Science Methodology and Delphi technique were described and evaluated as applicable to this study.

The research format was promoted as having a predictive purpose and making use of inductive reasoning. The data collection methods employed were described and justified. The primary data collection methods are case studies, web-based questionnaires and expert reviews. Secondary data in the form of a literature survey was also utilised. The population for collection of the data and the means of analysing the data were also outlined. The chapter concluded with an evaluation of the integrity and credibility of this research project.

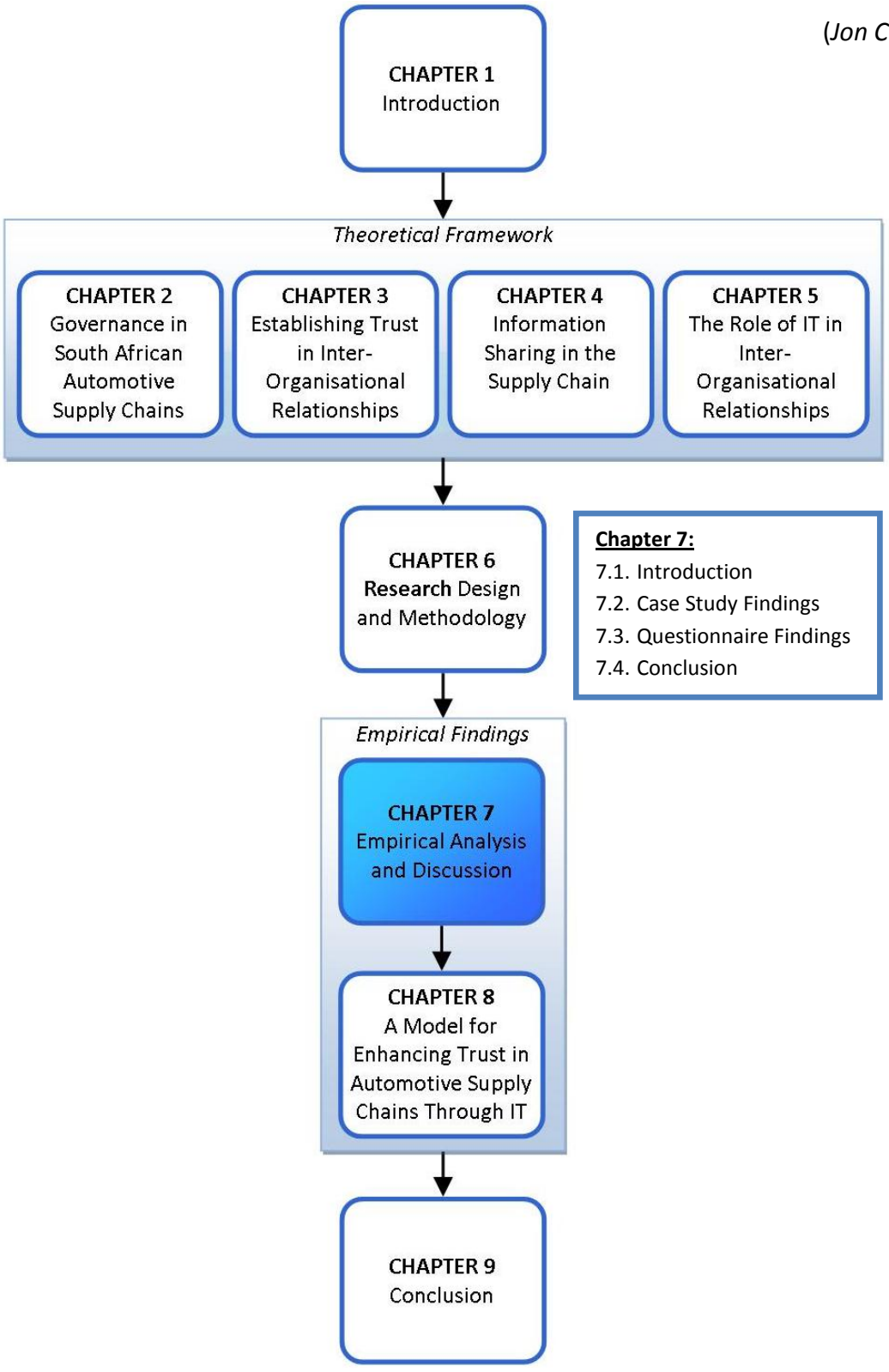
After describing the research method employed in this research, the empirical findings of the research project need to be described. The findings from the case study and web-based questionnaire are described in Chapter Seven.

Chapter 7:

Empirical Analysis and Discussion

"When the going gets tough, the tough get empirical"

(*Jon Carroll)*



7.1. Introduction

A detailed discussion of trust in automotive supply chain relationships and the relevance of Information Technology (IT) in this regard were put forward in the literature chapters as the theoretical basis for this study. The discussion included an analysis of the key theories employed in this study, namely the Prisoner's Dilemma (Game Theory) and Organisation Information Processing Theory (OIPT).

The research design and methodology used has also been outlined, however, the empirical analysis of the data collected in this study has not yet been discussed. This chapter presents the data obtained from two of the primary data sources, namely the case studies and questionnaires. The expert reviews (the last element of the primary data) are provided in Chapter Eight. The results of the case studies and questionnaires are analysed in terms of the secondary research objectives provided in Chapter One, namely:

1. To determine the factors that can enhance trust within an inter-organisational relationship in South African automotive supply chains.

2. To determine the relationship between trust and information sharing in South African automotive supply chains.

3. To determine the IT requirements to facilitate the trust-information sharing relationship in South African automotive supply chains.

This chapter begins with the findings obtained during the case studies at two automotive suppliers. First information about the background of the companies is described. The specific, relevant findings from the participant observations in relation to the research objectives are then discussed. The findings from the questionnaire distributed to automotive suppliers follows. These findings are discussed in terms of the response rate, background of participating companies and details of the pilot study. The relevant findings from this questionnaire in relation to the stated research objectives are then analysed. The findings from the

participant observations and questionnaire are used to produce the model described in Chapter Eight.

7.2. Case Study Findings

De Vos, Strydom, Fouche and Delport (2005) view case studies as fundamental to any research project. The involvement of the researcher in this type of data collection can vary from complete observation to complete involvement (De Vos, *et al.*, 2005). The researcher's participation in this scenario is a combination of observation and involvement.

In the participant observations, which were used to collect data for the case study, no evidence was found of free information flow in the inter-organisational relationships within a South African automotive supply chain. This is confirmed in the questionnaire findings discussed in section 7.3.

The case studies were completed at two Eastern Cape based automotive component suppliers to both local and international automotive Original Equipment Manufacturers (OEMs). The background of the two companies and the findings are detailed below.

7.2.1. Background of the Participating Companies

The case studies for this research project were selected due to involvement in the Programme for Industrial Manufacturing Excellence (PRIME), which gave initial access to the organisations. Subsequent involvement with the suppliers was, however, independent of this programme. The cases are considered to be representative of issues faced in similar component suppliers (based on involvement in PRIME).

The participants were chosen according to convenient sampling. A convenient sample is simply *"an easy to get sample*" (Wuensch, 2003, p.3). The researcher was selected for PRIME, a programme run under the auspices of the Advanced Manufacturing Technology Strategy and backed by the Department of Science and

Technology. Thus, the researcher was placed on a six week internship at Company A, followed by a six week internship at Company B. These internships provided adequate opportunity for data collection for this study.

Approval for the use of data elicited during the internships was obtained from management of the companies independent of the programme who organised the internship. Upon request from the management of these companies, the researcher assured participants that the company itself and employees who participated would remain anonymous.

7.2.2. Case Study Findings: Company A

The project at Company A involved examining a business process reengineering project. The project involved overcoming the overstock of small parts in finished goods at the supplier. The initial situation at the supplier involved producing the small parts continuously regardless of the needs of the automotive OEM that the parts are supplied to – this situation reflects the push nature of the traditional mass production process.

The undertaken project aimed to reduce the over-stock situation by embracing World Class Manufacturing (WCM) principles to pull stock through the production process. This involved communicating exact production requirements from the automotive OEM and reengineering the production process at the supplier.

This case study provided useful insight into the context of a multinational automotive supplier and the nature of inter-organisational relationships in automotive supply chains. In particular, the need to meet WCM and Lean Manufacturing standards (such as lowered inventory levels) without adequate planning information was noted.

The poor flow of information between the supplier and OEM was evident and had a negative impact on the effective and efficient operation of the pull system which was being implemented. Implementing a pull system at the supplier is not possible without accurate production information from the OEM. This information was not

provided timeously resulting in the failure of the supplier to implement the pull system. Thus, the importance of sharing information in a supply chain in order to enhance supply chain competitiveness was noted.

7.2.3. Case Study Findings: Company B

The event studied at Company B had the potential to shut down operations at the OEM and thus have a ripple effect on operations at other members of the supply chain. Information gained was not shared with other members in the supply chain, thereby having a negative impact on operations. This event is described below.

Observations relevant to this study centre upon one particular instance, specifically, the hard drive failure of a production machine that caused production to stop for over a week at this plant. This resulted in considerable losses as replacement products had to be shipped in from other manufacturing plants in order to supply the local automotive OEM and prevent incurring further penalties. This issue is typical of problems encountered at this company (based on similar observations at this company).

If information regarding this machine failure had been shared with the entire supply chain, all parties would have been able to adjust manufacturing for this period. This was not done as the supplier was concerned that the OEM would source a similar product elsewhere for production and thus jeopardise future contracts between the supplier and OEM.

In order to get this equipment functioning correctly, collaboration was required from a number of role players including: staff at the manufacturers of the production machine that malfunctioned, the manufacturers and local agents of the industrial computer that runs the machine, subject matter experts at the company's international head office in order to install the necessary software, and a local IT company to provide technical services.

The machine malfunctioned during the night shift and the night shift supervisor stopped production as he was not able to correct the fault. When the day shift

started, the supervisor was alerted and this information was also passed on to the manager to decide on a course of action. The day shift supervisor switched the machine on to find out the nature of the fault and observed a hard drive failure notification. It became apparent that the hard drive would require replacement.

The industrial computer unit was removed from the machine and the hard drive extracted. A new hard drive was bought from a local supplier and installed. Once installed it was found that Microsoft Windows could not be installed onto the computer and the company was compelled to call on a local IT services company to resolve this problem. This resulted in a delay as this company took considerable time to respond to the call. The technician reported that the new hard drive was larger than the old one, and was hence incompatible with the motherboard and BIOS of the industrial computer. The technician was able to resolve this issue and install Microsoft Windows so that the machine would boot.

The next issue arose that the company did not have a backup of the data and programs to run the machine and therefore was unable to get it operating again. The former IT supervisor had not left any material regarding the configuration or contacts for this machine. No manuals or installation files could be found either.

The manufacturer of the machine was contacted in order to find out about the software required. They referred them to the manufacturer of the industrial computer who subsequently referred them to the local agent who was unsure of the necessary requirements. This led to contacting subject matter experts in Germany who decided that the best method to restore the machine was to send compact discs with the hard drive image on it to South Africa.

Once the discs arrived in South Africa, there was further difficulty installing and getting the machine running, and once again contact with staff in Germany was necessary in order to find out the configuration settings required to get the machine operational. The interactions with all the role players proved to be inconvenient and expensive. In the case of the German contacts at the machine manufacturer, industrial computer manufacturer and the multinational

headquarters, there was a language barrier to contend with which made misinterpretation a significant issue.

The process followed to ensure the machine is operational is shown in Figure 7.1 on the following page. It is necessary to note at this point that the researcher believes the majority of these steps to be of no benefit to the problem-solving process, and at no point was contact made with the OEM or other supply chain members to raise awareness of the potential issue.

The effects of a lack of trust can be seen in this supply chain relationship. Had the supplier had a trust relationship with the OEM and other suppliers in the supply chain, information regarding the machine failure and possible production stoppages could have been shared. This would have allowed the OEM, and subsequently the entire supply chain, to adjust production schedules, for example, by manufacturing a different vehicle that did not make use of this supplier's components. The lack of trust in this supply chain resulted in temporarily shutting production down at the OEM and the supplier incurring costs of shipping components from an overseas-based partner and penalties associated with halting production at the OEM.

Thus, these observations have relevance for the second research objective, namely to determine the relationship between trust and information sharing in supply chain relationships. In this case, poor information sharing led to a low trust level in the inter-organisational relationship between the supplier and OEM.

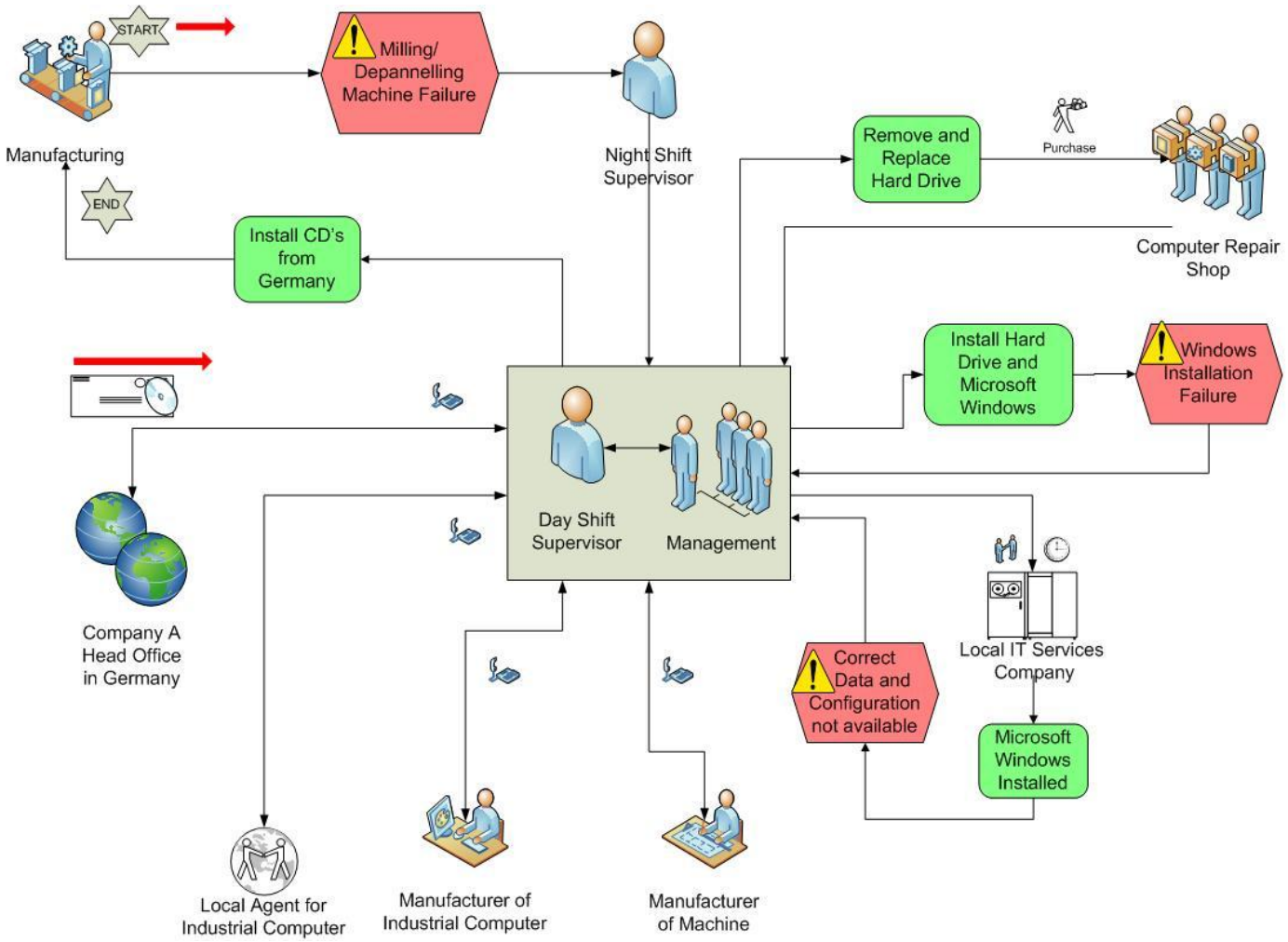


Figure 7.1: Resolution of Hard Drive Failure Problem

Findings from the web-based questionnaire to support these findings are discussed in the section that follows. The findings of the questionnaire also provide data in support of the other research objectives mentioned previously in this chapter.

7.3. Questionnaire Findings

Oates (2006) states that a questionnaire is a pre-defined set of questions assembled in a pre-determined order which respondents are then required to answer, thereby providing the researcher with data that can be analysed and interpreted. The aim of a questionnaire is to elicit the respondent's opinion in order to address the research problem (Collis & Hussey, 2009).

For this study, questionnaires were sent to supply chain participants in automotive suppliers in the Eastern Cape. The questionnaire aimed to elicit responses with regards to trust in inter-organisational relationships; the relationship between trust and information sharing and the use of IT in supply chain relationships.

The response rate, background of the respondents and details of the pilot study are outlined below. The findings of the questionnaire with respect to the research objectives are then described.

7.3.1. Response Rate

A total of 70 suppliers based in the Eastern Cape were asked to complete the questionnaire. This represents 37.5 % of all component suppliers in South Africa, and 76 % of the automotive component suppliers based in the Eastern Cape. These suppliers, although based in the Eastern Cape, supply components to OEMs situated across South Africa, as well as for export internationally. A total of 50 of the 70 suppliers responded. Thus, the response rate is 71.43 percent.

According to Oates (2006), it is common to eceive a response rate of 10 percent, however, a response rate of 30 percent or higher is preferred. Thus, as the response rate achieved in this study is considerably higher, this response rate is considered acceptable. The high rate of response can be attributed to relationships

developed with local automotive suppliers. The background of these suppliers is described in the next section.

7.3.2. Background of Participating Companies

The 50 supplier companies who completed the questionnaire each operate at different levels of the supply chain, in different OEM supply chains and supply different components. These respondents were also chosen according to a convenient sampling. This section provides the background information about the participating suppliers.

As discussed previously, various levels of suppliers exist in automotive supply chains. These are described as first tier, second tier, third tier and so on. First tier suppliers supply components directly to the OEM. Second tier suppliers are those who supply components or materials to the first tier suppliers. Thus, second tier suppliers are supplied by third tier suppliers. For the purposes of this study, only suppliers up to the third tier were asked to participate as the level of interaction between supply chain partners at lower tiers of the supply chain are not as relevant for this research project. The tier levels of the participating companies is depicted in Table 7.1 below.

Table 7.1: Tier Level of Participating Suppliers

	Frequency (N=50)	**Percent (%)**
First Tier Supplier	21	42.0
Second Tier Supplier	21	42.0
Third Tier Supplier	8	16.0
Total	**50**	**100.0**

A higher percentage of first and second tier suppliers were surveyed (42 % at each tier) as the interactions between these tiers provide a similar level of detail to the interaction observed during the participant observation. Third tier suppliers were also included to add a further level of detail.

There are eight of the top ten global automotive OEMs manufacturing in South Africa, each with a complicated network of suppliers. These OEMs are Mercedes Benz, Toyota, General Motors, Volkswagen, Ford, Fiat, BMW and Nissan. Despite being located in the Eastern Cape, these suppliers may supply components to more than one of these OEMs located around South Africa. The breakdown of suppliers per supply chain is provided below:

1. 13 of the respondents supply Mercedes Benz.
2. 18 of the respondents supply Toyota.
3. 17 of the respondents supply General Motors.
4. 14 of the respondents supply Volkswagen.
5. 14 of the respondents supply Ford.
6. 7 of the respondents supply Fiat.
7. 7 of the respondents supply BMW.
8. 12 of the respondents supply Nissan.

There are several types of components supplied by these Eastern Cape-based suppliers. These categories of components are: tyres, foundries, leather products, catalytic converters, engine and transmission, body panels and trimming, electrical components and brakes and suspension. The components supplied by the suppliers to the OEMs is summarised in Table 7.2.

Table 7.2: Components Supplied to Original Equipment Manufacturers

	Frequency (N=50)	Percent (%)
Tyres	6	12.0
Foundries	3	6.0
Leather Products	4	8.0
Catalytic Converters	4	8.0
Engine and Transmission	12	24.0
Body Panels and Trimming	8	16.0
Electrical Components	6	12.0
Brakes and Suspension	7	14.0
Total	**50**	**100.0**

Additional background information gathered about the participating suppliers includes the role of the employee surveyed and the frequency of supply to the OEM. The role of the employee surveyed is important, as this indicates that the individual who completed the questionnaire is able to provide relevant information for the purposes of this study. The roles of the respondents of this questionnaire are shown in Table 7.3.

Table 7.3: Role of the Questionnaire Respondent

	Frequency (N=50)	Percent (%)
Logistics Manager	7	14.0
Operations Manager	9	18.0
Supply Chain Manager	11	22.0
Procurement Manager	3	6.0
General Manager	20	40.0
Total	**50**	**100.0**

The individuals who completed the survey included logistics managers, operations managers, supply chain managers, procurement managers and general managers. These respondents are inherently involved in the coordination of the inter-organisational relationships. Table 7.4 shows the frequency of supply by the

supplier to the OEM. This indicates the frequency of contact between supplier and OEM, and thus the potential information sharing required to establish and maintain an inter-organisational relationship.

Table 7.4: Frequency of Contact

	Frequency (N=50)	Percent (%)
Daily	8	16.0
Weekly	33	66.0
Fortnightly	6	12.0
Monthly	3	6.0
Total	**50**	**100.0**

The majority of the automotive suppliers provide components on a weekly basis. In order to supply sufficient components on time to the OEM, suppliers need to receive appropriate information in a timely fashion. This is reiterated in the questionnaire findings discussed below.

Before sending out requests to suppliers to participate in the questionnaire, a pilot study was performed. This pilot study is described in the next section.

7.3.3. Pilot Study

The purpose of this pilot study was to ensure that the questionnaire was a refined research instrument. The pilot study made use of a number of colleagues as well as employees of the companies used for the participant observations. This step was used to refine the questionnaire to ensure the most appropriate responses were elicited by this research instrument.

Improving the quality of the questionnaire is also a contributing factor to the high response rate achieved in this study (Oates, 2006). From the pilot study it was determined that some questions required further explanation in order to gather the expected responses. The questionnaire was adjusted accordingly.

The following sections discuss the findings from the survey relevant to the secondary research objectives. Before these are discussed, a general discussion of barriers to trust and information sharing are provided in the next section.

7.3.4. Questionnaire Findings: Barriers to Trust and Information Sharing in Inter-Organisational Relationships

This research project seeks to investigate the optimal level of trust and information sharing in inter-organisational relationships and the use of IT in achieving this. In order to investigate the trust-information sharing relationship, respondents were asked to indicate barriers to trust and information sharing in their supply chain relationships. The following responses were obtained:

1. Mistrust/Lack of trust in a supply chain partner 24.8 %
2. Unwilling to share information 14.7 %
3. Poor communication between supply chain partners 11.7 %
4. Withholding information necessary for proper planning 10.0 %
5. Sharing information is viewed as a weakening of power 10.0 %
6. Poor information privacy 8.7 %
7. Concern about confidentiality of information 7.8 %
8. Cost of implementing inter-organisational systems 5.7 %
9. Inter-organisational systems are not compatible 3.9 %
10. Reputation of supply chain partner 2.7 %

It is important to note that a lack of trust and unwillingness to share information were the highest factors reported. Thus trust was viewed as important in

promoting information sharing and similarly, information sharing is viewed as aiding the enhancement of trust in the inter-organisational relationship.

This corresponds to the notion of the Prisoner's Dilemma which underpins this research project. In the Prisoner's Dilemma, the more information each party has about the other parties, the more they trust each other and cooperate in order to produce a mutually beneficial situation. Additionally, if the parties trust each other they share information that further enhances the trust level in the inter-organisational relationship. These particular findings point to the supply chain partner being unwilling to be vulnerable in the relationship by accepting the risk of sharing information. This points to a lack of trust in the supply chain relationships under investigation.

Other information sharing issues represent 48.2 % of the concerns raised through this item in the questionnaire. These information sharing related barriers include poor communication achieved between supply chain partners; the interpretation of sharing information as leading to a weakened power stance within the supply chain; and the privacy and confidentiality of information shared is below the expected level.

These findings are consistent with the literature survey findings discussed in Chapters Three and Four. Without open lines of communication between supply chain partners, information sharing is hindered. The view of weakening power through sharing information is also interesting as this points to an important perception that hinders the trust relationship between supply chain partners.

The remaining barriers to the optimisation of trust and information sharing relate to inter-organisational systems and the reputation of the supply chain partner. Cost of the system used to manage the inter-organisational relationship amounted to 5.7 % of the acknowledged barriers. These potential costs were discussed in the literature and attributed to implementation, training and configuring business processes. The incompatibility of inter-organisational systems was recognised by 3.9 % of the respondents. It is interesting to note that such a low percentage of

respondents recognised the impact of this factor, as the literature pointed to this as being a considerable influence.

The supplier's reputation also has an effect on the trust-information sharing relationship in the supply chain. As acknowledged in the literature, the reputation of a supplier has an effect on the level of trust placed in the supply chain partners. Several other factors are attributed to the level of trust in inter-organisational relationships. These are outlined in the next section.

7.3.5. Questionnaire Findings: Trust in the Inter-Organisational Relationship

A central theme of this research project is concerned with the extent to which supply chain partners trust each other. For this reason, the respondents' perception of having a good trusting relationship was sought. These results are reported per supply chain tier in Table 7.5.

Table 7.5: Summary of Responses for Trusting Relationship with Supply Chain Partners

	Strongly Disagree (%)	Disagree (%)	Agree (%)	Strongly Agree (%)
First Tier	28.6	33.3	28.6	9.5
Second Tier	28.6	38.1	23.8	9.5
Third Tier	50.0	37.5	12.5	0.0
Total	**32.00**	**36.0**	**24.0**	**8.0**

The mean for this category is 2.08 with a median of 2 (disagree). The participants perceived a trusting relationship to not exist with supply chain partners. This response was true for each of the supply chain tiers, as well as the overall response. Thus, proximity of the supplier to the OEM does not ensure trust in the inter-organisational relationship, and the issue of trust is exacerbated the further down the supply chain tiers. This finding is consistent with previous studies that point out the lack of trust in supply chain relationships.

In this research project a lack of trust is viewed as contributing to poor organisational and supply chain performance. For this reason, the participants were asked whether a lack of trust in supply chain partners hindered organisational and supply chain performance. These results are reported per supply chain tier in Table 7.6.

Table 7.6: Summary of Responses for Lack of Trust Hindering Performance

	Strongly Disagree (%)	Disagree (%)	Agree (%)	Strongly Agree (%)
First Tier	4.8	9.5	14.3	71.4
Second Tier	9.5	14.3	28.6	47.6
Third Tier	0.0	0.0	25.0	75.0
Total	**6.0**	**10.0**	**22.0**	**62.0**

The mean for this category is 3.39 with a median of 4 (strongly agree). The participants believe the lack of trust between supply chain partners affects the overall performance of the organisation and the supply chain. This response was true for each of the supply chain tiers, as well as the overall response. This is consistent with the observations made in section 7.2. This was also pointed out in the literature surveyed.

In addition, attributes of the supply chain partner can affect the level of trust in the supply chain. The respondents were asked to answer about the extent to which they agreed or disagreed that supply chain partner's honesty and the history of interactions with the supply chain partner affected the amount of trust attributed to the supply chain partner. These responses are summarised in Table 7.7.

Table 7.7: Summary of Responses for Supply Chain Partner Attributes

	Strongly Disagree (%)	Disagree (%)	Agree (%)	Strongly Agree (%)
Supply Chain Partner Honesty	4.0	6.0	42.0	42.0
History of Interactions with Supply Chain Partner	4.0	38.0	24.0	34.0

As can be seen in Table 7.7, both these supply chain partner attributes contribute to a perception of the supply chain partner and hence the amount of trust established. These two attributes of supply chain partners have been established in literature previously described. If a supply chain partner is perceived to act dishonestly, a trusting relationship cannot be established. Additionally, prior interactions with supply chain partners provide evidence of a supply chain partner's trustworthiness and thus is important for establishing trust in the inter-organisational relationship.

In addition to these trust attributes, information sharing can assist in the creation of trust in inter-organisational relationships. Therefore, the relationship between trust and information sharing in supply chain relationships is described in the following section.

7.3.6. Questionnaire Findings: Information Sharing and Trust in Supply Chains

This research project seeks to investigate the optimal level of trust and information sharing in inter-organisational relationships and the use of IT in achieving this. In order to investigate the trust-information sharing relationship, respondents were asked to indicate the types of information shared between supply chain partners. The following responses were obtained:

1. Inventory Information 46.4 %
2. Logistical Information 16.7 %
3. Order Information 16.7 %
4. Process Information 9.4 %
5. Tactical Information 4.3 %
6. Strategic Information 3.6 %
7. Customer Information 2.9 %

It is important to note that the majority of the information shared is concerned with inventory and logistical information which affect the production process. The accuracy of this information is essential to the effective and efficient operation of the production processes across the supply chain. The reasons for sharing this information were elicited from the respondents. The following responses were the most significant:

1. To facilitate the delivery of the correct components as and when needed.

2. Stock levels are kept at a minimum (to ensure compliance with world class and lean manufacturing principles), thus appropriate information is needed in order to ensure stock is available when needed.

3. To ensure continuity and quality standards are met.

These reasons for sharing information are complementary to previous literature survey findings. Ensuring the correct components are delivered is important for the achievement of just-in-time (JIT) manufacturing. This corresponds with the second reason provided above. The participant observations pointed to a reluctance to share inventory and production information, which resulted in a negative impact on supply chain operations. This shows the importance of adequate trust and information sharing in inter-organisational relationships.

As discussed in the literature, the level of trust and information sharing between supply chain partners was viewed as complementary. This is consistent with the Prisoner's Dilemma discussed previously. The amount of information that the various players have about each other is a key determinant of behaviour. Similarly, in a supply chain context where information is shared freely by all members of the supply chain, the benefits to all members is an increased level of trust in the inter-organisational relationship, and therefore effective and efficient supply chain operations. Thus, the respondents were questioned about the extent of

information sharing in their supply chain relationships. The responses are summarised in Table 7.8.

Table 7.8: Summary of Responses for Trust and Information Sharing

	Strongly Disagree (%)	Disagree (%)	Agree (%)	Strongly Agree (%)
Willing to share information	36.0	40.0	22.0	2.0
Communicate with supply chain partners regularly	34.0	38.0	24.0	4.0
Information shared is useful for business planning	22.0	50.0	22.0	6.0
Provide information that affects supply chain partners	14.30	40.0	32.0	14.0

As can be seen in Table 7.8, automotive suppliers are hesitant to share information. This is consistent with the findings of the participant observation discussed previously in this chapter. Additionally, 72 % of the respondents indicated that information received from supply chain partners is not useful for business planning. This indicates that the quality of information shared needs improvement, which points to the importance of the quality attributes established in Chapter Four. Information that affects the operations of other supply chain partners is also seldom shared, thus impacting on the overall supply chain performance. An example of such an instance was detailed in the participant observations. This provides evidence in support of the literature survey findings that poor information sharing affects trust in inter-organisational relationships.

The quality of information has previously been noted as affecting the sharing of information in the inter-organisational relationship. For this reason, the respondents were asked whether the quality of information received from a supply chain partner is suitable. These results are reported per supply chain tier in Table 7.9.

Table 7.9: Summary of Responses for Effect of Information Quality

	Strongly Disagree (%)	Disagree (%)	Agree (%)	Strongly Agree (%)
First Tier	19.0	42.9	33.3	4.8
Second Tier	19.0	42.9	33.3	4.8
Third Tier	25.0	62.5	12.5	0.0
Total	**20.0**	**46.0**	**30.0**	**4.0**

The mean for this category is 2.18 with a median of 2 (disagree). The participants believe that the information shared between supply chain partners is of lower quality than required. This response was true for each of the supply chain tiers, as well as the overall response. Poor quality information shared also affects the trust relationship between the supply chain partners. This is in line with the information-sharing trust trade-off discussed in relation to the Prisoner's Dilemma. If the quality of information shared is poor, supply chain partners are unable to make effective decisions based on the information, and thus trust is undermined in the supply chain relationship.

This study proposes that improving the level and quality of information sharing in order to improve trust between supply chain partners can be enhanced through the use of IT. This application of IT in supply chains is discussed in the section that follows.

7.3.7. Questionnaire Findings: The Use of Information Technology in Supply Chains

This research project proposes a model to enhance the level of trust in supply chain relationships through the use of IT. For this reason, several questions were asked of the respondents with regard to current practice in this area.

In so far as information sharing leads to increased trust, which consequently further improves information sharing, IT is necessary in order to support the sharing of information between supply chain partners. The respondents were

asked whether adequate infrastructure is available for information sharing among their supply chain partners. These results are reported per supply chain tier in Table 7.10.

Table 7.10: Summary of Adequacy of Infrastructure for Information Sharing

	Strongly Disagree (%)	Disagree (%)	Agree (%)	Strongly Agree (%)
First Tier	9.5	42.9	42.9	4.7
Second Tier	4.8	47.6	42.9	4.7
Third Tier	25.0	25.0	50.0	0.0
Total	**10.0**	**42.0**	**44.0**	**4.0**

The mean for this category is 2.42 with a median of 2 (disagree). The participants believe that the infrastructure for information sharing in the supply chain is inadequate. This response was true for each of the supply chain tiers, as well as the overall response. The literature points to the existence of adequate infrastructure in automotive supply chains for information sharing. This points to the existence of other issues contributing to the poor flow of information.

The current preferred means of information sharing between supply chain partners was surveyed. The following responses were elicited:

1. Email 31.8 %
2. Telephone 31.1 %
3. Electronic Data Interchange 14.9 %
4. Video Conferencing 12.8 %
5. Electronic Business Applications 6.7 %
6. Expert Systems 2.7 %

From these responses it can be seen that traditional information sharing methods such as email and telephone are still preferred methods. This could be an important factor in the inadequate information sharing reported previously. There is therefore a need for improving the automated sharing of production, logistic and inventory information.

Lastly, the respondents' view of IT impact on trust and information sharing was sought. The following responses were the most significant:

1. Improving both trust and information sharing will ensure supply chain efficiency and enhance decision making.

2. IT will allow for better, more honest communication between supply chain partners, which will in turn lead to trust formation between supply chain partners.

3. IT will enable supply chain partners to share information and integrate processes, thereby reshaping the inter-organisational dynamics and resulting in a more efficient supply chain.

These responses point to agreement with literature survey findings which led to the proposal of a cyclical relationship between trust and information sharing (which is expanded on in Chapter Eight). While these comments were positive, a few respondents had more adverse views; these include concerns about the risks of confidentiality breaches and concerns about the lack of guarantee of information integrity. These responses point to trust issues within the supply chain. If the respondents had sufficient trust in their supply chain partners, these factors would be irrelevant.

7.4. Conclusion

In this chapter the data collected by means of the case studies and the web-based questionnaire was represented. The categories used for this representation correspond to the research objectives stated in Chapter One.

From the case study findings it was found that the poor flow of information relating to production requirements between the OEM and the supplier was a barrier to the successful implementation of lean manufacturing principles. If suppliers are unable to implement lean manufacturing standards, they cannot achieve efficient and effective operations, thereby impacting on the competitiveness of the supply chain.

In the participant observations at Company B, the effects of a lack of trust resulted in the withholding of information regarding the machine failure. This resulted in production stoppages at the OEM and other suppliers and penalties being incurred by Company B. Had the information been shared, the entire supply chain would have had sufficient time to adjust production schedules to accommodate this issue. Thus, from the case study findings it is evident that both routine production information and information related to critical events needs to be shared within the supply chain.

From the questionnaire, findings with regard to the barriers to trust and information sharing were established. This reinforced the notion of the Prisoner's Dilemma which is a key theory for this research project. In this regard, the amount of information that the various players have about each other is a key determinant of behaviour. When information is shared freely by all members of the supply chain, the benefits to all members is an increased level of trust in the inter-organisational relationship, and therefore effective and efficient supply chain operations.

The questionnaire provided data in support of literature survey findings about trust in inter-organisational relationships. A low level of trust and its negative effect on supply chain operations was established. The perception of supply chain partner honesty and prior interactions with the supply chain partner were seen as important in establishing trust in the relationship.

Responses about trust and information sharing pointed to a complementary relationship between the two components. These findings reinforced the proposed

cyclical relationship between trust and information sharing that is the basis for the development of the model in Chapter Eight.

As this study aims to create a model to enhance the level of trust in supply chain relationships through the use of IT, the respondents commented on current IT practices supporting the inter-organisational relationships. These findings showed that respondents viewed current infrastructure as inadequate to promote trust and information sharing in the supply chain relationship. This finding was contrary to the findings from previous studies that showed a high level of IT enablement in automotive supply chains. This is indicative of other factors impacting on trust and information sharing in the inter-organisational relationship.

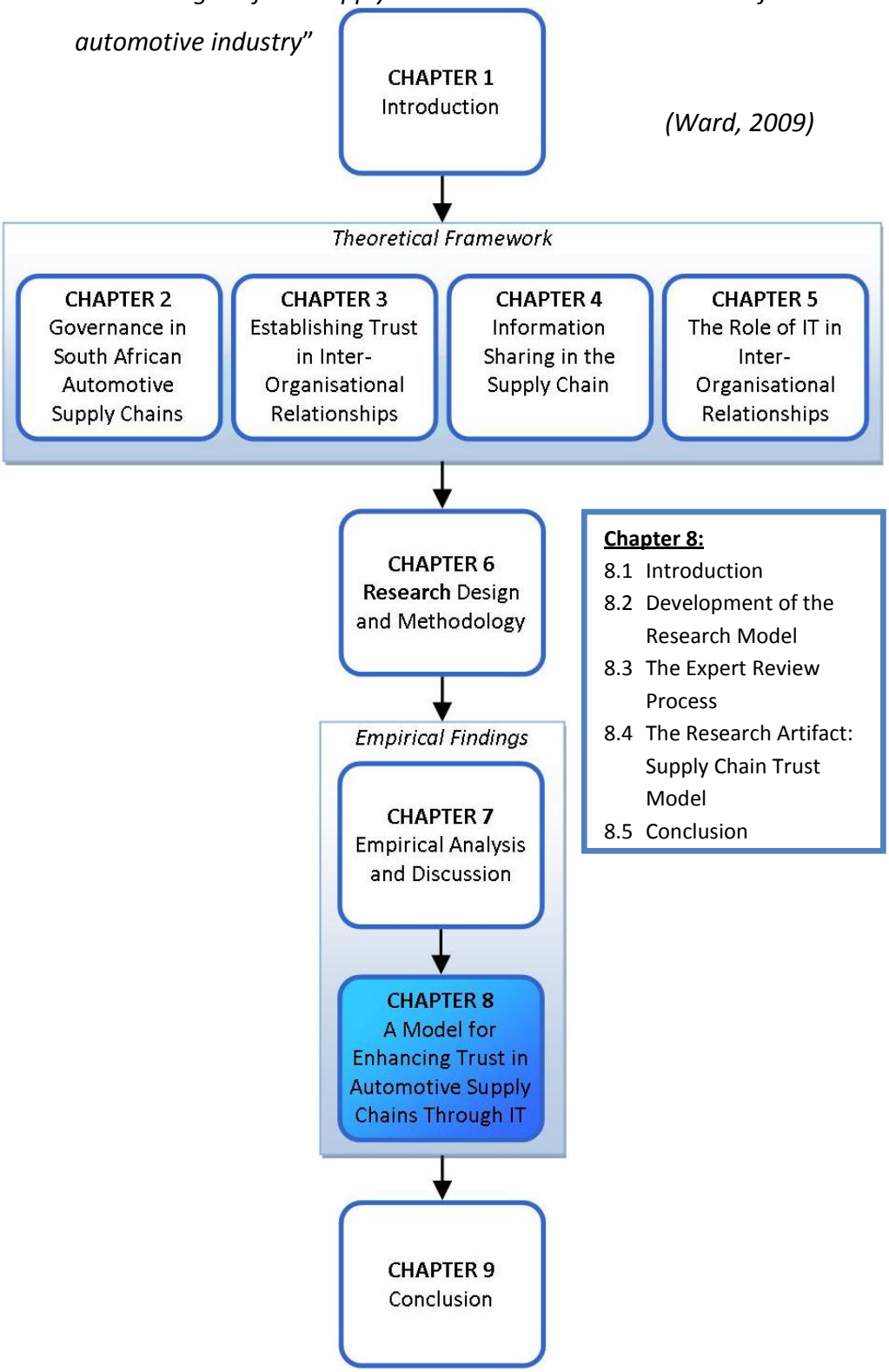
The chapter that follows provides a discussion of the model for enhancing trust in automotive supply chains through the use of IT which is the primary objective of this research project. This model was based upon the literature survey findings and the primary data discussed in this chapter. The remaining primary data collected, in the form of expert reviews used to refine the model, is also provided in this chapter.

Chapter 8:

A Model for Enhancing Trust in Automotive Supply Chains Through Information Technology

"The strength of the supply chain is critical to the success of the automotive industry"

(Ward, 2009)



Chapter 8:

8.1 Introduction
8.2 Development of the Research Model
8.3 The Expert Review Process
8.4 The Research Artifact: Supply Chain Trust Model
8.5 Conclusion

8.1. Introduction

The previous chapters discussed the research design and methodology as well as the empirical findings. This study was conducted within the interpretivist paradigm, following the Design Science Methodology. Design Science allows for the development of an artifact (in this research this is a model) through an iterative research process. In order to satisfy the iterative nature of Design Science, the Delphi technique was used to refine the research findings through an iterative cycle of feedback on the research model. This chapter discusses the model for enhancing trust in automotive supply chains through Information Technology (IT), as well as the refinement of this model using the Delphi technique.

The research model draws on relevant literature and theory (as discussed in Chapters Two to Five) and the empirical findings discussed in Chapter Seven. From these, both insufficient trust and information sharing are viewed as contributing factors to the ineffectiveness and inefficiency of a supply chain's operations, and the resultant negative effect on competitive advantage. Additionally, the cyclical nature of the relationship between trust and information sharing has been described. This research project aims to formulate a causal model that can be used to enhance inter-organisational trust in automotive supply chains through the effective use of IT.

This chapter begins by introducing the proposed model and explaining each element of it. Following this, the refinement of the model using a Delphi technique in the form of expert reviews is outlined.

8.2. Development of the Research Model

In this section the proposed research model is presented. This model aims to address the primary research objective in terms of enhancing trust in the supply chain through the appropriate use of IT. This model expands on the preliminary solution discussed in Chapter Four which alluded to the potential cyclical relationship between trust and information sharing. In this section, the

development of the model and an explanation of each element of the research artifact are provided.

8.2.1. Initial Research Model

In Chapter Four a preliminary solution to the research problem was provided based on the theoretical findings discussed. From the literature surveyed it was recognised that several works have highlighted a relationship between trust and information sharing in a singular direction:

1. Premkumar, Ramamurthy and Saunders (2005) recognise that information flow is restricted due to the competitive nature of the automotive industry and propose that in order to enhance trust in the supply chain relationships, information flow should be enhanced.

2. Kwon and Suh (2005) found that the level of trust between supply chain partners was highly reliant upon the level of asset investment and information sharing structures. Information sharing, in particular, was found to play a role in reducing uncertainty in the supply chain relationship and thereby improving the level of trust.

3. Chu and Fang (2006) identify information sharing as one of the determinants of the level of trust between supply chain partners.

4. Ghosh and Fedorowicz (2008) see trust as a governance mechanism that plays a crucial role in sharing information among business partners.

In order to have a sufficient level of trust in a relationship, a significant level of information sharing is required. Better decision making can occur if there is sufficient information, and the resultant improved operational performance experienced results in improved trust in the supply chain partners who have shared the information. Conversely, the sharing of information will only occur if there is a sufficient level of trust among supply chain partners. If there is insufficient trust in

supply chain partners, there will be unwillingness to share information. Thus, the relationship between trust and information sharing is cyclical – it is not a relationship that occurs in a single direction only, as established by the existing literature.

Having previously established the role IT has in facilitating information sharing (and thereby enhancing trust), this vital component cannot be ignored. Jharkharia and Shankar (2004) view information sharing as a basic enabler for the effective management of a supply chain which needs to be facilitated by IT.

The cyclical relationship between trust and information sharing and the underlying supporting role of IT is represented in the diagram below (Figure 8.1):

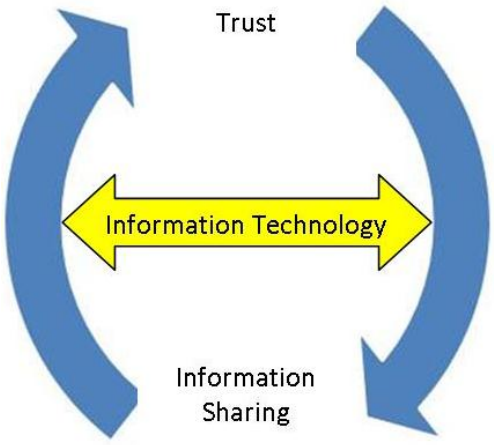


Figure 8.1: Trust-information Sharing Relationship (Piderit, Flowerday & Von Solms, 2011)

This proposed cyclical relationship is the basis of the model for establishing trust in automotive supply chains through IT, which is the primary objective of this research project and described in further detail in the remainder of this chapter.

8.2.2. Proposed Model for Enhancing Trust in Automotive Supply Chains Through Information Technology

Insufficient trust among supply chain partners leads to inefficient and ineffective operations within the supply chain, and consequently negatively impacts the supply chain's competitive advantage (Covey 2008). For this reason, South African

automotive supply chains need to have a sufficient level of trust entrenched in the relationships among supply chain partners in order to compete effectively against their global counterparts.

Information sharing can be disrupted through insufficient trust among supply chain partners (Fedorowicz & Ghosh, 2008). This leads to ineffective and inefficient operations in the supply chain, as insufficient information is available to all supply chain partners in order to make effective decisions. Insufficient information sharing can thus be viewed as detrimental to the supply chain's competitiveness.

Thus, both insufficient trust and information sharing are viewed as contributing factors to the ineffectiveness and inefficiency of a supply chain's operations, and the resultant negative effect on competitive advantage. Additionally, the cyclical nature of the relationship between trust and information sharing emerges, as shown in the initial research model depicted above.

The following model (Figure 8.2) has been developed to accomplish the research objectives mentioned above. The six key components of the model, namely: perceived risk in the relationship, level of information sharing in the relationship, the perceived trustworthiness of the supply chain partner, system trust, trusting behaviour and improved information sharing are described in detail in the sections that follow. Each component is linked to both the primary and secondary data described above which provides evidence in support of including this component in the model.

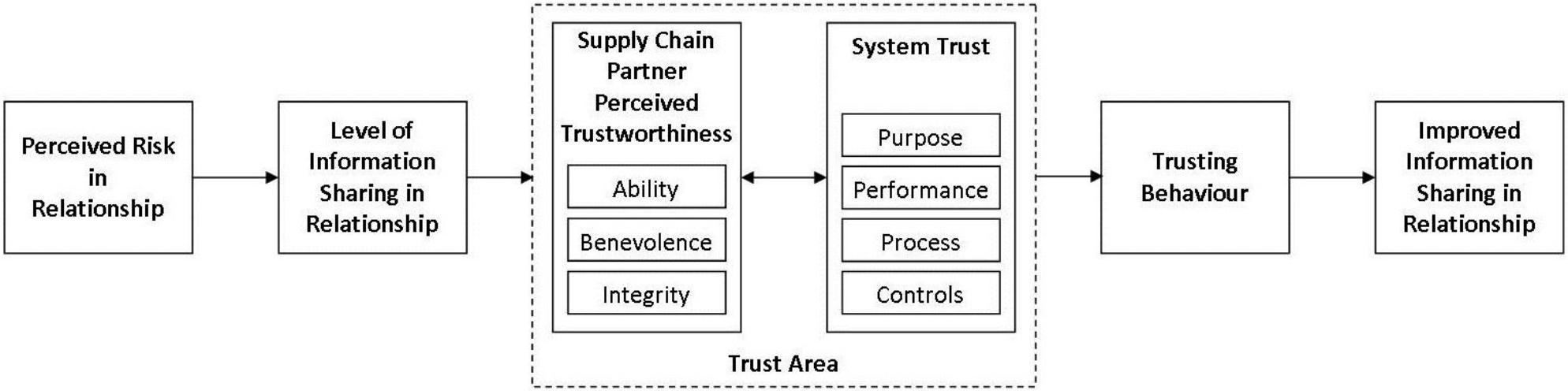


Figure 8.2: Proposed Model for Enhancing Trust in Automotive Supply Chains Through Information Technology

8.2.3. Perceived Risk in Relationship

As established in the literature, trust is defined as a willingness to take risk or a willingness to be vulnerable to the actions of the supply chain party. Therefore, in order to enhance trust in the supply chain relationship, it is necessary to establish the perceived risk in the inter-organisational relationship. Thus, this was included as the first element of the research model.

From the theoretical literature survey findings, the following was noted with regards to perceived risk in a supply chain relationship. Mayer, Davis and Schoorman (1995) and Das and Teng (2004) cite several authors who recognise the importance of risk in understanding trust, but do not agree on the relationship between the two concepts. Schoorman, Mayer and Davis (2007) view trust as a determinant of risk-taking in a relationship. Thus, the level of trust in a relationship is determined by the amount of risk the company is willing to take.

As this study focuses on information sharing as a means of enhancing trust, consideration was given to the risk resulting from this shared information. Ghosh and Fedorowicz (2008) provide the example of the risks of information leakage which can result in reluctance to share sensitive production data. This type of risk also needs to be considered before embarking in a supply chain transaction.

According to Mishra, Raghunathan and Yue (2007), many supply chain studies assume that information shared in supply chains is always truthful and often do not consider the possibility that one party distorts information. Thus, the risk of basing decisions on such distorted information is also relevant

A discussion of perceived risk is not complete without relating this to the Prisoner's Dilemma which is the underlying theory for this research project. Without knowing

anything about the supply chain partners, the organisation does not know what the outcome of sharing information (or of any other interaction) with the rest of the supply chain will be. Thus, an element of risk is established in the relationship.

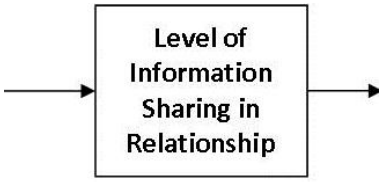
From the empirical findings, the following was noted with regards to perceived risk in a supply chain relationship:

1. When asked about the barriers to trust in inter-organisational relationships, respondents to the questionnaire reported an unwillingness to share information among the highest factors. These particular findings point to the supply chain partner being unwilling to be vulnerable in the relationship by accepting the risk of sharing information or participating in the inter-organisational relationship. This highlights the need to evaluate the level of perceived risk in the relationship.

2. Additionally, the respondents' view of IT impact on trust and information sharing was sought. Concerns about the risks of confidentiality breaches when participating in a supply chain relationship and concerns about the lack of guarantee of information integrity were raised. These responses point to trust issues within the supply chain. If the respondents had sufficient trust in their supply chain partners, these factors would be irrelevant.

In the proposed model, the perceived risk in the relationship is the extent to which a supply chain partner believes in the likelihood of supply chain members acting contrary to mutual benefit. Thus, a high level of risk results in supply chain partners acting opportunistically, while a perception of low risk in the relationship will lead to increased sharing of information with supply chain partners. Thus in order to mitigate the risk perceived to exist in the relationship and enhance trust, information needs to be shared with supply chain partners. The level of information sharing is the next component of the proposed model and is discussed in the next section.

8.2.4. Level of Information Sharing in Relationship



An adequate level of information sharing is needed in the supply chain. In this regard, Game Theory (in particular the Prisoner's Dilemma) has been used to illustrate the importance of information sharing and the concept of trust.

In terms of the governance of supply chains, in the decentralised chain organism supply chain model preferred in Chapter Two, there is a need to reduce uncertainty through shared information. This type of supply chain will be unable to function effectively without the free flow of information between supply chain partners. Without a dominant firm or Channel Master (as described in Chapter Two) which sets the terms of trade for the supply chain, the sharing of information will assist in the successful operation of the supply chain.

From the literature survey findings, in terms of the Prisoner's Dilemma, if information is freely shared by all members of the supply chain the benefits to all members is an increased level of trust in the inter-organisational relationship and therefore effective and efficient supply chain operations. If no members of the supply chain reveal information, none can benefit from the improved operations described. If some parties share information whilst others do not, those that have not shared information can benefit far more than those that have shared information. Thus, the ideal situation would be for supply chain partners to share information freely as this would be to the benefit of the entire supply chain.

In addition to the Prisoner's Dilemma, the Organisational Information Processing Theory (OIPT) was recognised as being relevant for the sharing of information in supply chain relationships. The OIPT identifies a trade-off required between information processing needs and capabilities (Premkumar, *et al.*, 2005). This is

relevant in the supply chain context as it points to the need to balance shared information and the support structures (usually IT) to share this information.

From the literature survey it has been noted that there are several benefits of information sharing in supply chains which positively impact on the performance of the entire supply chain. Information sharing is beneficial with regards to coordinating the supply chain and reducing uncertainty within the supply chain (Ghosh & Fedorowicz, 2008). These benefits contribute to the efficient and effective operation of the supply chain. Additionally, by reducing uncertainty, information sharing provides a means for establishing trust in an inter-organisational relationship.

From the empirical findings the following is relevant in terms of the level of information sharing:

1. In the case study at Company A, the poor flow of information between the supplier and OEM was evident and had a negative impact on the effective and efficient operation of the pull system which was being implemented. Thus, the importance of sharing information in a supply chain in order to enhance supply chain competitiveness was noted.

2. At Company B, information regarding the machine failure and possible production stoppages should have been shared. This would have allowed the OEM, and subsequently the entire supply chain, to adjust production schedules, for example, by manufacturing a different vehicle that did not make use of this supplier's components. The lack of trust resulting from a failure to share this information in this supply chain resulted in production temporarily shutting down at the OEM and the supplier incurring costs of shipping components from an overseas-based partner and penalties associated with halting production at the OEM. This points to a need to improve information sharing in this type of relationship.

3. Barriers to effective information sharing were established in the results of the questionnaire. These information-sharing related barriers include poor communication achieved between supply chain partners, the interpretation of sharing information as leading to a weakened power stance within the supply chain, and the privacy and confidentiality of information shared is below the expected level. Without open lines of communication between supply chain partners, information sharing is hindered. The view of weakening power through sharing information is also interesting as this points to an important perception that hinders the trust relationship between supply chain partners.

4. It is important to note that the questionnaire findings established that the majority of the information shared is concerned with inventory and logistical information which affect the production process. The accuracy of this information is essential to the effective and efficient operation of the production processes across the supply chain.

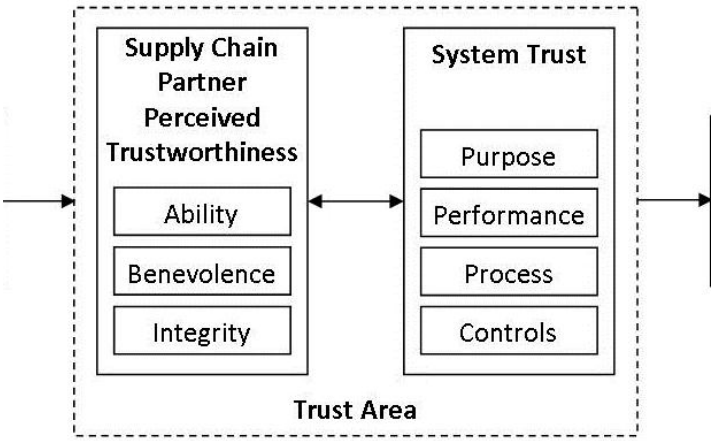
5. Respondents were questioned about the extent of information sharing in their supply chain relationships. The findings pointed out that automotive suppliers are hesitant to share information. This is consistent with the findings of the participant observation previously discussed in this chapter. Additionally, 72 % of the respondents indicated that information received from supply chain partners is not useful for business planning. This indicates that the quality of information shared needs improvement, which points to the importance of the quality attributes established in Chapter Four. Information that affects the operations of other supply chain partners is also seldom shared, thus impacting on the overall supply chain performance. An example of such an instance was detailed in the case study. This provides evidence in support of the literature survey

findings that poor information sharing affects trust in inter-organisational relationships.

6. The participants believe that the information shared between supply chain partners is of lower quality than required. Poor quality of information shared also affects the trust relationship between the supply chain partners. This is in line with the information-sharing trust trade-off discussed in relation to the Prisoner's Dilemma. If the quality of information shared is poor, supply chain partners are not able to make effective decisions based on the information, and thus trust is undermined in the supply chain relationship.

Thus, the amount and quality of information shared plays an important role in the determination of the level of trust in the supply chain relationship. The more information shared by the supply chain partners, the higher the level of trust in the relationship. The trust area, which consists of the supply chain partner perceived trustworthiness and system trust is described in the next section.

8.2.5. Trust Area



In the previous section it was mentioned that improved information sharing assists in the establishment of trust in an inter-organisational relationship. This can be compared to the Prisoner's Dilemma discussed numerous times throughout this research project. In this regard, the supplier's choice to co-operate and willingly supply information is directly related to the amount of information available and

therefore the level of trust that each of the supply chain partners place in the others. This highlights the complicated relationship between trust and information sharing under investigation in this study.

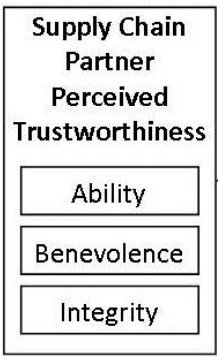
Trust in the supply chain context comprises two components, namely:

1. *Supply Chain Partner Perceived Trustworthiness*: This is the philosophical aspect of trust which is concerned with deciding whether or not each individual supply chain company can be trusted. This is described in detail in section 8.2.6.

2. *System Trust*: This component represents the more practical aspects of establishing trust in the supply chain relationship. As inter-organisational relationships are largely impersonal, the enhancement of trust in the IT systems used to manage the relationships is important. This is described in detail in section 8.2.7.

Together these two components assist in establishing trust in the relationship. The next section describes the supply chain partner perceived trustworthiness.

8.2.6. Supply Chain Partner Perceived Trustworthiness



The three attributes of supply chain partner trustworthiness discussed in this component of the research model are the philosophical aspects of trust which need to be considered in the supply chain relationship. As discussed in Chapter Three, Mayer, *et al.* (1995) propose three characteristics that form a foundation for the development of trust, based on an analysis of the characteristics described by other

experts in the field (see Table 3.1). These characteristics are ability, benevolence and integrity.

1. *Ability:* This element relates to the competence of the supply chain partner to fulfill their role in the relationship. Ability is defined as the skills, competencies and characteristics that ensure the trustee has influence in the relationship (Mayer, *et al.*, 1995). In the supply chain context this would be the supply chain partner's ability to perform the responsibilities assigned to them in a timely and appropriate fashion.

2. *Benevolence:* This element relates to the loyalty of the supply chain partner to the best interests of the entire supply chain. Benevolence is defined as the extent to which the trustee is believed to want to act in the trustor's best interests (Mayer, *et al.*, 1995). In the supply chain context, benevolence is the extent to which a supply chain partner cooperates in order to ensure mutually beneficial gains.

3. *Integrity:* This element relates to the honesty of the supply chain partner. Integrity is defined as a perception that the trustee prescribes to the principles that the trustor finds acceptable (Mayer, *et al.*, 1995). In the supply chain context, integrity refers to the belief that the supply chain partner will act in the best interests of the entire supply chain.

Most authors in trust research view these three factors as the determinants of trustworthiness, thus they have been included in the research model to determine supply chain partner trustworthiness. Furthermore, Mayer, *et al.* (1995) view trustworthiness as a continuum – this was described in Chapter Three through the diagram shown below (Figure 8.3). The level of ability, benevolence and integrity would determine the trustee's position along the continuum.

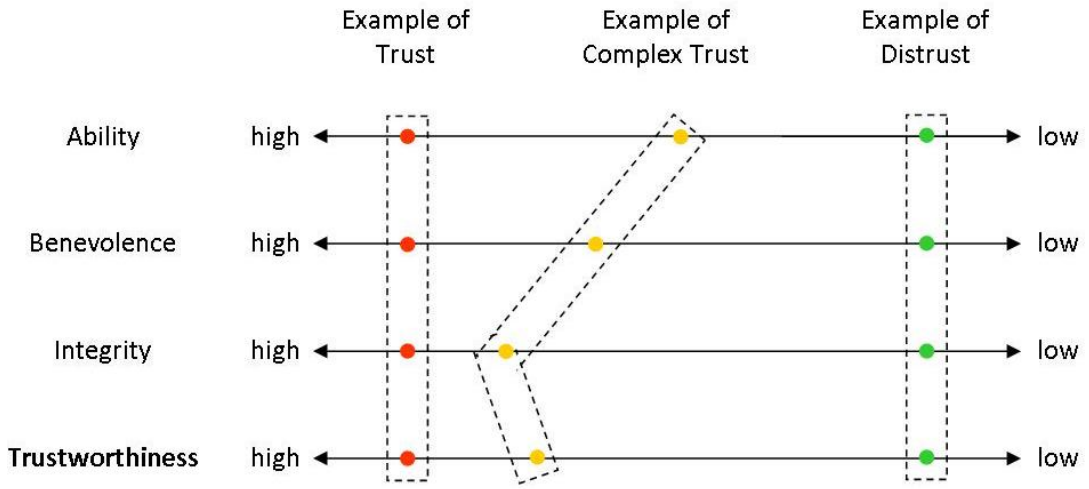


Figure 8.3: Trustworthiness Continuum (Adapted from: Stahl and Sitkin, 2010)

As depicted in Figure 8.3, if the level of ability, benevolence and integrity are perceived to be high, the level of perceived trustworthiness will be high, as seen in the example of trust above. If the level of ability, benevolence and integrity are perceived to be low, the level of perceived trustworthiness will be low, as seen in the example of distrust above. If the levels of ability, benevolence and integrity vary along the continuum, the perceived level of trustworthiness can be placed along this continuum, as seen in the example of complex trust above.

From the empirical findings, the following was established regarding supply chain partner perceived trustworthiness:

1. General findings about trust in the supply chain were obtained through the questionnaire. The participants perceived a trusting relationship to not exist with supply chain partners. For this reason, the participants were asked whether a lack of trust in supply chain partners hindered organisational and supply chain performance. The participants believe the lack of trust between supply chain partners affects the overall performance of the organisation and the supply chain.

2. At Company B the lack of trust in this supply chain resulted in production shutting down temporarily at the OEM and the supplier incurring costs of shipping components from an overseas-based

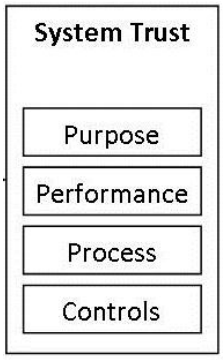
partner and penalties associated with halting production at the OEM. This lack of trust was affected by perceptions of benevolence and integrity of the OEM. Company B feared that the OEM would switch to another supplier should they be made aware of the potential production issue, thus they decided not to share required information with the supply chain.

3. The questionnaire findings pointed out that the supplier's reputation has an effect on the establishment of trust in the supply chain. This corresponds to the Ability construct included in this model. In addition, the idea of predictability discussed in Chapter Three is relevant, as predictable behaviour as a supplier's reputation assists in assessing supply chain partner trustworthiness.

4. In order to assess the importance of the benevolence and integrity components of the model, the respondents were asked to answer about the extent to which they agreed or disagreed that supply chain partner's honesty and the history of interactions with the supply chain partner affected the amount of trust attributed to the supply chain partner. Both these supply chain partner attributes were shown to contribute to a perception of the supply chain partner, and hence the amount of trust established.

In addition to supply chain partner trustworthiness, the trust aspect of the model also considers System Trust. This is an important inclusion in this model as the systems used to manage the inter-organisational relationship (in terms of facilitating information sharing and trust) are a key consideration of this research project. This System Trust is discussed in the next section.

8.2.7. System Trust



The three aspects of System Trust discussed in this section are the practical aspects relating to trust which need to be considered in the supply chain relationship. System Trust refers to the impersonal technology structures that are in place to aid future interactions between supply chain partners. Cripps, Salo and Standing (2009) define System Trust as:

> *"The subjective probability by which organisations believe that the underlying technology infrastructure is capable of facilitating transactions according to their confident expectations."*

Trust in the inter-organisational systems is seen to be an important factor in the optimal use of these systems in creating supply chain competitive advantage (Cripps, *et al.*, 2009). However, it needs to be considered that using IT in inter-organisational relationships also impersonalises the relationship, which can have a resultant negative affect on trust in the relationship.

Thus, a balance between trust and IT-enablement of the supply chain is needed. When trust exceeds the capabilities of the system, this leads to overtrust and misuse. Conversely, where trust falls short of the capabilities of the system, this leads to distrust and disuse. Where trust and the system capabilities match, this is referred to as calibrated trust and appropriate use of the IT systems in place.

As discussed in Chapter Five, Gao and Lee (2005) propose three components of system trust, namely: purpose, performance and process. These are also referred to by Cheng, Lai and Singh (2007) as nature of use (performance), nature of

processes (process), and nature of IT (purpose). In addition to these three components, the model includes controls as a means of mitigating the existence of risk in the supply chain relationship. These components of System Trust in supply chain technology are expected to result in more appropriate reliance and avoid unintended competitive behaviour caused by inappropriate use of technology.

1. *Purpose:* The purpose of the IT used can often be misunderstood, thus all supply chain partners need to ensure a common understanding of the purpose and intended use of the technology managing the relationship.

2. *Performance:* Feedback regarding the performance of the IT managing the relationship can promote appropriate reliance. This element of System Trust is reliant on the Ability construct of the Trustworthiness component.

3. *Process:* The process that needs to be followed in using the technology needs to be communicated and adhered to by all supply chain members. In order to achieve an IT-enabled supply chain requires business processes in each supply chain partner to be redesigned in order to adapt to the processes supported by the system implemented (Jharkharia & Shankar, 2004). Failure to adapt business processes is generally considered a major contribution to the ineffective operation of the supply chain. If the supply chain partners do not adapt business processes to fit the IT systems implemented, then the information provided by the supply chain systems is likely to be inadequate. This would not allow the establishment of trust in the inter-organisational relationship.

4. *Controls:* Controls can be used to manage the level of risk in the supply chain relationship. An alternative method of dealing with risk is the use of control systems. However, trust and controls as means of handling risks cannot be mutually exclusive. If the level of trust is

lower than the risk in the relationship, control systems can bridge the gap and reduce the level of risk to the extent to which trust would be an effective control. This however needs to be carefully balanced. If the control system in place is too stringent it will not foster the development of trust. This is a result of little or no perceived risk in the relationship and hence any trustworthiness is seen as a result of the controls and not the trustee.

From the empirical findings, the following was noted with regards to System Trust:

1. The questionnaire findings established that costs related to implementing IT systems to manage the inter-organisational relationship as being the primary barrier to effective use of IT in this regard. These potential costs were discussed in the literature and attributed to implementation, training and configuring business processes. This establishes the need to include the process and performance components in the model.

2. The respondents were asked whether adequate infrastructure is available for information sharing among their supply chain partners. The participants believe that the infrastructure for information sharing in the supply chain is inadequate. However, the literature points to the existence of adequate infrastructure in automotive supply chains for information sharing. This points to the existence of other issues contributing to the poor flow of information. Thus, this confirms the need to ensure that the purpose of systems used in the inter-organisational relationship is understood by all supply chain partners to promote effective use of IT systems in place.

3. The respondents' view of IT impact on trust and information sharing was sought. The following responses were the most significant:

    a. Improving both trust and information sharing will ensure supply chain efficiency and enhance decision making.

b. IT will allow for better, more honest communication between supply chain partners, which will in turn lead to trust formation between supply chain partners.

c. IT will enable supply chain partners to share information and integrate processes, thereby reshaping the inter-organisational dynamics and resulting in a more efficient supply chain.

4. A few respondents had more adverse views of the impact of IT on trust; these include concerns about the risks of confidentiality breaches, and concerns about the lack of guarantee of information integrity. These responses point to trust issues within the supply chain and the need to establish controls to reduce this risk for supply chain partners.

Thus, supply chain partners need to trust each other based on an assessment of ability, benevolence and integrity of the supply chain partner, and knowledge of the purpose, process, performance and controls related to the IT system used to manage the inter-organisational relationship. If the components of the supply chain partner trustworthiness and system trust are satisfied, this leads to trusting behaviour in the supply chain relationship. This trusting behaviour is discussed in the next section.

8.2.8. Trusting Behaviour

Trusting Behaviour is the ability to voluntarily depend on a supply chain partner (based on System Trust and awareness of the supply chain partner's perceived trustworthiness). This component of the research model represents the extent to which a party to the supply chain relationship is willing to engage in the supply chain relationship based on perceptions of the supply chain partner and trust in the

system that facilitates the relationship. Thus, this component of the model is the outcome of establishing information sharing and trust in the inter-organisational relationship.

Li (2004) defines trusting behaviour as the trustor's actions to depend on the trustee, or make the trustor vulnerable to the trustee. Thus, having considered the characteristics of the supply chain partner and of the system used in the inter-organisational relationship, the supply chain partner can confidently cooperate in the supply chain relationship, and thereby expose themselves to the risk of supply chain transactions.

From the literature survey findings, Game Theory (in particular the Prisoner's Dilemma) is applicable for considering trusting behaviour. This theory is appropriate in a supply chain context which consists of numerous supply chain partners (or players). The Prisoner's Dilemma is used to study the choices made when costs and benefits are not fixed, but are rather dependent upon other players and the shared information available to them. According to Flowerday and Von Solms (2006), the amount of information that the various players have about each other is a key determinant of behaviour. Similarly, in a supply chain context where information is shared freely by all members of the supply chain, the benefits to all members is an increased level of trust in the inter-organisational relationship, and therefore effective and efficient supply chain operations.

The empirical findings related to trusting behaviour are as follows:

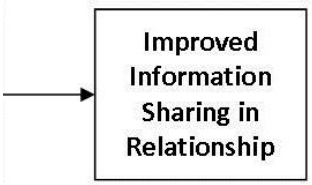
1. In the case study of Company B, the lack of perceived trustworthiness of the supply chain partners led to production temporarily shutting down at the OEM and the supplier incurring costs of shipping components from an overseas-based partner and penalties associated with halting production at the OEM. Thus, trusting behaviour had not been established in this supply chain relationship.

2. From the questionnaire findings, it was established that the participants perceived a trusting relationship to not exist with supply

chain partners. This response was true for each of the supply chain tiers, as well as the overall response. Thus, proximity of the supplier to the OEM does not ensure trust in the inter-organisational relationship, and the issue of trust is exacerbated the further down the supply chain tiers. This finding is consistent with previous studies which point out the lack of trust in supply chain relationships.

The trusting behaviour, which is essentially a willingness to engage in the relationship, leads to a willingness to share information with the supply chain partner. Thus, the output of this trusting behaviour is a willingness to share information within the supply chain. This improved information sharing in the supply chain relationship is discussed in the next section.

8.2.9. Improved Information Sharing in Relationship



Where adequate levels of trust exist in the inter-organisational relationships, then information sharing among supply chain partners is maximised. With increased information sharing, transactional costs are reduced and efficiency improved, thereby allowing the supply chain to compete effectively. At the same time, the more information that is shared, the more trust can be established within the supply chain.

From the literature surveyed, it was found that better decision making can occur if there is sufficient information. The resultant improved operational performance experienced, results in improved trust in the supply chain partners that have shared the information. Conversely, the sharing of information will only occur if there is a sufficient level of trust among supply chain partners. If there is insufficient trust in supply chain partners there will be unwillingness to share

information. This is comparable to previous explanations of the Prisoner's Dilemma.

From the empirical findings, the following is relevant in terms of improved information sharing:

1. At Company B, information regarding the machine failure and possible production stoppages should have been shared. The lack of trust resulting from a failure to share this information in this supply chain resulted in production temporarily shutting down at the OEM and the supplier incurring costs of shipping components from an overseas-based partner and penalties associated with halting production at the OEM. Thus, if trusting behaviour had been established in the relationship, information would have been shared and resulted in improved supply chain performance.

2. It is important to note that the questionnaire findings established that the majority of the information shared is concerned with inventory and logistical information which affect the production process. The accuracy of this information is essential to the effective and efficient operation of the production processes across the supply chain.

3. As discussed in the literature, the level of trust and information sharing between supply chain partners was viewed as complementary. This is consistent with the Prisoner's Dilemma previously discussed. The amount of information that the various players have about each other is a key determinant of behaviour. Similarly, in a supply chain context where information is shared freely by all members of the supply chain, the benefits to all members is an increased level of trust in the inter-organisational relationship, and therefore effective and efficient supply chain operations. Thus, the respondents were questioned about the extent of information sharing in their supply chain relationships. The findings revealed that automotive suppliers are hesitant to share

information. This is consistent with the findings of the participant observation discussed previously in this chapter.

Thus, based on literature and empirical findings, a cyclical relationship between trust and information sharing is established. Improvements in trust lead to improvements in information sharing. Similarly, improvements in information sharing lead to improved trust levels. Thus, the efficiency and effectiveness of the supply chain is optimised. The next section discusses components that were considered for inclusion in the research model, but were not incorporated in the model described above.

8.2.10. Components Not Included in the Model

In the creation of the model described above, a few other components were considered. These components were eliminated prior to the expert review process. These components and the reasons for not including these in the model are described below.

Initially, Trusting Intention was included as an additional step before Trusting Behaviour. This was excluded as an intention to trust was established when the trustworthiness of the supply chain partner and system were assessed. Thus, this was an unnecessary step in the model.

ICT Use in Supply Chain Relationship was included as an additional construct. However, this was seen to be unnecessary as IT systems are used in all the supply chain relationships. Therefore, the problem of trust in the supply chain relationship was not reliant upon the use of the IT systems, but rather on trust in the system. Therefore, the System Trust component was included in place of this construct.

As a final step to the model, a supply chain competitiveness construct was initially included. However, this was not the desired outcome of the research model and was therefore removed.

Having described the development of the research model in the sections above, the remaining element of the primary data needs to be described. This final step of the primary data collection is the expert review of the model described above. This is analysed in the section that follows.

8.3. The Expert Review Process

This section describes the process whereby the research project's main contribution (namely the model) was critically analysed by a number of experts. By following the Delphi technique, as part of the Design Science Methodology followed in this study, a total number of seventeen experts in the field of trust and supply chains were approached and requested to conduct a critical analysis of the study's contribution.

According to Skulmoski, Hartman and Krahn (2007), the experts used for a Delphi study should meet four criteria: (i) knowledge and experience relevant to the research; (ii) capacity and willingness to participate; (iii) sufficient time to participate; and (iv) effective communication skills. These four criteria have been met by the experts engaged in for the evaluation of the research model.

The Delphi technique employed in this study took the form of an expert review to evaluate the research artifact. Hartman and Baldwin (1995) also made use of a Delphi technique to validate the research outcome. Thus, this is a valid means of evaluating the research artifact. This evaluation of the research artifact is a necessary step in the Design Science Methodology (as described in Chapter Six). The use of expert review also enhances the credibility of this research project.

This critical analysis took place over four rounds of review. The respondents were asked to comment on: the suitability of the model for addressing the stated research objectives; the use of supply chain partner trustworthiness and system trust to constitute trust in the supply chain relationship (as well as inquiring about the need for additional components in these areas); and the cyclical relationship between trust and information sharing established in this research project.

General comment on the research model was also requested. The feedback from each round of review was used to refine the research model. The details of each of the rounds are provided in the sections below.

8.3.1. Expert Review Round One

In the first round of expert review, two experts in supply chain management were approached and requested to review the research contribution. The responses from the reviewers were summarised and used to further develop and refine the study. The main recommendation's and results obtained from this round were:

1. Both reviewers viewed the research objectives and outcomes to be original, relevant and significant.

2. A reviewer stated that the use of the Prisoner's Dilemma and the Organisational Information Processing Theory (OIPT) in this study was highly significant, but it required more detail. As a result, the explanation of these theories (in terms of the model components) was included.

3. With regards to the OIPT, the information processing needs and capabilities and components need to be elaborated on in the model. In this regard, the information sharing components of the model refer to the information processing needs, while the System Trust provides the basis for information processing capabilities.

4. A reviewer appreciated the use of a real-world background in the South African Automotive industry to explore the role of trust and information sharing in supply chain management.

The comments from these experts pointed to the use of the Prisoner's Dilemma and OIPT as relevant; however, it was not immediately apparent when reviewing the model. A better explanation of how these theories related to the model was

required (and thus included). A balance between information shared and the use of IT was recognised as being important.

8.3.2. Expert Review Round Two

After the first round of expert reviews, the research model was updated and a second round of review commenced. In the second round, four experts in the area of trust research were asked to assess the study. The comments and opinions were summarised and used to again refine the study. The notable responses were as follows:

1. One reviewer believed this study to be of value to supply chain management and the automotive industry. Another reviewer viewed this study as advancing a very important concept of trust in supply chain information management paradigms.

2. Two of the reviewers felt that the cyclical relationship between trust and information sharing needs to be elaborated on. This concept is referred to throughout the study, but is not explicitly expressed in the research model. For this reason, a feedback loop was included in the refined model shown in section 8.4.

3. One reviewer required an explanation of the attainment of competitive supply chains through ensuring adequate trust and information sharing. The reviewer saw this as an important point that had not been adequately discussed. An explanation of this is provided in Chapter Three.

4. One reviewer was not satisfied with the explanation of the Prisoner's Dilemma and how this is intertwined with the main themes of this research project. This explanation was again elaborated on.

The notable change required from this round of review was the need for a feedback loop from the final information sharing component. The study refers to a

cyclical information sharing-trust relationship; however, this was not explicitly depicted in the research model.

8.3.3. Expert Review Round Three

A third round of expert review was then conducted. This final round of assessment involved eleven experts who have made recognisable contributions to the area of trust and/or supply chain management research in recent years. These reviewers include international contributors. The following responses were attained:

1. Reviewers complemented the separation of perceptions of supply chain partner trustworthiness from that of System Trust.

2. Reviewers had difficulty distinguishing between System Trust and trusting behaviour, as they viewed the system as being an automated set of behaviours. In this regard an explanation of System Trust as being a set of requirements that must be met in order to establish a trusting behaviour is needed.

3. Reviewers suggested that information used for operations (transactional data) and information used for decision making (analytical data) should be treated differently in this model. This was however not included, as regardless of the type of information, the same factors affect the distribution of the information in the supply chain.

4. Reviewers agreed that perceptions of risk and trustworthiness need to be separated from Trusting Behaviour.

These expert review comments pointed to the need to better explain certain aspects of the research model. However at this point no notable changes were included to the model.

8.3.4. Expert Review Round Four

In the final round of review, the research model was again sent to the eleven experts identified in the previous round. A detailed explanation of the concepts which raised concern in the previous round of review was provided.

In this round, agreement was obtained from all but two of the experts. The remaining experts still felt that information used for operations (transactional data) and information used for decision making (analytical data) should be treated differently in this model. However, this was beyond the scope of the research. This research project seeks to investigate the relationship between trust and information sharing regardless of the type of information shared. Therefore, the study did not consider the differences in these types of information. This can be considered as a possibility for future research.

Having considered all feedback obtained on the model through the four rounds of expert review, the model was refined and is depicted in the section that follows.

8.4. The Research Artifact: Supply Chain Trust Model

After refinement of the research model through the expert review process described above, the model is provided to enhance trust in automotive supply chains. The model is illustrated in Figure 8.4.

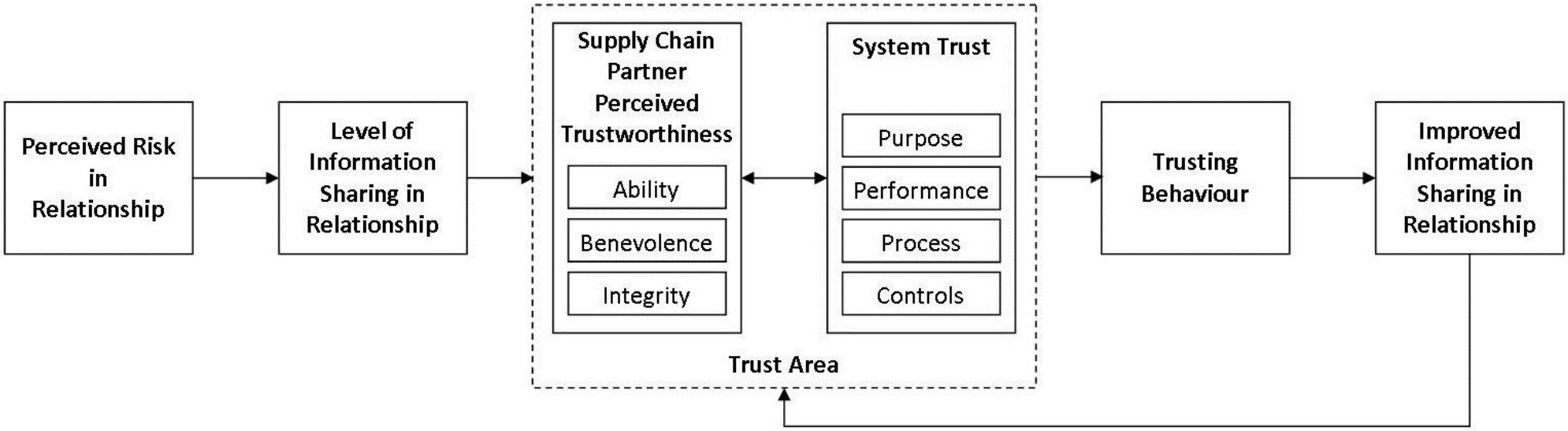


Figure 8.4: A Model for Enhancing Trust in Automotive Supply Chains Through Information Technology

The only significant change to the model is the inclusion of the feedback loop from the final components. This acknowledges the cyclical relationship between trust and information sharing alluded to in the discussion provided in previous chapters. The remaining comments from the expert reviews were related to previously incomplete explanations of the model and these have been addressed and provided in the previous sections.

8.5. Conclusion

This chapter presented the proposed model for enhancing trust in automotive supply chains through IT. A detailed explanation of the six key components of the proposed model was provided. These six components are perceived risk, level of information sharing, supply chain partner trustworthiness, system trust, trusting behaviour and improved information sharing.

The refinement of this model through the use of the Delphi technique and expert reviews were detailed in this chapter. Following this refinement, the main contribution of this research project, the model for enhancing trust in automotive supply chains through IT, was presented.

This study aimed to formulate a model that can be used to enhance inter-organisational trust in automotive supply chains through the effective use of IT. In order to fulfill this objective, the secondary objectives were investigated, namely:

1. The factors that can enhance trust within an inter-organisational relationship in South African automotive supply chains. Thus, perceived risk and trustworthiness were included in the model.

2. The relationship between trust and information sharing in South African automotive supply chains. Thus, a cyclical relationship between trust and information sharing was established in the model described above.

3. The IT requirements to facilitate the trust-information sharing relationship in South African automotive supply chains were investigated. This objective was addressed through the inclusion of the System Trust components.

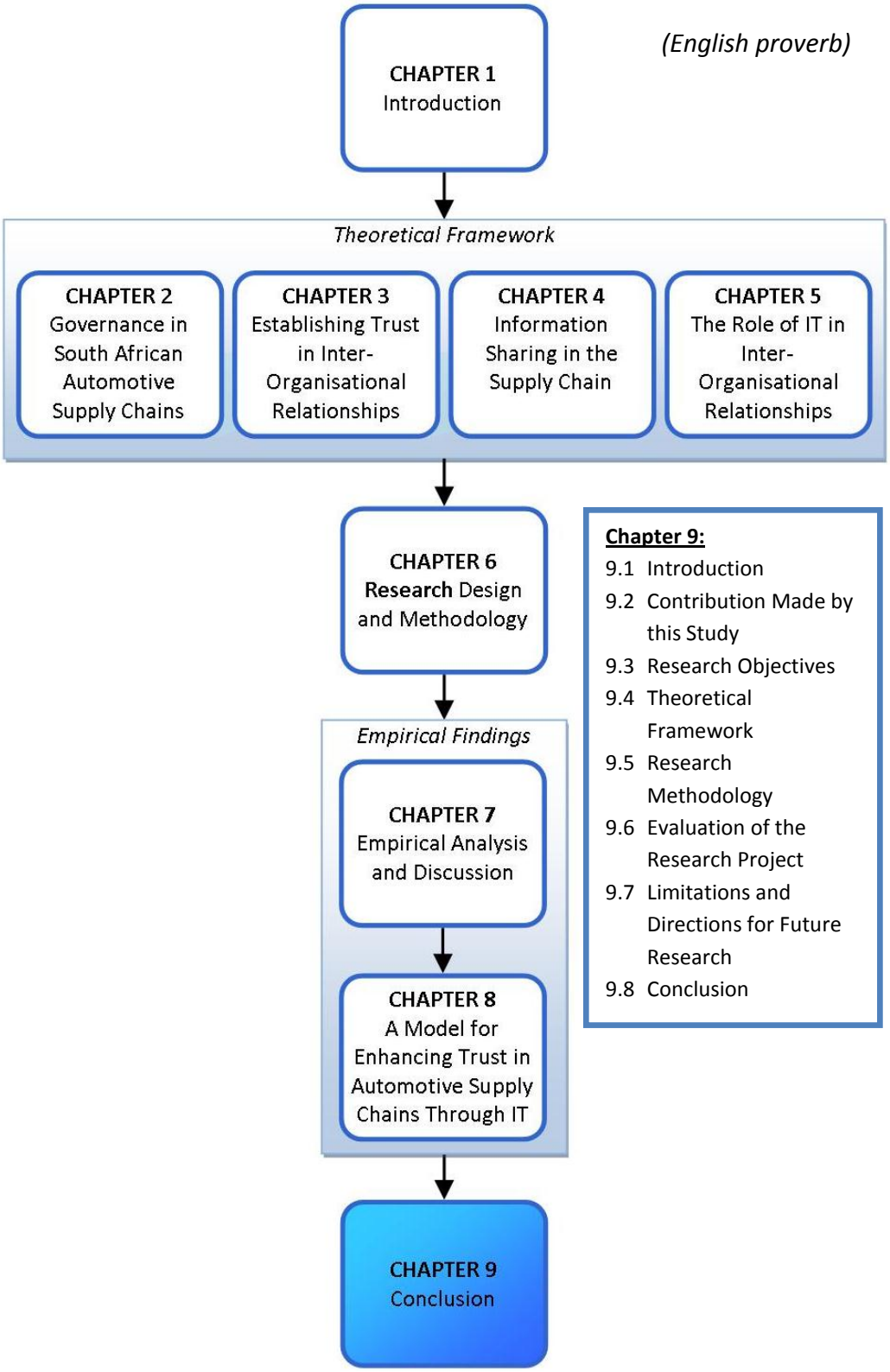
The following chapter will provide a summative conclusion of key aspects of this study. This concludes this research project by applying the knowledge gained from the research to the research objectives for this study.

Chapter 9:

Conclusion

"All good things must come to an end."

(English proverb)



Chapter 9:

9.1 Introduction
9.2 Contribution Made by this Study
9.3 Research Objectives
9.4 Theoretical Framework
9.5 Research Methodology
9.6 Evaluation of the Research Project
9.7 Limitations and Directions for Future Research
9.8 Conclusion

9.1. Introduction

The previous chapter discussed the findings and recommendations of the study and provided the research model which can be used to enhance trust in automotive supply chains through the use of Information Technology (IT). The model presented in this study was based on secondary data collected from a review of relevant literature and from primary data obtained through participant observations and the web-based survey developed as part of the Design Science Methodology approach used in this study. This model was then refined through the use of expert reviews using the Delphi technique, which satisfied the Design Science requirement that the evaluation of the research artifact be iterative.

This chapter provides a summative conclusion to the research project and begins by discussing the contribution made by this study. The research objectives, theoretical framework and research methodology are then outlined. Following this, an evaluation of the research project and the limitations and directions for future research are detailed.

9.2. Contribution Made by this Study

It has been highlighted that the efficient and effective operation of a supply chain results in an improved competitive position for the supply chain. This study set out to develop a model to improve the efficiency and effectiveness of supply chain operations through improving the level of trust and information sharing in inter-organisational relationships.

The model developed and discussed in Chapter Eight is the primary contribution of this research study. This model was developed considering the unique aspects of automotive supply chains.

The specific contribution made through the development of this model was the proposal of a cyclical relationship between trust and information sharing. Previous studies have established the value of information sharing in enhancing trust in

inter-organisational relationships, or the role of trust in promoting information sharing. Thus, considering these previous studies, this research project suggested and evaluated the cyclical relationship.

9.3. Research Objectives

The research question that this study investigates is: ***How can IT enhance inter-organisational trust in South African automotive supply chains?*** The primary objective of this research project is to formulate a model that can be used to enhance inter-organisational trust in automotive supply chains through the effective use of IT.

In order to achieve the primary objective, the following secondary objectives were considered:

1. *To determine the factors that can enhance trust within an inter-organisational relationship in South African automotive supply chains.*

   The theory of this research objective was addressed in Chapter Three. From the literature survey several definitions of trust were provided. In addition to the definition of trust, the literature survey revealed the importance of trust in inter-organisational relationships, namely: the reduction of transaction costs, the improvement of supply chain performance, and the sharing of information for mutual benefit. Several key trust models were discussed in this chapter along with the components suggested in these models.

   From the empirical findings, factors relating to the ability, benevolence and integrity of the supply chain partners were confirmed. These findings were obtained through the web-based questionnaire. In particular, respondents agreed that supplier performance and prior contact with the supply chain partner were relevant for establishing trust. This led to the inclusion of perceived risk and supply chain partner trustworthiness in the model.

2. *To determine the relationship between trust and information sharing in South African automotive supply chains.*

   The theory of this research objective was addressed in Chapter Four. From the literature survey it has been noted that the benefits of information sharing in supply chains include coordinating and reducing uncertainty in the supply chain. In addition, the literature has shown that certain requirements need to be met in order for information sharing to occur. These prerequisites need to be considered in conjunction with barriers that exist with regard to information sharing in supply chains.

   From the empirical findings, aspects relating to the Prisoner's Dilemma and the Organisational Information Processing Theory (OIPT) were confirmed through the case study and questionnaire. The findings from literature and empirical work led to the proposal of a cyclical relationship between trust and information sharing. This proposed relationship was confirmed by the expert reviews. These findings led to the inclusion of two information sharing-related components of the model. A feedback loop representing the cyclical relationship was also included after feedback from the expert reviews.

3. *To determine the IT requirements to facilitate the trust-information sharing relationship in South African automotive supply chains.*

   The theory of this research objective was addressed in Chapter Five. From the literature survey it has been noted that the most important impact IT has in the supply chain is related to the sharing of information which enhances decision making. In addition, the literature has shown that there are considerable barriers to IT implementation in supply chains. The literature survey has also provided an analysis of the concept of System Trust. The dimensions of System Trust: purpose, performance and process, need to be

considered in order to ensure trust in systems, and therefore optimal information flow.

The empirical findings described the use of IT to improve information sharing between supply chain partners, which will, in turn, lead to trust formation between supply chain partners. This in turn reshapes the inter-organisational dynamics and results in a more efficient supply chain. The dimensions of System Trust and the need to establish control mechanisms was also confirmed in the questionnaire findings.

Based on these theoretical and empirical findings and following the Design Science Methodology, the model for enhancing trust in automotive supply chains through IT was proposed. This was then refined through expert reviews in the Delphi technique. The refined model which fulfils the primary objective of this research project was then presented.

9.4. Theoretical Framework

In order to develop the model for enhancing trust in automotive supply chain through IT, four key frameworks were used, namely: Game Theory (specifically the Prisoner's Dilemma), Organisational Information Processing Theory, Mayer, Davis and Schoorman's (1995) Proposed Model of Trust and Han, Liu, Sun and Yu's (2006) Relationship Among Trust Constructs.

The Prisoner's Dilemma is used to study the choices made when costs and benefits are not fixed, but are rather dependent upon other players and the shared information available to them. According to Flowerday and Von Solms (2006), the amount of information that the various players have about each other is a key determinant of behaviour. Similarly, in a supply chain context where information is shared freely by all members of the supply chain, the benefits to all members is an increased level of trust in the inter-organisational relationship, and therefore effective and efficient supply chain operations.

The Organisational Information Processing Theory identifies information processing needs and capabilities and the need to obtain optimal performance through a balance of these factors. The theory views quality information as a requirement in order to handle uncertainty and improve decision making. According to Premkumar, Ramamurthy and Saunders (2005), organisations have two strategies for dealing with this uncertainty:

1. Develop buffers, for example inventory buffers to reduce the uncertainty related to demand and supply; or

2. Enhance information flow, for example implementing integrated information systems to improve information flow and reduce uncertainty.

Similarly, in supply chains, improving information flow between supply chain partners reduces uncertainty in the relationship.

Mayer, *et al.*'s (1995) Proposed Model of Trust distinguishes between trustor and trustee characteristics that foster a trusting relationship. Every individual's propensity to trust will differ, thus the *Trustor's Propensity* referred to in the model is a general willingness to trust others. This influences how much trust we instill in another party before considering any of the trustee's characteristics. Mayer, *et al.* (1995) propose three characteristics that form a foundation for the perception of trustworthiness. These characteristics are ability, benevolence and integrity.

Han, *et al.*'s (2006) Relationship Among Trust Constructs is based on the definitions of trust adopted by the social sciences. Han, *et al.* (2006) view the determinants of trust in distributed networks to be the offer of incentives for good behaviour, predictions of future behaviour and the detection of selfish and malicious entities. Supply chains are an example of these distributed networks thus making this model relevant for this study.

The theoretical framework included multiple trust and information sharing models and theories which provided a firm foundation for the development of the research

model. The next section provides an overview of the research methodology used to conduct the study.

9.5. Research Methodology

This study was conducted within an interpretivist paradigm, with an important influence from the Design Science paradigm. The research methodology applicable was the qualitative approach as this is consistent with the interpretivist paradigm adopted for the study. The Design Science Methodology and Delphi technique were used in this study. The research format had a predictive purpose and made use of inductive reasoning.

Having considered the various options for approaching Design Science research, this study adopted Hevner, March, Park and Sam's (2004) seven guidelines. This is the most widely cited set of guidelines for Design Science research and is thus relevant in this study. The seven steps were adopted in this research project as follows:

1. *Design as an Artifact*: This study produced a model to enhance inter-organisational trust in automotive supply chains through the effective use of IT.

2. *Problem Relevance*: In this study the problem under investigation is that insufficient trust and information sharing contribute to the ineffectiveness and inefficiency of a supply chain's operations. A solution was proposed in terms of the use of IT in this context.

3. *Design Evaluation*: The research model is evaluated through applicable data gathering and analysis techniques (as described below).

4. *Research Contributions*: The contribution of this study is the research model, which is considered a foundation contribution as it extends the knowledge base of the field. In particular, the cyclical relationship between trust and information is a significant contribution.

5. *Research Rigor*: In terms of rigor, the research project employed valid data gathering and analysis techniques and the model was evaluated using expert review.

6. *Design as a Search Process*: This guideline was satisfied through the use of case studies to ensure applicability to the problem domain. Additionally, the iterative nature of the search process is achieved through the use of the Delphi technique.

7. *Communication of Research*: This guideline is satisfied by the publishing of the journal article included as Appendix A. Another research paper outlining the contribution of this research project will be written.

This study makes use of case studies, web-based questionnaires and expert reviews as primary data collection methods, and literature survey as secondary data collection. The approach to using these data collection techniques is depicted in Figure 9.1.

As shown in Figure 9.1, the literature survey was used to form the theoretical base for this study. This theoretical base and the findings from the case studies influenced the creation of the questionnaire used to gather empirical data. These empirical findings, combined with the secondary data, led to the creation of the research artifact (the model for enhancing trust in automotive supply chains through IT). This model was then evaluated using the expert reviews as part of the Delphi technique. Thus an iterative set of reviews were undertaken.

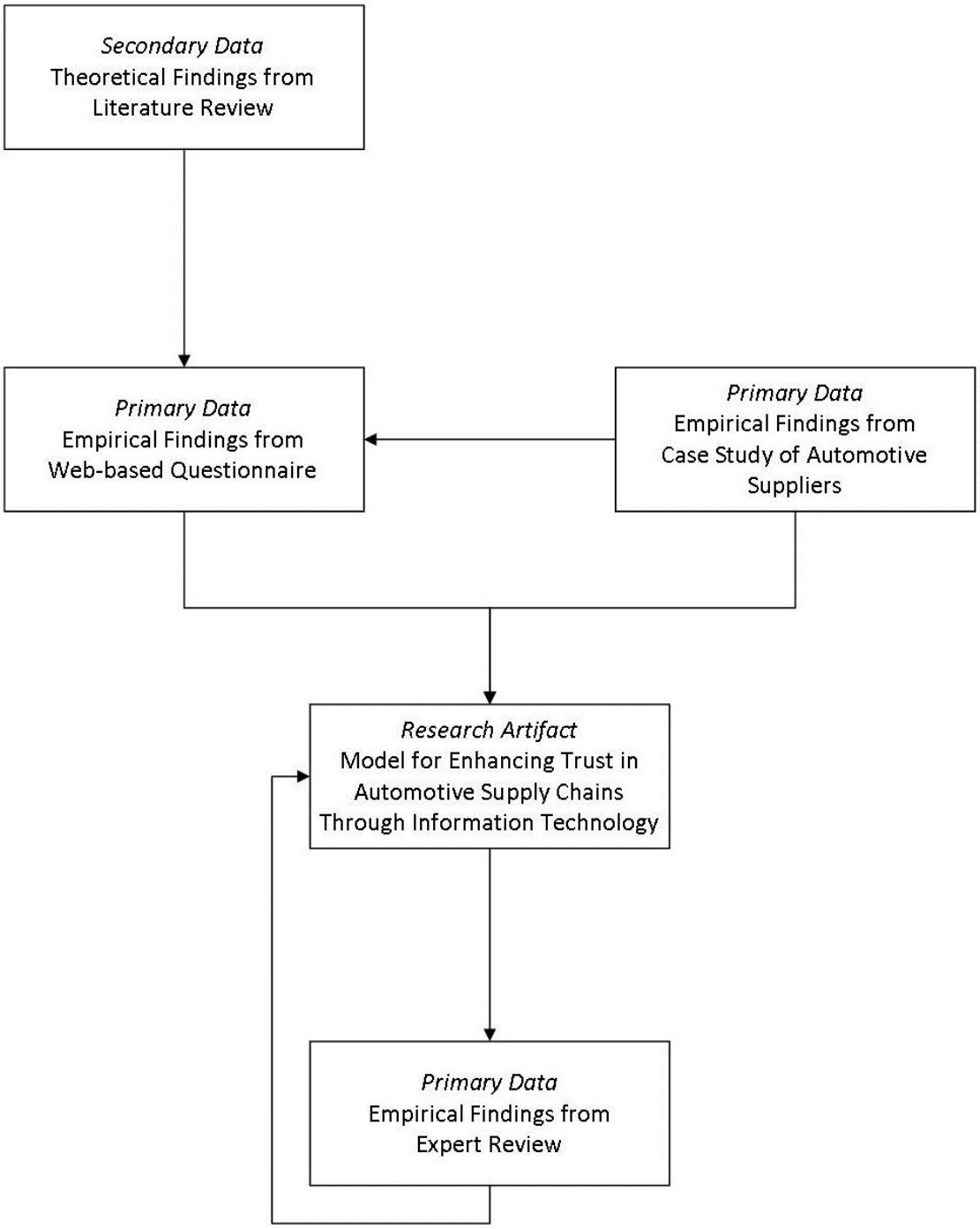


Figure 9.1: Data Collection Process

9.6. Evaluation of the Research Project

Research evaluation is a necessary step in order to ensure the credibility and integrity of the research project. Oates (2006) provides a set of equivalent criteria for positivist and interpretivist research. These are shown in Table 9.1.

Table 9.1: Quality in Positivist and Interpretivist Research (Oates, 2006)

Positivism	Interpretivism
Validity	Trustworthiness
Objectivity	Confirmability
Reliability	Dependability
Internal validity	Credibility
External validity	Transferability

As this is an interpretivist study, the interpretivist criteria apply to this research as follows:

1. *Trustworthiness*: With respect to the Delphi technique employed to evaluate the artifact produced as part of the Design Science process, the trustworthiness of the experts used to refine the research model was evaluated. The experts used in this process are respected in their respective field. Experts were selected from both trust and supply chain management research. Thus, the recommendations made by these experts can be considered trustworthy.

2. *Confirmability*: This criterion has been met through the use of multiple data collection techniques culminating in the expert review in order to confirm the outcome of the research. The use of case studies and questionnaire findings confirmed the theoretical findings. This led to the development of the research model which was then confirmed through expert reviews.

3. *Dependability*: Dependability is established through the use of literature from recognised authors and the contribution from experts in the field of study in the form of the expert review. The use of established theories and models that have been tested in numerous research projects add to the dependability of this project. The theories and models used in this study include: the Prisoner's Dilemma, the Organisational Information Processing Theory, Mayer, *et al.*'s (1995)

Proposed Model of Trust and Han, *et al.*'s (2006) Relationship Among Trust Constructs.

4. *Credibility*: Credibility has been achieved through the use of multiple data collection techniques and the use of expert review (as described with regards to confirmability).

5. *Transferability*: Transferability has been achieved as the research model can be applied to other inter-organisational settings with similar characteristics.

Through the application of these five criteria, the research project can therefore be considered credible. In addition, Hevner, *et al.* (2004) provide five options for evaluating Design Science research. These evaluation methods are depicted in Table 9.2 below.

Table 9.2: Design Evaluation Methods (Hevner, *et al.*, 2004)

1. Observational	Case Study: Study artifact in depth in business environment
	Field Study: Monitor use of artifact in multiple projects
2. Analytical	Static Analysis: Examine structure of artifact for static qualities (e.g., complexity)
	Architecture Analysis: Study fit of artifact into technical IS architecture
	Optimization: Demonstrate inherent optimal properties of artifact or provide optimality bounds on artifact behavior
	Dynamic Analysis: Study artifact in use for dynamic qualities (e.g., performance)
3. Experimental	Controlled Experiment: Study artifact in controlled environment for qualities (e.g., usability)
	Simulation . Execute artifact with artificial data
4. Testing	Functional (Black Box) Testing: Execute artifact interfaces to discover failures and identify defects
	Structural (White Box) Testing: Perform coverage testing of some metric (e.g., execution paths) in the artifact implementation
5. Descriptive	Informed Argument: Use information from the knowledge base (e.g., relevant research) to build a convincing argument for the artifact's utility
	Scenarios: Construct detailed scenarios around the artifact to demonstrate its utility

This research project made use of the following Design Science evaluation techniques:

1. *Observational*: Case Studies of two automotive suppliers informed the development and refinement of the research artifact.

2. *Analytical*: This research project made use of expert reviews to analyse the structure, fit and performance of the artifact. The outcomes of these expert reviews were incorporated into the final research artifact.

Through the use of these evaluation methods, the research project is considered to have met the requirements of Design Science and thus is a valid Design Science research project.

9.7. Limitations and Directions for Future Research

This study attempts to address the lack of trust experienced among members of the automotive supply chains. A specific focus of this research project was on the inter-relation between trust and information sharing. With regards to information sharing, the distinction between types of information shared by supply chain partners was not considered in this study. This point was raised by one of the expert reviews.

In this research project the difference between analytical and transactional data was seen as irrelevant. The focus of the research project was to establish the sharing of information to enhance trust regardless of the type of information. The different means of sharing and handling these two distinct types of supply chain information can be considered in further research.

9.8. Conclusion

This thesis presented a study of the inter-organisational relationships in automotive supply chains, and the role of trust and information sharing in improving the

efficiency and effectiveness of the supply chain operations. The outcome of this study was the development of the model for enhancing trust in automotive supply chains. The value of this study can be seen to be the resultant improvement in supply chain competitiveness when trust is optimised in inter-organisational relationships.

Reference List

Agarwal, A., & Shankar, R. (2003). On-line trust building in e-enabled supply chain. *Supply Chain Management: An International Journal, 8*(4), pp. 324-334.

Ahmad, A., Guy, G., & Wasana, B. (2011). Developing an IS-impact decision tool: A literature based design science roadmap. *European Conference on Information Systems.* Helsinki, 9-11 June.

Ahmadjian, C., & Lincoln, J. (2001). Keiretsu, governance and learning: Case studies in change from the Japanese automotive industry. *Organization Science, 12*(6), pp. 683-701.

Akkermans, H., Bogerd, P., & Van Doremalen, J. (2004). Travail, transparency and trust: A case study of computer-supported collaborative supply chain planning in high-tech electronics. *European Journal of Operational Research, 153*, pp. 445-456.

Amiri, A. (2006). Designing a distribution network in a supply chain system: Formulation and effecient solution procedure. *European Journal of Operational Research*, *171*(1), pp. 567-576.

Andreoni, J., Harbaugh, W., & Vesterlund, L. (2003). The carrot or the stick: Rewards, punishment and cooperation. *The American Economic Review, 93*(3), pp. 893-902.

Ayling, R., & Mewse, A.J. (2009). Evaluating internet interviews with gay men. *Qualitative Health Research*, *19*(4), pp. 566-576.

Barnes, J., & Morris, M. (2008). Staying alive in the global automotive industry: What can developing economies learn from South Africa about linking into global automotive value chains? *The European Journal of Development Research, 20*(1), pp. 31-55.

Black, A. (1998). The impact of trade liberalization on the South African automotive industry. *TIPS Policy Forum.* Gauteng: 9-11 September.

Blackwell Publishing. (2010). Company brief: General. *Africa Research Bulletin: Economic, financial and technical series, 47*(3), pp. 18645-18648.

Burnes, B., & West, P. (2000). Applying organisational learning: Lessons from the automotive industry. *International Journal of Operations and Production Management, 20*(10), pp. 1236-1251.

Butler, J. (1999). Trust expectations, information sharing, climate of trust, and negotiation effectiveness and efficiency. *Group & Organization Management, 24*, pp. 217-238.

Cadbury (2004). *The financial aspects of corporate governance.* London: Professional Publishing Ltd.

Callaghan, M., & Shaw, R. (2001) Relationship orientation: Towards an antecedent model of trust in marketing relationships. *Proceedings of the Australian and New Zealand Marketing Academy Conference 2001*., pp. 1-9, ANZMAC, Dunedin.

Carlsson, S., Henningson, S., Hratinski, S., & Keller, C. (2011). Socio-technical IS design science research: Developing design theory for IS integration management. *Information Systems E-Business Management, 9*, pp. 109-131.

Chatterjee, S. (2009). Trust and learning as moderators in achieving global supply-chain competitiveness: Evidence from the Chinese and Indian auto-component sectors. *Global Business Review, 10*(1), pp. 87-102.

Cheng, T., Lai, K.H., & Singh, N. (2007). Intra-organizational perspectives on IT-enabled supply chains. *Communications of the ACM, 50*(1), pp. 59-65.

Cheung, C. M. K., & Lee, M. K. O. (2001). Trust in Internet shopping: Instrument development and validation through classical and modern approaches. *Journal of Global Information Management*, 9(3), pp. 23-35.

Childerhouse, P., Hermiz, R., Mason-Jones, R., Popp, A., & Towill, D. (2003). Information flow in automotive supply chains - Identifying and learning to overcome barriers to change. *Industrial Management and Data Systems, 103*(7), pp. 491-502.

Chu, S-Y., & Fang, W.C. (2006). Exploring the relationships of trust and commitment in supply chain management. *The Journal of American Academy of Business, Cambridge, 9*(1), pp. 224-228.

Clarke, T. (2004). *Theories of corporate governance: The philosophical foundations of corporate governance.* New York: Routledge.

Collis, J., & Hussey, R. (2009). *Business research: A practical guide for undergraduate and postgraduate students.* London: Palgrave Macmillan.

Commission on Global Governance. (1995). *Our Global Neighbourhood.* Oxford: Oxford University Press.

Cooper, D., & Schindler, P. (2003). *Business research methods* (8th ed.). New York: McGraw-Hill/Irwin.

Costa, A., & Bijlsma-Frankema, K. (2007). Trust and control interrelations: New perspectives on the trust-control nexus. *Group and Organization Management, 32*(4), pp. 392-406.

Coughlan, P. & Rukstad, M.G., (2001). *DaimlerChrysler knowledge management strategy*. Boston: Harvard Business School Publishing.

Covey, S. (2008). *The speed of trust: The one thing that changes everything.* New York: Free Press.

Creswell, J. W. (2003). *Research design: Quantitative, qualitative, and mixed methods approaches*. Thousand Oaks: SAGE.

Cripps, H., Salo, J., & Standing, C. (2009). Enablers and impediments to IT adoption in business relationships: Evidence from Australia and Finland. *Journal of Systems and Information Technology, 11*(2), pp. 185-200.

Das, T., & Teng, B.-S. (2004). The risk-based view of trust: A conceptual framework. *Journal of Business and Psychology, 19*(1), pp. 85-116.

Dasgupta, P. (1988). Trust as a commodity, in D. Gambetta (ed.), *Trust: Making and breaking cooperative relations.* Oxford: Basil Blackwell.

De Vos, A., Strydom, H., Fouche, C., & Delport, C. (2005). *Research at grass roots for the social sciences and human service professions* (Third ed.). Pretoria: Van Schaik.

Denzin, N.K. and Lincoln, Y.S. (2000). *Handbook of qualitative research (*2nd ed.). London: Sage Publications.

Department of Trade and Industry. (2005). *Current developments in the automotive industry 2004.* Retrieved January 15, 2011, from http://apps.thedti.gov.za/mediareleases/AIS_media.pdf.

Department of Trade and Industry. (2010). *Media release: Minister Davies approve Automotive Investment Scheme guidelines.* Retrieved January 15, 2011, from http://apps.thedti.gov.za/mediareleases/AIS_media.pdf.

Drake, M., & Schlachter, J. (2008). A virtue-ethics analysis of supply chain collaboration. *Journal of Business Ethics,* (82), pp. 851-864.

Dyer, J., & Chu, W. (2002). The role of trustworthiness in reducing transaction costs and improving performance: Empirical evidence from the United States, Japan and Korea. *Organization Science, 14*, pp. 57-68.

Eisman, A. (2008). Achieving a high-performance supply chain: Sharing information with partners. *Business Intelligence Journal, 13*(2), pp. 29-37.

Ellis, S. (2006). *An overview of the global and South African automotive industry.* Hillcrest: Programme for Industrial Manufacturing Excellence.

Fachinelli, A., Ueltschy, L., & Ueltschy, M. (2007). The impact of culture on the generation of trust in global supply chain relationships. *The Marketing Management Journal, 17*(1), pp. 15-26.

Farris, G.F., Senner, E.E. & Butterfield, D.A. (1973). Trust, culture and organisational behaviour. *Industrial Relations*, 12, pp. 144- 157.

Fawcett, S. E., Magnan, G. M., & McCarter, M. W. (2008). Benefits, barriers, and bridges to effective supply chain management. *Supply Chain Management: An International Journal, 13*(1), pp. 35-48.

Ferrin, D., Bligh, M., & Kohles, J. (2007). Can I trust you to trust me: A theory of trust, monitoring, and cooperation in interpersonal and intergroup relationships. *Group & Organisation Management, 32*(4), pp. 465-499.

Fingar, C. (2002). *Car wars*. Retrieved July 2, 2006, from ifDi magazine: http://www.fdimagazine.com/news/fullstory.php/aid/191/Car_wars.html.

Flowerday, S., & Von Solms, R. (2006). Trust: An element of information security. In S. Fischer-Hubner, K. Rannenberg, L. Yngstrom, & S. Lindskog, *Security and privacy in dynamic environments,* pp. 87-98, USA: IFIP.

Ford Motor Company. (2005). *Challenge facing the automotive industry*. Retrieved March 30, 2006, from Ford Sustainability Report: http://corporate.ford.com/doc/2004-05_sustainability_report.pdf.

Franse, R. (2006). *The response of an original equipment manufacturer to the motor industry development programme: A case study.* MA Dissertation, Rhodes University, Department of Business Management.

Galbraith, J.R. (1973). *Designing complex organisations.* Massachusetts: Addison-Wesley.

Gao, J., & Lee, J. (2005). Trust, information technology, and cooperation in supply chains. *Supply Chain Forum: An International Journal, 6*(2), pp. 82-89.

Gasser, L., Majchrzak, A., & Markus, M. (2002). Design theory for systems that support emergent knowledge processes. *MIS Quarterly, 26*(3), pp. 179-212.

Ghosh, A., & Fedorowicz, J. (2008). The role of trust in supply chain governance. *Business Process Management Journal, 14*(4), pp. 453-470.

Gulati, R., & Sytch, M. (2007). Dependence assymmetry and joint dependence in interorganizational relationships: Effects of embeddedness on a manufacturer's performance in procurement relationships. *Administrative Science Quarterly, 52*, pp. 32-69.

Gunasekaran, A., & Ngai, E. (2004). Information systems in supply chain integration and management. *European Journal of Operational Research, 159*, pp. 269-295.

Halldorsson, A., Kotzab, H., Mikkola, J., & Skjott-Larson, T. (2007). Complementary theories to supply chain management. *Supply chain management: An international journal, 12*(4), pp. 284-296.

Han, Z., Liu, K., Sun, Y., & Yu, W. (2006). A trust evaluation framework in distributed networks: Vulnerability analysis and defense against attacks. *IEEE INFOCOM conference on computer communications*, pp. 1-13, Barcelona.

Hartman, F. & Baldwin, A. (1995). Using technology to improve the Delphi method. *Journal of Computing in Civil Engineering*, 9, pp.244 - 249.

Hevner, A., March, S., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly,* 28(1), pp. 75-105.

Hill, C., & Scudder, G. (2002). The use of electronic data interchange for supply chain coordination in the food industry. *Journal of Operations Management, 20*, pp. 375-387.

Hoetker, G., Swaminathan, A., & Mitchell, W. (2007). Modularity and the impact of buyer-supplier relationships on the survival of suppliers. *Management science, 53*(2), pp. 178-191.

Hsu, C.-C., & Sandford, B. (2007). The Delphi Technique: Making Sense of Consensus. *Practical Assessment, Research and Evaluation, 12*(10), pp. 1-8.

Huang, J., & Fox, M. (2006). An ontology of trust - formal semantics and transitivity. *ICEC*, pp. 259-270. Fredericton.

Hyperwave (2007). Audi and Volkswagen. Retrieved September 1, 2001 from http://www.hyperwave.com/e/customers/audi.

Ibrahim, M. (2004). Studying interorganizational systems using multiple perspectives. *Sixth International Conference on Electronic Commerce*, pp. 319-324.

Jain, K., & Dubey, A. (2005). Supply chain collaboration: A governance perspective. *Supply Chain Forum: An International Journal, 6*(2), pp. 50-57.

Jenkins, M. & Tallman, S. (2010). The shifting geography of competitive advantage: Clusters, networks and firms, J*ournal of Economic Geography*, 10(4), pp. 1–20.

Jharkharia, S., & Shankar, R. (2004). IT enablement of supply chains: Modeling the enablers. *International Journal of Productivity and Performance Management, 53*(8), pp. 700-712.

Kappe, F. (2001). Knowledge management: A practical example at BMW. *I-Know 2001*. Graz, 12 July 2001.

Klein, J., & Richey, R. (2007). *Design and development research.* New Jersey: Lawrence Erlbaum Associates.

Klein, R., Rai, A., & Straub, D. (2007). Competitive and cooperative positioning in supply chain logistics relationships. *Decision Sciences, 38*(4), pp. 611-646.

Kleist, V. (2004). A transaction cost model of electronic trust: Transactional return, incentives for network security and optimal risk in the digital economy. *Electronic Commerce Research, 4*, pp. 41-57.

Koeszegi, S. (2004). Trust-building strategies in inter-organizational negotiations. *Journal of Managerial Psychology, 19*(6), pp. 640-660.

Kramer, R. (1999). Trust and distrust in organizationa: Emerging perspectives, enduring questions. *Annu Rev Psychol, 50*, pp. 569-598.

Kwon, I.-W., & Suh, T. (2005). Trust, commitment and relationships in supply chain management: A path analysis. *Supply Chain Management: An International Journal, 10*(1), pp. 26-33.

Lauer, T. (2000). Side effects of mandatory EDI order processing in the automotive supply chain. *Business Process Management Journal, 6*(5), pp. 366-375.

Lazar, L. (2002). *Trust issues in the formation of supply chain agreements.* PhD Thesis, Graduate School of Clemson University, Industrial Management.

Lee, J., & See, K. (2004). Trust in automation: Designing for appropriate reliance. *Human Factors, 46*(1), pp. 50-80.

Lewis, J. (1999). *Trusted partners: How companies build mutual trust and win together.* New York: Free Press.

Lewis, I., & Talalayevsky, A. (2004). Improving interorganizational supply chain through optimization of information flows. *The Journal of Enterprise Information Management, 17*(3), pp. 229-237.

Li, X. (2004). *The formation of trust in a national ID system: A trust model based on the TRA/TPB.* Dissertation, Washington State University.

Li, X., Valacich, J., & Hess, T. (2004). Predicting user trust in information systems: A comparison of competing trust models. *37th Hawaii International Conference on System Science*, pp. 1-10.

Liker, J. (2004). *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer.* New York: McGraw-Hill.

Lindquist, A., Berglund, F., & Johannesson, H. (2008). Supplier integration and communication strategies in collaborative platform development. *Concurrent Engineering, 16*(1), pp. 23-35.

Liu, X.F. (2007). Study on the application of information technology in supply chain management. *Journal of US-China Public Administration, 4*(1), pp. 72-76.

Lorentzen, J. (2006). *Multinationals on the periphery: DaimlerChrysler South Africa, human capital upgrading and regional economic development.* Cape Town: Human Sciences Research Council Press.

Lui, S. (2009). The roles of competence, trust, formal contract, and time horizon in interorganizational learning. *Organization Studies, 30*(4), pp. 333-353.

Mak'Ochieng, A. (2003). *A case study of the strategic nature of DaimlerChrysler South Africa's corporate social investment programmes in the local communities of the Border-Kei region in the Eastern Cape province.* MA Dissertation, Rhodes University, Department of Business Management.

Mallalieu, L. (2005). An examination of the role of customer attributions in understanding trust loss and recovery in buyer-seller relationships. *Supply Chain Forum: An International Journal, 6*(2), pp. 68-80.

Mangold, P. (2009). *Mercedes-Benz*. Retrieved April 27, 2009, from South African Automotive Week: http://www.saaw.co.za/News/09-04-27/mercedes-benz.aspx

Masuku, M., & Kirsten, J. (2004). The role of trust in the performance of supply chains: A dyad analysis of smallholder farmers and processing firms in the sugar industry in Swaziland. *Agrekon, 43*(2), pp. 147-161.

Maxwell, J. (2005). *Qualitative Research Design: An Interactive Approach.* California: SAGE Publications.

Mayer, R., Davis, J., & Schoorman, F. (1995). An integrative model of organizational trust. *Academy of Management Review, 20*(3), pp. 709-734.

McKnight, H., Choudhury, V., & Kacmar, C. (2002). The impact of initial consumer trust on intentions to transact with a web site: A trust building model. *Journal of Strategic Information Systems, 11*, pp. 297-323.

Menzies, J.L. & De Cieri, H. (2003). Antecedents and consequences of Trust in Strategic Alliances. *Working Paper 8/03*. Monash University, Department of Management.

Mishra, A. K. (1996). Organizational response to crisis: The centrality of trust. In R. M. Kramer & T. R. Tyler (Eds.), Trust in Organizations: Frontiers of Theory and Research, pp. 261-287. Thousand Oaks: Sage.

Mishra, B., Raghunathan, S., & Yue, X. (2007). Information sharing in supply chains: Incentives for information distortion. *IIE Transactions, 39*, pp. 863-877.

Moorman, C., Deshpande, R. & Zaltman, G. (1993), Factors affecting trust in market research relationships. *Journal of Marketing* 57, pp. 81-102.

Motwani, J., Madan, M., & Gunasekaran, A. (2000). Information technology in managing global supply chains. *Logistics Information Management, 13*(5), pp. 320-327.

Mouton, J. (2001). *How to succeed in your Masters and Doctoral Studies.* Pretoria: Van Schaik Publishers.

Mukhtar, M., Jailani, N., Abdullah, S., Yahya, Y., & Abdullah, Z. (2009). A framework for analyzing e-supply chains. *European Journal of Scientific Research, 25*(4), pp. 649-662.

Muller, M., & Seuring, S. (2007). Reducing information technology-based transaction costs in supply chains. *Industrial Management & Data Systems, 107*(4), pp. 484-500.

Myers, M.D. (1997). Qualitative research in information systems. *MIS Quarterly. 21*(2), , pp. 241 – 242.

Naesens, K., Pintelon, L., & Taillieu, T. (2007). A framework for implementing and sustaining trust in horizontal partnerships. *Supply chain forum: An international journal, 8*(1), pp. 32-44.

Nann, N., Kumar, S. & Wang,L. (2007). The Collaboration Network Structure in Open Source Projects. *Proceedings of the Sixth Annual Symposium on Research in Systems Analysis & Design*, Tulsa, May 2007.

National Association of Automobile Manufacturers of South Africa . (2006). *Key Information on the SOuth African Automotive Industry.* Pretoria: Department of Trade and Industry.

Oates, B. (2006). *Researching Information Systems and Computing.* London: Sage Publications.

Olivier, M. (2004). *Information Technology Research: A practical guide for Computer Science and Informatics.* Pretoria: Van Schaik Publishers.

Organisation for Economic Co-operation and Development. (2004). *Principles of corporate governance.* Paris: Organisation for Economic Co-operation and Development.

Pagano, A., & Zagnoli, P. (2001). *Modularization, knowledge management and supply chain relations: The trajectory of a European commercial vehicle assembler.* Retrieved April 10, 2006, from http://www.univ-evry.fr/labos/gerpisa/actes/32/32-4.pdf

Peterson, H. (2002). The 'learning' supply chain: Pipeline or pipedream. *American Journa of Agricultural Economics, 85*(5), pp. 1329-1336.

Piderit, R., Flowerday, S. & Von Solms, R. (2011). Enabling information sharing by establishing trust in supply chains: A case study in the South African automotive industry. *SA Journal of Information Management* 13(1), Art. 473.

Poirier, C. (2003). *The supply chain manager's problem-solver: Maximizing the value of collaboration and technology.* New York: St Lucie Press.

Premkumar, G., Ramamurthy, K., & Saunders, C. (2005). Information processing view of organizations: An exploratory examination of fit in the context. *Journal of Management Information Systems, 22*(1), pp. 257-294.

Ridings, C., Gefen, D., & Arinze, B. (2002). Some antecedents and effects of trust in virtual communities. *Journal of Strategic Information Systems*, 11(3-4), pp. 271-295.

Ring, P.S. & Van de Ven, A.H. (1994). Developmental processes of cooperative interorganizational relationships. *Academy of Management Review*, *19(*1), pp. 90- 118.

Rotter, J. B., (1967) A New Scale for the Measurement of Interpersonal Trust. J*ournal of Personality*, 35, pp. 651-665.

Rusman, E., Van Bruggen, J., & Valcke, M. (2009). Empirical testing of a conceptual model and measurement instrument for the assessment of trustworthiness of project team members. *8th AAMAS.* Budapest.

Ryu, S. (2006). The effect of external and internal environments on interfirm governance. *Journal of Business-to-Business Marketing, 13*(2), pp. 67-89.

Sahay, B. (2003). Understanding trust in supply chain relationships. *Industrial Management and Data Systems, 103*(8), pp. 553-563.

Saunders, C., Wu, Y., Li, Y., & Weisfeld, S. (2004). Interorganizational trust in B2B relationships. *6th International Conference on Electronic Commerce*, pp. 272-279.

Schoorman, F., Mayer, R., & Davis, J. (2007). An integrative model of organizational trust: Past, present, and future. *Academy of Management Review, 32*(2), pp. 344-354.

Sen, S., Saha, S., & Banerjee, D. (2005). Trust-based contracting in supply chains. *International Conference on Autonomous Agents and Multiagent Systems*, pp. 1251-1252, Utrecht.

Sengun, A., & Wasti, S. (2009). Revisiting trust and control: Effects on perceived relationship performance. *International Small Business Journal, 27*(1), pp. 39-69.

Shapiro, J. (2007). *Modelling the Supply Chain.* Toronto: Thomson.

Sheng, S., Brown, J., & Nicholson, C. (2005). The mediating role of communication in interorganizational channels. *Journal of Marketing Channels, 13*(2), pp. 51-80.

Simatupang, T., & Sridharan, R. (2002). The Collaborative Supply Chain. *The International Journal of Logistics Management, 13*(1), pp. 15-30.

Simchi-Levi, D., P. Kaminsky, & Simchi-Levi, E. (2003). *Designing and managing the supply chain*, (2nd ed.) Richard D. Irwin, Inc.: Boston.

Skulmoski, G., Hartman, F., & Krahn, J. (2007). The Delphi Method for Graduate Research. *Journal of Information Technology Education, 6*, pp. 1-21.

Smeltzer, L. (1997). The meaning and origin of trust in buyer-supplier relationships. *International Journal of Purchasing and Materials Management, Winter*, pp. 40-48.

Sodano, V. (2002). Trust, economic performance and the food system: Can trust lead up to unwanted results? *5th International Conference on Chain and Network Management in Agribusiness and the Food Industry*, pp. 104-115. Noorwijk.

Stahl, G., & Sitkin, S. (2010) Trust dynamics in mergers and acquisitions: The role of relationship history, interfirm distance, and acquirer's integration approach, *Advances in Mergers and Acquisitions*, 9, pp. 51-83.

Statistics South Africa. (2011). *Quarterly Labour Force Survey: Quarter 3 (July to September)* . Pretoria: Statistics South Africa.

Stephen, A., & Coote, L. (2005). Towards an understanding of the governance of complex networks of relationships: Uncertainty, governance system choices, and performance outcomes. *American Marketing Association*, pp. 112.

Thomas, R., & Skinner, L. (2010). Total trust and trust assymetry: Does trust need to be equally distributed in interfirm relationships? *Journal of Relationship Marketing, 9*, pp. 43-53.

Todd, A. (2005). Trust enabled supply networks: Uncovering the trust-building secrets of highly collaborative supply chains. *Third Annual Symposium on Supply Chain Management*, pp. 1-21. Toronto.

Tucci, C., Kaufman, A., Wood, C., & Theyel, G. (2005). Collaboration and learning in the software supply chain. *Supply Chain Forum: An International Journal, 6*(1), pp. 16-28.

Vaishnavi, V., & Kuechler, W. (2008). *Design Science Research Methods and Patterns: Innovating Information and Communication Technology.* Florida: Auerbach Publications.

Venter, I. (2010). *New auto investment scheme, with budget nears completion*. Retrieved December 22, 2010, from http://www.engineeringnews.co.za/article/auto-investment-scheme-nearly-completed-dti-has-budget-for-scheme-confirms-davies-2010-04-08

Vlachos, I., & Bourlakis, M. (2006). Supply chain collaboration between retailers and manufacturers: Do they trust each other? *Supply Chain Forum: An International Journal, 7*(1), pp. 70-80.

Volkswagen (2007). *Knowledge Management: Knowledge at Volkswagen*. Retrieved September 1, 2010, from http://www.vw-personal.de/ww/en/wissen/ wissensmanagement.html/

Vollmann, T., Berry, W., Whybark, D., & Jacobs, F. (2005). *Manufacturing Planning and Control for supply chain management.* New York: McGraw-Hill.

Wang, E., & Wei, H.L. (2007). Interorganizational governance value creation: Coordinating for information visibility and flexibility in supply chains. *Decision Sciences, 38*(4), pp. 647-674.

Ward, A. (2009). *Toyota*. Retrieved April 28, 2009, from South African Automotive Week: http://www.saaw.co.za/News/09-04-28/toyota.aspx

Webster, S. (2008). *Principles and Tools for Supply Chain Management.* New York: McGraw-Hill.

Welty, B., & Becerra-Fernandez, I. (2001). Managing trust and commitment in collaborative supply chain relationships. *Communications of the ACM, 44*(6), pp. 67-73.

Wuensch, K.L. (2003). *Sampling*. Retreved October 20, 2009, from <core.ecu.edu/psyc/wuenschk/docs2210/Research-2-Sampling.doc>

Yin, R.K. (2003). Case Study Research: Design and Methods (3rd ed.). California: SAGE Publications.

Yu, Z., Yan, H., & Chang, T. (2001). Benefits of information sharing with supply chain partnerships. *Industrial Management and Data Systems, 101*(3), pp.114-119.

Zhang, C., & Li, S. (2006). Secure information sharing in internet-based supply chain management systems. *Journal of Computer Information Systems, Summer 2006*, pp. 18-24.

Zhu, W., Gavirneni, S., & Kapuscinski, R. (2010). Periodic flexibility, information sharing and supply chain performance. *IIE Transactions, 42*, pp. 173-187.

Abbreviations

AIDS	Acquired Immuno-Deficiency Syndrome
AIS	Automotive Investment Scheme
APDP	Automotive Production and Development Programme
CoP	Community of Practice
DRP	Distribution Requirements Planning
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
GDP	Gross Domestic Product
IT	Information Technology
JIT	Just-In-Time
MIDP	Motor Industry Development Programme
MRP	Material Requirements Planning
OEM	Original Equipment Manufacturer
OIPT	Organisational Information Processing Theory
PRIME	Programme for Industrial Manufacturing Excellence
SLA	Service Level Agreement
TPS	Toyota Production System
TRA	Theory of Reasoned Action
TRB	Theory of Reasoned Behaviour
WCM	World Class Manufacturing

Appendix

A Piderit, R., Flowerday, S. & Von Solms, R. (2011). Enabling information sharing by establishing trust in supply chains: A case study in the South African automotive industry. *SA Journal of Information Management,* 13(1), Art. 473.