

**The Impact of Information and Communication
Technology on Trust and Information Sharing in
South African Automotive Supply Chains**

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**Impact of Information and Communication Technology (ICT) on Trust and
Information Sharing in South African Automotive Supply Chains**

by

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Abstract

The automotive industry is one of the most important sectors of the SA economy, with eight of the top ten manufacturers producing vehicles in South Africa for both the local and international markets. Central to the automotive industry is the supply chain, which relies on inter-organisational relationships that exist between supply chain partners in order to operate efficiently and effectively. As these supply chains often entail more than 200 suppliers, trust is essential for effective business transactions.

Previous studies pointed out that there is insufficient information sharing among supply chain partners which results in mistrust in the inter-organisational relationship. This is a major concern because poor information sharing combined with a lack of trust impacts the supply chains negatively and compromises the efficiency and effectiveness of the supply chain's operations. Thus trust and information sharing are key elements of supply chain relationships and are the focus of this research project. Additionally Information and Communication Technology (ICT) can be useful in facilitating information sharing, thereby enhancing trust, and hence is a third factor considered in this study.

The impact of ICT in improving information sharing and fostering trust cannot be ignored and is therefore a major focus for this research project. As organisations seek to improve supply chain efficiency through increased integration, ICT can be considered as a key enabler for supply chain management by supporting information sharing. Uncertainty in the supply chain relationships can be improved by improving information flow in the supply chain. This uncertainty can be reduced if ICT is used to balance information sharing needs and capabilities. The Organisational Information Processing Theory (OITP), a key theory used in this research project, identifies information processing needs and capabilities and the need to obtain optimal performance through a balance of these factors.

Some supply chain partners are, however, wary of the possibility of partners abusing their trust and reaping all the benefits from supply chain integration while not contributing to the relationship. This has the potential to undermine inter-organisational dynamics, and can be compared to the Prisoner's Dilemma. Thus Prisoner's Dilemma is

an underlying theory for this study. A balance between trust and information sharing therefore is critical to successful supply chain relationships, which must be monitored and managed by ICT.

A research framework to ensure that a balance between trust and information sharing is maintained when using ICT to manage supply chain relationships in the SA automotive industry is proposed in this research project. The framework was developed based on the examination of existing theories and data collected from questionnaires. The framework consists of the following elements: a matrix depicting the use of ICT to support supply chain relationships; connectivity, information sharing capability and willingness, which determine the level of information sharing in the supply chain relationship; ability, benevolence and integrity as trust determinants; the resultant improved information sharing, collaboration and coordination; trust, confidence and control which improve supply chain management and ultimately result in efficient and effective supply chain relationships. This framework can be used by automotive supply chain partners in order to improve information sharing across the supply chain and thereby enhance trust.

Keywords: Information and Communications Technology, Information Sharing, Trust, Prisoner's Dilemma, Organisational Informational Processing Theory

Declaration

I, Chiedza Precious Goche, 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 fulfilment of the requirements for an equivalent or higher qualification at any other recognised institution.

Signature : _____

Date : 31 January 2012

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Table of Contents

ABSTRACT.....	I
DECLARATION	III
ACKNOWLEDGEMENTS	IV
LIST OF FIGURES	XII
LIST OF TABLES	XIII
CHAPTER 1:INTRODUCTION.....	1
1.1 BACKGROUND.....	2
1.2 STATEMENT OF THE PROBLEM	4
1.3 RESEARCH QUESTIONS AND OBJECTIVES	4
1.3.1 Primary Research Question	4
1.3.2 Secondary Research Questions.....	5
1.3.3 Objective of the Study	6
1.4 SIGNIFICANCE OF THE STUDY	6
1.5 LITERATURE REVIEW	7
1.5.1 Trust	7
1.5.2 Information Sharing.....	8
1.5.3 ICT and the Supply Chain.....	9
1.6 RESEARCH DESIGN.....	10
1.6.1 Underlying Theories	10
1.6.2 Research Paradigm.....	11
1.7 RESEARCH METHODOLOGY.....	13
1.7.1 Data Collection Methods	13
1.7.2 Data Analysis Methods	13

1.7.3	<i>Recommendations</i>	14
1.8	DELIMITATION OF THE STUDY	15
1.9	ETHICAL CONSIDERATIONS	15
1.10	OUTLINE OF PROPOSED CHAPTERS	16
CHAPTER 2: OVERVIEW OF THE SOUTH AFRICAN AUTOMOTIVE INDUSTRY		18
2.1	INTRODUCTION.....	19
2.2	THE IMPORTANCE OF THE SOUTH AFRICAN AUTOMOTIVE INDUSTRY	19
2.3	AUTOMOTIVE POLICIES	23
2.3.1	<i>The Motor Industry Development Programme</i>	23
2.3.2	<i>Objectives of the MIDP</i>	26
2.3.3	<i>Key Features of the MIDP</i>	27
2.3.4	<i>The Automotive Investment Scheme (AIS)</i>	28
2.4	CHALLENGES FACED BY THE SA AUTOMOTIVE INDUSTRY.....	28
2.5	CONCLUSION.....	29
CHAPTER 3: THE IMPORTANCE OF TRUST IN AUTOMOTIVE SUPPLY CHAINS		31
3.1	INTRODUCTION.....	32
3.2	IMPORTANCE OF TRUST.....	33
3.3	DEFINING TRUST	35
3.4	TRUST DEVELOPMENT	37
3.4.1	<i>Mayer, Davis and Schoorman's Trust Model</i>	37
3.4.2	<i>McKnight, Choudhury and Kacmar's (2002) Initial Trust Model</i>	39
3.5	FORMS OF TRUST	41
3.5.1	<i>Competence Trust</i>	41

3.5.2	<i>Contractual Trust</i>	42
3.5.3	<i>Calculative Trust</i>	42
3.6	TRUST IN INTER-ORGANISATIONAL RELATIONSHIPS	43
3.7	GAME THEORY (PRISONER’S DILEMMA) AND TRUST	45
3.8	TRUST, INFORMATION AND CONTROL IN SUPPLY CHAINS.....	47
3.9	CONCLUSION.....	48
CHAPTER 4: BUILDING TRUST THROUGH INFORMATION SHARING		50
4.1	INTRODUCTION.....	51
4.2	IMPORTANCE OF INFORMATION SHARING	52
4.2.1	<i>Enhanced integration of supply chain partners</i>	53
4.2.2	<i>Improved management of information within supply chains</i>	53
4.2.3	<i>Enhancing trust through ICT</i>	53
4.3	IMPROVING INFORMATION SHARING IN SUPPLY CHAIN NETWORKS.....	54
4.4	CLASSIFICATION OF INFORMATION IN A SUPPLY CHAIN.....	56
4.5	CONNECTIVITY, WILLINGNESS AND INFORMATION SHARING CAPABILITY	58
4.6	BARRIERS TO EFFECTIVE INFORMATION SHARING	60
4.6.1	<i>The cost and difficulty of executing advanced systems</i>	62
4.6.2	<i>Systems Incompatibility</i>	62
4.6.3	<i>Levels of Connectivity</i>	62
4.6.4	<i>Understanding the willingness dimension of information sharing</i>	62
4.7	INFORMATION SHARING ENABLERS AFFECTING TRUST	63
4.7.1	<i>Open and Transparent flow of information</i>	63
4.7.2	<i>Defined use of information</i>	64

4.7.3	<i>Fair and equal treatment of chain members</i>	64
4.7.4	<i>Reliability of information</i>	64
4.7.5	<i>Confidence in truthfulness of information</i>	65
4.7.6	<i>Undistorted Communication</i>	65
4.7.7	<i>Respect for the confidentiality of information</i>	65
4.7.8	<i>Sincerity in providing the information</i>	65
4.8	THE ORGANISATIONAL INFORMATION PROCESSING THEORY.....	67
4.9	TECHNOLOGY NEEDED FOR INFORMATION SHARING.....	68
4.10	CONCLUSION	68
CHAPTER 5:USING ICT TO FACILITATE INFORMATION SHARING		70
5.1	INTRODUCTION.....	71
5.2	INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN SCM.....	72
5.3	THE IMPACT OF ICTS ON SUPPLY CHAINS.....	76
5.4	OBSTACLES TO ICT USE FOR INFORMATION SHARING	76
5.5	OBJECTIVES OF ICT IN SUPPLY CHAIN MANAGEMENT.....	78
5.6	COMMUNICATION TECHNOLOGIES ENABLING INFORMATION SHARING	80
5.6.1	<i>Electronic Data Interchange (EDI)</i>	80
5.6.2	<i>Bar code Technology</i>	81
5.6.3	<i>Expert system/ artificial intelligence</i>	82
5.6.4	<i>Vendor-managed Inventory (VMI)</i>	82
5.6.5	<i>Database Technology/ data warehousing technology</i>	83
5.6.6	<i>Network technology/ electronic business</i>	84
5.6.7	<i>Enterprise Resource Planning</i>	85

5.7	CONCLUSION.....	86
CHAPTER 6: RESEARCH DESIGN AND METHODOLOGY.....		88
6.1	INTRODUCTION.....	89
6.2	RESEARCH PARADIGM.....	90
6.3	RESEARCH METHODOLOGY.....	91
6.4	DATA COLLECTION METHODS	93
6.4.1	<i>Primary Data Collection Methods</i>	94
6.4.2	<i>Secondary Data Collection Methods</i>	95
6.5	SAMPLE AND POPULATION	95
6.6	DATA ANALYSIS	97
6.6.1	<i>Check-in</i>	97
6.6.2	<i>Editing</i>	98
6.6.3	<i>Coding</i>	98
6.6.4	<i>Transferring the data</i>	98
6.7	RESEARCH EVALUATION	98
6.8	ETHICAL CONSIDERATIONS.....	99
6.9	CONCLUSION.....	99
CHAPTER 7: EMPIRICAL ANALYSIS AND DISCUSSION		101
7.1	INTRODUCTION.....	102
7.2	RESPONSE RATE.....	103
7.3	BACKGROUND OF PARTICIPATING ORGANISATIONS.....	104
7.4	EMPIRICAL FINDINGS	109
7.4.1	<i>First Research Sub-question</i>	109

7.4.2	<i>Second Research Sub-question</i>	114
7.4.3	<i>Third Research Sub-question</i>	119
7.5	CONCLUSION	121
CHAPTER 8:A FRAMEWORK FOR ENHANCING TRUST IN AUTOMOTIVE SUPPLY CHAINS THROUGH ICT		122
8.1	INTRODUCTION	123
8.2	THE PROPOSED FRAMEWORK	123
8.2.1	<i>ICT Support Matrix</i>	126
8.2.2	<i>Connectivity, information sharing capability and Willingness</i>	127
8.2.3	<i>Ability, Benevolence and Integrity</i>	129
8.2.4	<i>Adequate Information Sharing, Collaboration and Coordination</i>	130
8.2.5	<i>Trust, Confidence and Control</i>	132
8.2.6	<i>Efficient and Effective Supply Chain Relationships</i>	133
8.3	CONCLUSION	134
CHAPTER 9:CONCLUSION		135
9.1	INTRODUCTION	136
9.2	THEORETICAL FRAMEWORK	136
9.3	SUMMARY OF RESEARCH FINDINGS	139
9.4	CONTRIBUTION MADE BY THIS STUDY	142
9.5	LIMITATIONS OF THE STUDY	143
9.6	DIRECTIONS FOR FUTURE RESEARCH	143
9.7	EVALUATION OF THE RESEARCH PROJECT	143
9.8	CONCLUSION	144
REFERENCES		146

ABBREVIATIONS	168
QUESTIONNAIRE	169

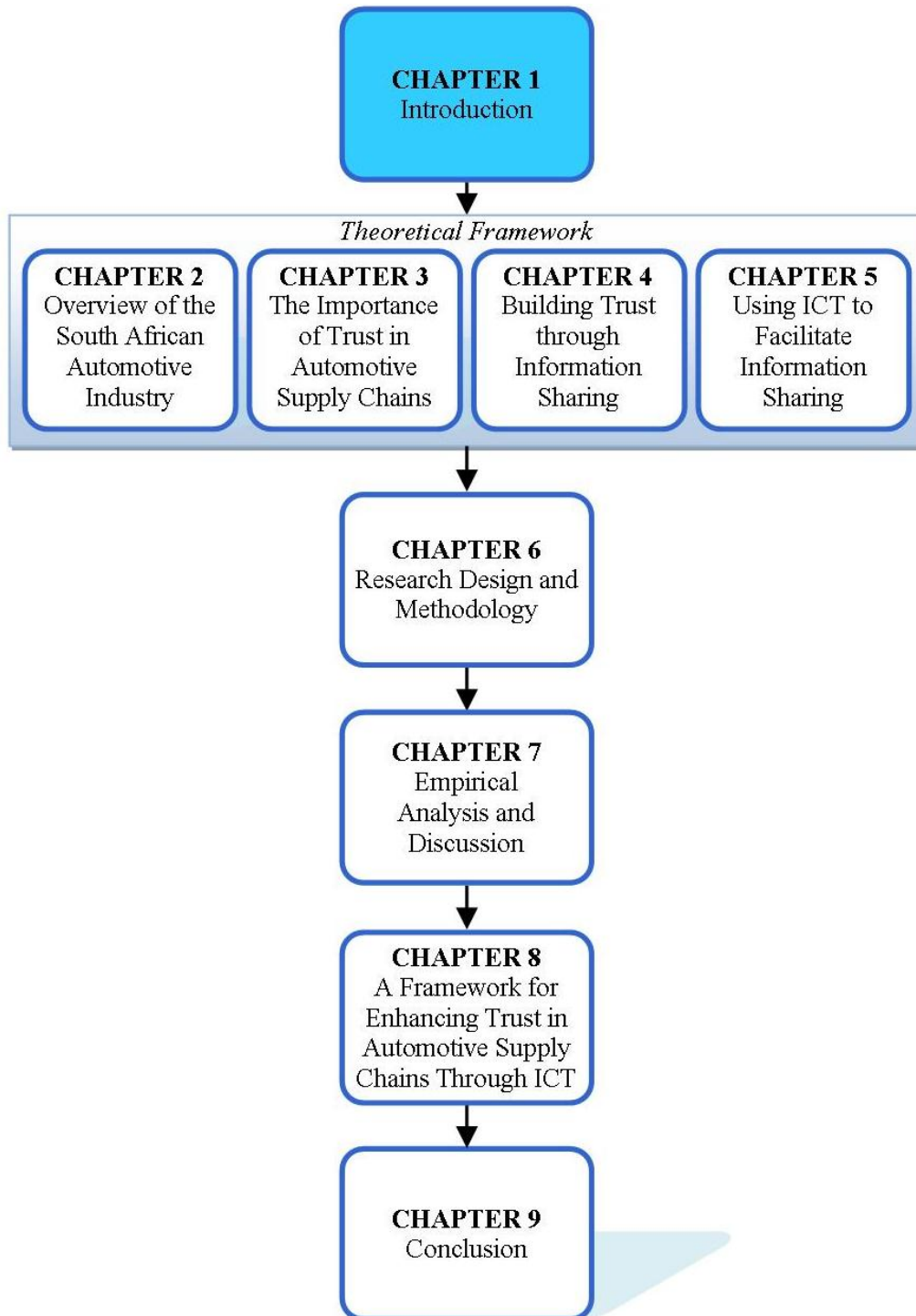
List of Figures

Figure 1.1: Typology of Assumptions on a Continuum of Paradigms	12
Figure 1.2 Outline of the proposed chapters	16
Figure 2.1: Automotive Industry Growth	20
Figure 2.2: Automotive Sector GDP.....	21
Figure 3.1: Mayer, Davis and Schoorman's Trust Model.....	37
Figure 3.2: Initial Trust Model	39
Figure 3.3: Das & Teng's Trust Model	47
Figure 4.1: A contingency perspective of information sharing capability as a strategic enabler.....	59
Figure 4.2: The Connectivity-Willingness Matrix.....	60
Figure 4.3: Diagrammatic Representation of the Organisational Information Processing Theory.....	67
Figure 5.1: ICTs available to supply chains	74
Figure 5.2: The functional role of ICT in supply chain management.....	78
Figure 6.1: Sampling Designs.....	96
Figure 6.2: Data Analysis Process	97
Figure 7.1: Communication Technologies currently utilised	120
Figure 8.1: Framework to ensure that a balance between trust and information sharing is maintained when using ICT	125

List of Tables

Table 2.1: Projected Exports.....	22
Table 2.2: Employment levels in the automotive industry	23
Table 4.1: Classification of production information.....	57
Table 7.1: Positions of Respondents.....	105
Table 7.2: Level in Supply Chain	106
Table 7.3: OEM Supplied	107
Table 7.4: Raw Materials Supplied.....	108
Table 7.5: Supply Frequency	109
Table 7.6: Trust relationship with partner suppliers	110
Table 7.7: Lack of trust and achieving desired results	111
Table 7.8: Organisations' perception on information shared by suppliers	111
Table 7.9: Organisations' confidence in partner suppliers	112
Table 7.10: Supplier partner honesty and information sharing	112
Table 7.11: Long term relationships and intention to share information.....	113
Table 7.12: Barriers to effective information sharing.....	115
Table 7.13: Level and quality of information sharing among supply chain partners ...	117
Table 7.14: Information shared by suppliers	118
Table 9.1: Quality in Positivist and Interpretivist Research	143

Chapter 1: Introduction



1.1 Background

Recent years have seen a significant contribution towards the country's economic growth from the automotive sector (Department of Trade and Industry, 2005). Despite the economic downturn of 2009, the automotive industry has recovered well and shown a significant upward trend, with vehicle sales continuing to grow and indicate sustainable growth (Blackwell Publishing, 2010). A major challenge therefore rests on the South African automotive industry to continue to expand on this contribution. Key to the automotive sector's successful operations is the supply chain. As automotive manufacturers are highly reliant on an extensive network of suppliers, the supply chain serves as the context for this study.

In a survey that was carried out for some key suppliers in the automotive industry by Aigbedo and Tanniru, (2005), a lack of trust was indicated as resulting from poor information sharing between supply chain partners. Information sharing is therefore critical in developing and maintaining effective relationships between suppliers which rely on trust for optimal performance. A high level of trust among supply chain partners is the basis of successful supply chain performance (Handfield & Bechtel, 2002). For the supplier, good performance usually results in increased sales volumes and the potential for additional future partnerships (Bagchi, Byoung-Chun & Skjoett-Larsen, 2009).

According to Bowersox, Closs and Stank (2000) trust improves the probability of the supply chain performing well, and conversely, inefficient and ineffective performance will result from mistrust among the supply chain partners which causes transaction costs to escalate. This view has also been expressed by Covey (2008) who highlights that the efficiency of the supply chain is greatly affected by a lack of trust. Kwon and Suh (2005) emphasise that in order for supply chain management to be successful, shared information and trust are crucial. Thus information sharing and trust are key factors considered in this study.

The sharing of information in a supply chain will at times require the dissemination of highly confidential details. Should this confidential information be shared with other parties by a supply chain partner, this would result in a break down of trust in the

relationship, and may prompt future reluctance in information sharing from supply chain partners (Bowersox, Closs & Stank, 2000). The availability of the information will eventually be meaningless if it cannot be shared by the partners. Thus, the complex relationship between trust and information sharing is the focus of this research project.

In developing supply chain relationships, a number of specific Information and Communication Technologies (ICTs) can be employed to develop and maintain strong trusting relationships with supply chain partners. The role and importance of ICT therefore needs to be considered in this context. In particular, when considering the research problem under investigation, the use of ICT to promote information sharing, and ultimately trust, is an important consideration.

The use of ICT in a supply chain allows rapid communication between supply chain partners and enables sharing large quantities of quality information on both tactical and strategic operations (Shapiro, 2010). As mentioned earlier, shared information contributes to trust formation, thus ICT is an enabler of efficient supply chain operations – and the focus of this research project. For example the World Wide Web, Electronic Data Interchange (EDI), Electronic Mail, and Enterprise Resource Planning (ERP) allow organisations to share digital data instantly. Thus, this study aims to establish how ICT can be utilised to improve relationships by enabling information sharing and enhancing trust.

The outcome of this research project is the proposal of a framework to ensure that a balance between trust and information sharing is maintained when using ICT to manage supply chain relationships. The next section of this chapter outlines the statement of the research problem, followed by the research questions and objectives of this research project. Following this, the significance of the study will be briefly discussed, after which a more detailed literature review of the concepts that are central to this study, namely trust, information sharing and ICT, is provided. Next the research design is discussed in terms of the underlying theories and chosen research paradigm. The research methodology, delimitation of the study and ethical considerations are then provided, and the proposed chapter outline for the research project concludes this chapter.

1.2 Statement of the Problem

One of the major concerns in South African automotive supply chains is the poor level of information sharing which leads to mistrust among supply chain partners (Ittman, 2002). This lack of trust impacts the supply chain negatively and thus causes efficiency and effectiveness, which are cornerstones of supply chain goals to be compromised. Matsubara and Pourmohammadi (2009) support this by stating that the success of supply chain relationships is negatively affected by a lack of trust.

The trust aspect of supply chain relationships can be enhanced by the use of ICT (Huang & Gangopadhyay, 2004). ICT is vital in supply chain management as it supports information sharing (Phillips, Lawrence & Hardy, 2000); which is basic to coordination in a supply chain and hence enables the establishment of trust. For this reason, it is very important for South African Automotive supply chains to make use of ICT to foster trust and information sharing in the inter-organisational relationships to enhance productivity.

Therefore, the problem investigated in this research project is a lack of trust between supply chain partners that results from inefficient information sharing.

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

1.3 Research Questions and Objectives

1.3.1 Primary Research Question

How does ICT impact on the trust-information sharing relationship in South African automotive supply chains?

This primary research question is addressed through the following Secondary Research Questions:

1.3.2 Secondary Research Questions

1.3.2.1. What are the factors which influence trust in South African automotive supply chains?

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 and thereby improving the level of trust (Kwon & Suh, 2005).

1.3.2.2. What are the barriers to effective information sharing in South African automotive supply chains?

The reputation of the supply chain partners, the level and quality of communication between these supply chain partners, and perceived satisfaction have a negative impact on information sharing in supply chain relationships (Chu & Fang, 2006). Additionally, the method of sharing information is a concern, as the inappropriate use of ICT in the inter-organisational system may be detrimental to information sharing.

1.3.2.3 How can ICT enhance information sharing and thereby enhance trust in South African automotive supply chains?

Various forms of technology such as forecasting systems can play a role in reducing the impact of mistrust in the supply chain (Gao & Lee, 2005). Expert systems, ERP, EDI, communication technologies, database technologies and network technologies are required in order to ensure coordination of the entire supply chain and enhance the competitiveness of the supply chain as a whole (Liu, 2007). When information is shared among supply chain partners through these ICTs, decisions can be made effectively, fostering trust in the process (Clark & Lee, 2000).

Complementary to these research questions, the following objective was considered for this research project:

1.3.3 Objective of the Study

This study aimed to develop a framework to ensure that a balance between trust and information sharing is maintained when using ICT to manage supply chain relationships in the South African automotive industry. This framework was based on the literature findings and the results from the questionnaire obtained from the automotive suppliers.

Having outlined the research questions and objectives of this study, the following section highlights the importance of this research project.

1.4 Significance of the Study

The automotive industry is of great economic importance to South Africa, and hence this research project is significant (Department of Trade and Industry, 2005). Ensuring that South Africa continues to be a viable production site for OEMs who have invested here, is reliant on 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 through the enhancement of inter-organisational relationships which are built on trust and information sharing. Because these supply chains consist of over 200 suppliers, the automotive supply chain was the focal point of this research project. Trust and information sharing are thus very important to manage and ensure the efficiency and effectiveness of the entire supply chain.

A lack of trust and information sharing is a big challenge to inter-organisational relationships in the automotive supply chain (Ittman, 2002). According to Petersen, Ragatz and Monczka (2005), inter-organisational relationships must be improved in order to develop superior supply chain networks. The performance of the supply chain is ultimately greatly improved by strong inter-organisational relationships. As such it is

very important for SA automotive supply chains to foster trust and information sharing to enhance their productivity and improve the inter-organisational relationships. The literature reviewed to gather a better understanding of the identified problem will be discussed in the following section.

1.5 Literature Review

Interactions among organisations in supply chains can be improved by sharing of information. Through the use ICTs, partners in the supply chain can reduce barriers and costs of sharing information. The effective use of ICT is a key enabler of improved coordination and collaboration with supply chain partners (Tummala, Johnson, & Phillips, 2006). This will improve information sharing and therefore enhance trust. Ultimately this results in improved efficiency and effectiveness of the supply chain.

This literature review briefly outlines trust, information sharing and the use of ICT in facilitating these elements. A full discussion of these concepts is provided in future chapters of this research project. As this research project aims to investigate the relationship between trust and information sharing and the role of ICT in facilitating these factors, these sections provide valuable background to this research.

1.5.1 Trust

One view of trust amongst supply chain partners consists of two parts, namely: dependability, which is belief that the other party is reliable or dependable; and benevolence, which is the belief that the other party would act in the mutual best interests of the supply chain (Kim, Ferrin, & Rao, 2008). This strengthens the notion that in order for supply chain partners to have good trusting relationships, they should be reliable, open, honest and respectful of the confidentiality of the information that is shared by their supply chain partners.

Additionally, Corsten and Kumar (2005) argue that a high level of information sharing is the basis for the establishment of trust in inter-organisational relationships. Because trust decreases the fear of information spill overs, trust also prompts future information sharing (Klein, 2007). This research project therefore seeks to discover how trust can be enhanced through information sharing in South African automotive supply chains so as

to improve the relationships amongst supply chain partners and thereby improve the efficiency and effectiveness of the chain as a whole.

This is in line with what was suggested by Liker and Choi (2004), who state that trust between supply chain partners should be encouraged through extensive information sharing and the formation of deeper inter-organisational relationships. A more detailed discussion on trust is provided in Chapter 3. As information sharing is important to trust establishment, this is described in the next section.

1.5.2 Information Sharing

The global market has become very competitive requiring supply chain members to have quicker and easier access to information as well as better information flow if they are to survive (Lau & Lee, 2000). A responsive supply chain must be established where large amounts of information are shared, as this will facilitate collaboration among the supply chain partners. The fear of information being used unjustly, to their detriment is one of the biggest reasons why many companies are unwilling to share information with their trading partners (Zhao, Xie & Zhang, 2002). More importantly, the more information shared, the higher the level of trust in supply chains, thus this study seeks to establish how trust can be fostered through improved information sharing.

To achieve success, an organisation must possess and share information about the different aspects of the supply chain (Handfield & Bechtel, 2002). Information sharing in the supply chain includes the sharing of knowledge of the production status, process planning and goals of the companies among supply chain partners to serve customers effectively and efficiently (Khurana, Mishra, Rajeev & Singh, 2010). This shared information allows all supply chain partners to make effective decisions, and thus leads to efficient supply chain operations. Advances in ICT have made this information sharing more convenient.

Therefore, for activities to be coordinated in the supply chain, the different partners in a supply chain have to share information. Henderson (2002) has suggested that supply chain partners should share information not only on simple operational and financial data such as cost of goods and scheduling, but should also share strategic information such as forecasting, strategic goals, and new product designs to maximise the potential

from the supply chain alliances. Information flow improves coordination between supply chain processes, and this enables material flow and reduces inventory costs (Suhong & Binshan, 2006). A lack of information sharing between partners in a supply chain may substantially affect the overall performance of the supply chain.

A study in a hardwood supply chain in Virginia, USA showed that increased information sharing between supply chain members increased material flow through the supply chain (Attaran, 2004). An increase in information sharing, through the advanced knowledge of customer demand by a supplier, was found to reduce the inventory buffers throughout the supply chain by up to 38 percent and increase the total material flow through the supply chain by 10 percent (Stiess, 2010). This study illustrates the importance of information sharing and how effective and efficient any supply chain can be if information is shared.

Cetindamar, Catay and Basmaci (2005) have reported that the establishment of efficient and effective communication mechanisms in supply chains facilitates the sharing of information which in turn builds trust and leads to effective supply chain management. Operational costs can be reduced by information sharing which in turn improves the scheduling and efficiency of current resources of the organisation. Khurana, Mishra, Rajeev, & Singh, (2010) have reported that timely information sharing fosters trust by assisting in resolving disputes and aligning perceptions and expectations. As such, it is important that information is shared, and properly managed so as to enhance the success of the supply chain.

As the sharing of information is mainly accomplished through ICT, the use of ICT to enhance trust and information sharing in supply chain relationships is discussed in the next section.

1.5.3 ICT and the Supply Chain

The advances in ICT are enabling organisations to be able to share information more efficiently (Chatfield, Kim, Harrison, & Hayya, 2004). A very good example can be the Internet which allows organisations to transfer digital data instantly and with high fidelity at no cost at all (Karaesmen & Buzacott, 2002). Li (2002) suggests that no technical obstacles are present for information sharing, however a major setback lies in

that the supply chain partners are faced with is the decision on what information should be shared, the people that the information is to be shared with, and the way it should be shared to improve effectiveness.

If properly implemented, ICT can facilitate information sharing, resulting in improved trust and coordination among the different organisations in the supply chain, and thus can be beneficial to individual organisations as well as the supply chain. Getting the right information at the right time is very important and this can be achieved more effectively through the use of ICT. ICT in the supply chain will be discussed in more detail in Chapter 5.

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

1.6 Research Design

This research design first discusses the underlying theories for this research project. This is followed by a discussion of the choice of research paradigm in this study.

1.6.1 Underlying Theories

This research project refers to the Organisational Information Processing Theory and Game Theory (specifically the Prisoner's Dilemma). 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 in inter-organisational relationships (Premkumar, Ramamurthy & Saunders, 2005). This can also be applied to supply chains because uncertainty in the relationships can be improved by improving information flow in the supply chain. This uncertainty can be reduced if ICT is used to balance information sharing needs and capabilities.

Bagchi, Byoung-Chun, and Skjoett-Larsen (2009); and Flowerday and Von Solms (2006) explain that Game Theory is used to study the choices made when costs and benefits are not fixed, but are rather dependent on other players (in this case supply chain partners) and the shared information available to the players.

Game theory provides a useful formalism to investigate the dynamics of co-operative relationships such as those in the supply chain. A well-known example of the game theory concept is the Prisoner's Dilemma which is describe by Flowerday and Von Solms (2006). In this situation two suspects can either confess or not confess when they are captured by the police. The two prisoners are secluded from each other, and the police visit each of them and offer a deal which entails that one of them would be freed on condition that they offer evidence against the other one. If neither agrees to the offer, they are in fact combining forces against the police, leading to both of them getting only a small sentence because of lack of proof and thus they both gain. If one of them however betrays the other by confessing to the police, the traitor will gain more. If both betray, both will be punished, but more severely than if they had refused to cooperate. The dilemma resides in the fact that each prisoner has a choice between only two options, but cannot make a good decision without knowing what the other one will do.

Similarly, in a supply chain, one organisation may have a better forecast of demand than another organisation, or may possess superior information regarding its own operating procedures and is not willing to let go of this information and hence benefits more than the other players in the supply chain. Thus, only with free flow of information in the supply chain, can effective decisions be made that are beneficial to all members of the supply chain.

A more detailed explanation of these theories will be presented in Chapter 3 and Chapter 4 in relation to the research problem. A discussion of the choice of research paradigm is necessary and follows in the next section.

1.6.2 Research Paradigm

A paradigm is described by Voce (2004) as a framework within which theories are built, that fundamentally influences how one sees the world, determines ones' perspective, and shapes ones' understanding of how things are connected. Quite a number of paradigms exist, which can be differentiated by the basis of their philosophical assumptions. Collis and Hussey (2009) provide an illustration of the paradigm options available to researchers:

1.7 Research Methodology

This research project will employ qualitative methods for data collection, with some supporting quantitative data also being collected. The main reason for using this approach is that there is room for the researcher to explore the richness and depth of explorations and descriptions (Neill, 2006).

The study includes empirical research and a literature review comprised of secondary data including current literature, frameworks, conference proceedings, models, guidelines, current trends in the SA automotive supply chain and other similar studies. 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.

1.7.1 Data Collection Methods

The data collection technique that was used in this study was 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 framework to ensure that a balance between trust and information sharing is maintained when using ICT to manage supply chain relationships in the SA automotive industry. The data collected from this research instrument was analysed using the methods outlined below.

1.7.2 Data Analysis Methods

All fieldwork concludes in the analysis and interpretation of some set of data, be it quantitative survey data, experimental recordings, historical and literary texts, qualitative transcripts or discursive data (Mouton, 2005). Mouton (2005) goes further to say that analysis involves breaking up data into manageable themes, patterns, trends and relationships. The aim of analysis is to understand the different constitutive

elements of the data through an assessment of the relationships between concepts, constructs or variables, and to see whether there are any patterns or trends that can be identified or isolated, or to establish themes in the data.

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. The use of a data analysis spiral when conducting qualitative research was suggested by Creswell (2003). In this model, a four step process will help to transform the raw data into the final report. The steps are as follows:

1. Organisation: in this step, large data units are broken into smaller ones;
2. Perusal of the data: the objective of this step is to obtain a “sense” of the data and start preliminary interpretations;
3. Classification: this step is when the data is grouped into categories;
4. Synthesis: this is whereby the data is tabulated and new propositions can be offered.

Taking into account the details of this project, the researcher decided to follow these steps. Firstly, the respondents were asked questions based on the level of information sharing within their supply chain and competitive strength of the organisation, trust issues and the impact of ICT on information sharing using a structured 4 point Likert-type scale. The basis of these questions was the findings from the literature reviewed. Secondly, the responses were grouped into categories based on whether they related more to trust, information sharing or ICT. The responses were then grouped according to the research questions and appropriate methods were used to analyse the data. Charts, graphs and tables were used to summarise the data. Recommendations are made based on the findings of the data collected.

1.7.3 Recommendations

Based on the conclusion of the data collection, analysis and evaluation, a framework was developed based on the findings of this study. The framework proposed in this study which is the contribution of this research project provides a guide for how supply

chain partners can achieve efficiency and effectiveness of the entire supply chain through the use of ICT for improved information sharing which enhances trust. The literature reviewed showed that supply chain partners do not share information effectively, and hence they are not willing to trust supply chain partners. Improved ICTs make information sharing easier and more effective. This research project therefore explored how information sharing can be enhanced through ICT and how consequently trust can be enhanced to ensure that the supply chain is efficient and effective. The delimitations to the study are highlighted below.

1.8 Delimitation of the Study

The scope of the research project will focus on the effects of ICT on trust formation and information sharing in SA automotive supply chains in the Eastern Cape. The research involved only first, second and third tier suppliers in these supply chains. This research does not consider other supply chain variables that influence inter-organisational relationships such as logistical concerns, human resources and cultural differences. Although there were no particular ethical considerations that had to be considered for this study, a brief overview of the ethical considerations are detailed in the next section.

1.9 Ethical Considerations

“A research design should not cause mental or physical harm to participants and should make data integrity a first priority” (Cooper and Schindler, 2003:16). Ethical concerns in research reflect vital moral issues about the practice of responsible behaviours in society. Some unethical activities include violating non-disclosure agreements, breaking respondent confidentiality, misrepresenting results, deceiving people, and invoicing irregularities (Saunders, Lewis, & Thornhill, 2007).

The researcher made sure that none of these unethical issues arose during the study. No specific ethical considerations were applicable to this study; however, in order to maintain confidentiality, names of the organisations were not used in the reporting of the empirical findings.

1.10 Outline of Proposed Chapters

Figure 1.2 below illustrates the outline of the proposed chapters.

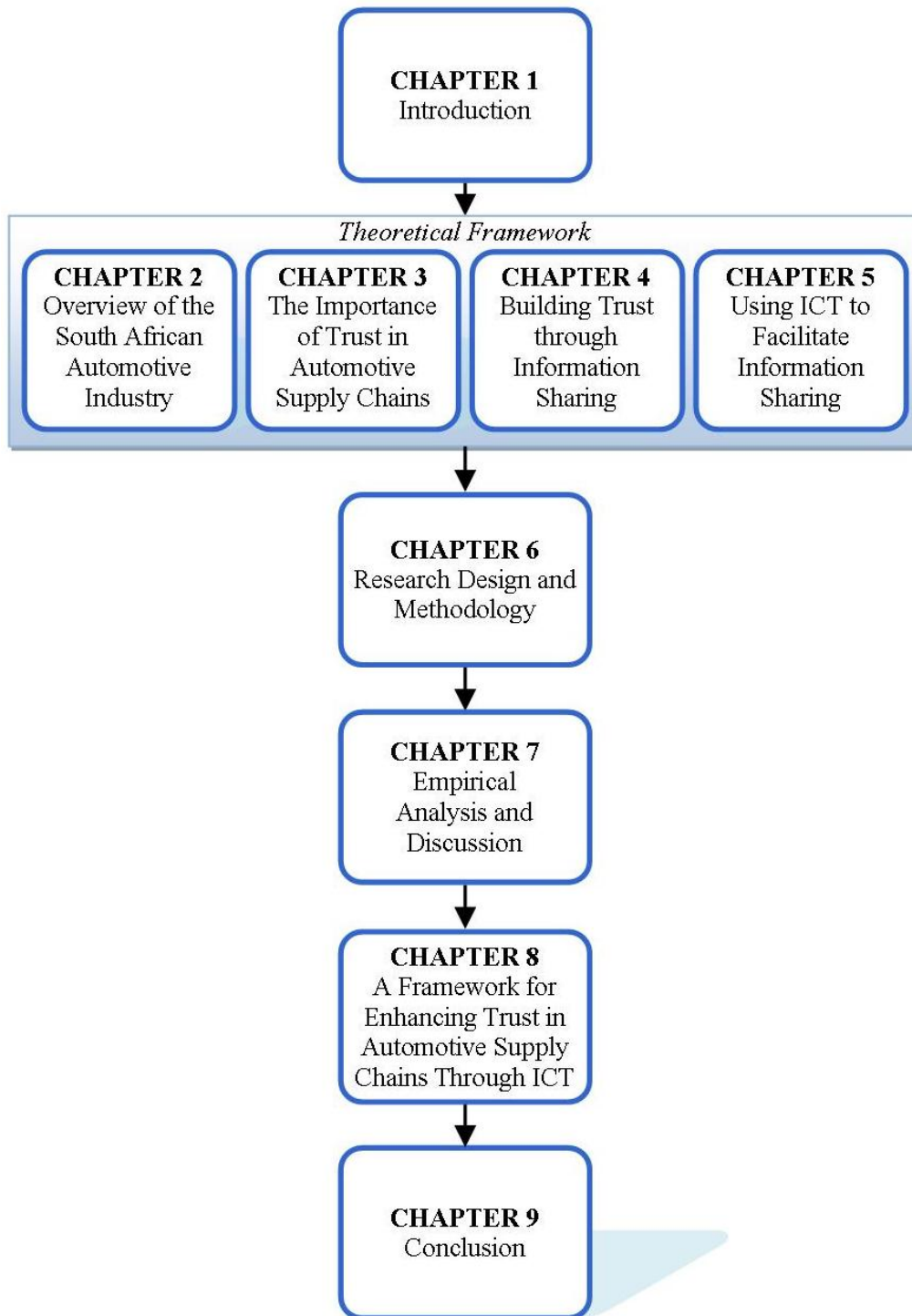


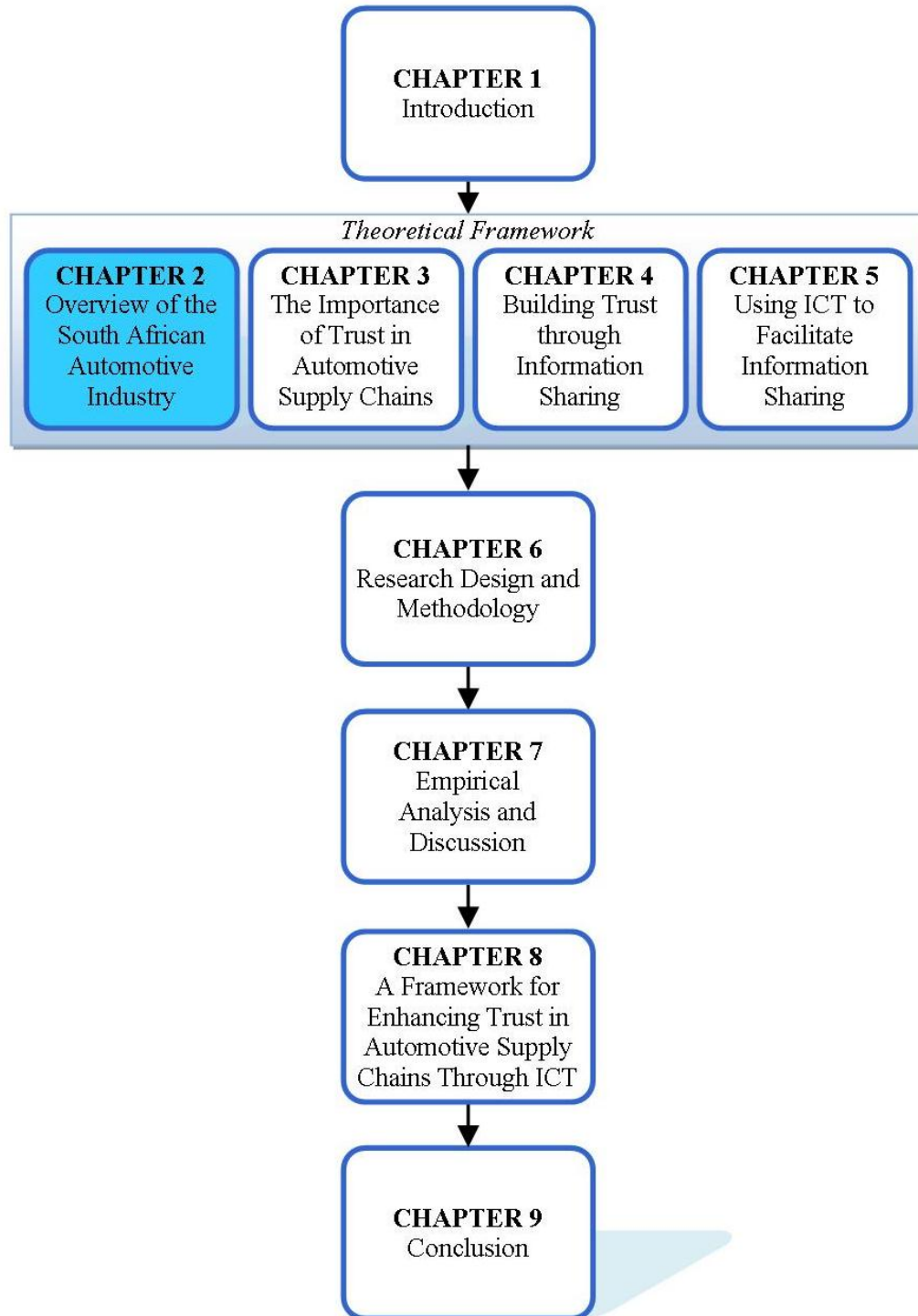
Figure 1.2 Outline of the proposed chapters

Chapter 1 has provided an introduction and background on the specific area of study as well as defined the problem, (along with its sub problems) that was investigated. Chapter 2 will give a background of the SA automotive supply chain which provides the context for this research project. Chapter 3 will explain the importance of trust in the supply chains. Its effect on supply chain performance will be analysed and discussed. Game theory in particular the prisoner's dilemma will also be discussed in detail in this regard. The barriers to effective information sharing in automotive supply chains will be discussed in Chapter 4. The Organisational Information Processing Theory (OIPT) as underlying theory for this research project will be examined, as well as a detailed discussion on information sharing in supply chain networks, benefits of information sharing, and the classification of information in the supply chain. This chapter will also examine how trust can be built through information sharing.

The importance of ICT in enhancing information sharing, and thereby enhancing trust will be discussed in Chapter 5. This chapter will evaluate the importance of ICT in supply chain relationships for information sharing. Objectives of ICT in SCM will be explained as well as the communication technologies enabling information sharing. Obstacles to ICT use for information sharing in supply chains, the role of ICT in the supply chain and the impact of ICTs on supply chains will be discussed, and the chapter will conclude by stating the overall benefits of utilising ICT for information sharing in the automotive industry. Chapter 6 will explain the research design and methodology used to investigate the research problem. A detailed description of the research design scheme, the methods that were used, and the procedures that were followed for collecting and analysing data, will be given.

Chapter 7 will focus on viewing, understanding and analysing the results obtained from the questionnaire. In Chapter 8 the framework that was developed as the outcome of this study is discussed. Chapter 9 provides the conclusion as well as directions for future research.

Chapter 2: Overview of the South African Automotive Industry



2.1 Introduction

Having identified the problem of a lack of information sharing that is detrimental to the establishment of trust in the automotive supply chain as the problem under investigation in this research project, this chapter focuses on understanding the SA automotive industry in detail including its impact and importance to the South African economy. This background information is necessary to provide insight into the context of this research project, in particular, the complicated network of suppliers necessary for automotive production, and the difficulties in managing relationships in these supply chains.

In terms of vehicle production the South African industry is ranked 19th in the world and, according to NAAMSA's Annual Report (2004), is responsible for approximately 80 percent of Africa's vehicle output, and 0.7 percent of global vehicle production. Since the introduction of the Motor Industry Development Programme (MIDP) in 1995 the major challenge the automotive industry faces is the increased exposure to international competition (Black, 1998). Other automotive policies such as the Automotive Incentive Scheme (AIS) which is the first phase of the Automotive Production and Development Programme (APDP) have since replaced the MIDP and they present new challenges and opportunities for automotive manufacturers.

This chapter provides background to the automotive industry which is the context of this study. It is important to be aware of the environment in which the automotive supply chains investigated operate. The chapter begins with an overview of the importance of the South African Automotive Industry to set the context for this study. The policies that govern the automotive industry are then provided and the chapter concludes with a brief overview of challenges faced by the South African automotive industry.

2.2 The Importance of the South African Automotive Industry

The objective 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.

Coega IDZ, (2005) highlights that South Africa's motor industry was founded in 1924 when Ford started assembling the Model T in Port Elizabeth, which today forms part of Nelson Mandela Bay. Hartzenberg and Marudzikwa (2002) also explain that the local automotive industry was established in the 1920s when General Motors and Ford entered the market as manufacturers. With the exception of the Great Depression and the Second World War, the first four decades saw rapid expansion and as a result many manufacturers entered the market. A total of 87 000 vehicles were produced annually in South Africa by 1960, making it the biggest vehicle manufacturer amongst the developing countries (Hartzenberg & Marudzikwa, 2002).

There has been a steady growth in South Africa's role in the World automotive industry, both in the assembly and component sectors. According to the National Association of Automotive Component and Allied Manufacturers (NAACAM), this growth has had a positive impact on the component industry, predicting growth of ten percent in 2005 and with inflation remaining fairly stable, this growth will lead to an increase in Gross Domestic Product of more than four percent. The manufacturing growth is shown in the graph below:

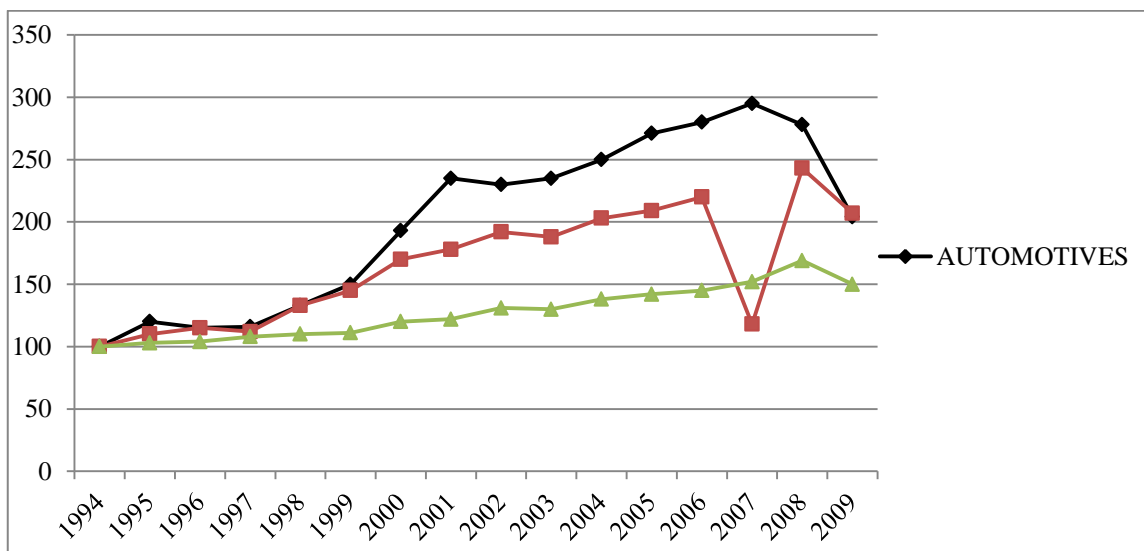


Figure 2.1: Automotive Industry Growth (Source: NAAMSA Annual Report, 2004)

In South Africa, the automotive industry is largely located in two provinces, the Eastern Cape (coastal) and Gauteng (inland). Logistical problems have been faced in the country's ports by South African exporters which have been weighed down by congestion. A competitive international automotive trading environment which will force the industry to improve operational efficiencies and achieve world-class standards in production costs and quality is a major challenge facing the industry (Robertson, 2005). South Africa Information (2005) further affirms this by stating that South Africa's automotive industry has become an increasingly important contributor to the country's gross domestic product, mainly through strong growth in the motor vehicle and component exporting sectors. Some statistics have been supplied by the National Association of Automobile Manufacturers of South Africa (NAAMSA, 2007) indicating the growth of this industry and they are highlighted below:

1. The automotive industry is the leading manufacturing sector in the SA economy and contributed 5,9% of SA GDP of R 2 423 billion in 2009 and an estimated 6.5 % in 2010 as shown in the graph below:

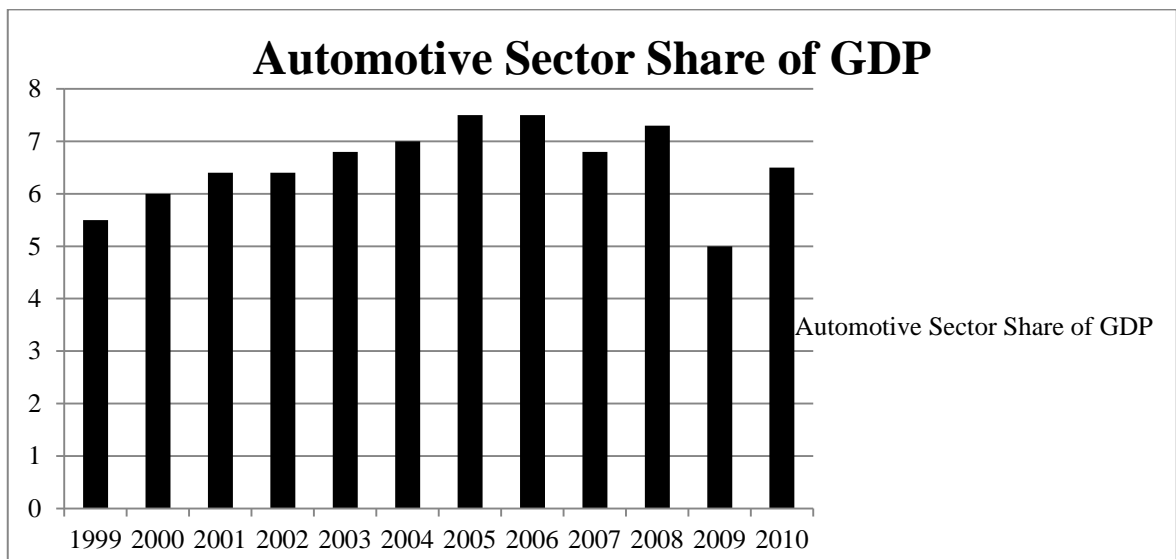


Figure 2.2: Automotive Sector GDP (Source: NAAMSA Annual Report, 2007)

2. Exports of South African produced motor vehicles have grown from 17 947 in 2003 and are projected to increase to 366 000 vehicles in 2012 as illustrated by the table below:

Table 2.1: Projected Exports (Source: NAAMSA Annual Report, 2007)

	2009	2010	2011 Projection	2012 Projection
BMW	37 814	38 206	39 000	45 000
Ford	9 811	11 546	30 000	75 000
General Motors	1609	1 219	30 000	10 000
Mercedes	37 719	38 904	38 000	40 000
Nissan	7 825	9 253	13 000	14 000
Toyota	55 597	55 704	88 500	100 000
VWSA	29 361	76 781	78 000	80 000
Total Industry Exports		174 947	239 465	291 000

A report published by NAAMSA (2004) states that the broader automotive industry represents the third largest sector in the South African economy, after mining and agriculture. This industry is the largest manufacturing sector with a contribution of 6,6 percent to the country's gross domestic product and accounts for about 28 percent of the country's manufacturing output. Motor manufacturers' capital investment in South Africa is in excess of R14 billion, whilst investment by the component supplier industry is estimated at about R7.5 billion.

Not only does this industry play an important role in contributing to the economy of the country, but also plays a significant role in the employment of over 306 000 employees, 74 500 of which are from the automotive components sector. The components sector has experienced the highest increase in employment levels out of all the manufacturing sectors of the automotive industry with a 27 percent change; whereas the vehicle and tyre manufacturing industries only experienced two percent each. The employment levels for the industry are illustrated in the table below:

Table 2.2: Employment levels in the automotive industry (Source: NAAMSA Annual Report, 2004)

	1999	2000	2001	2002	2003	2004
Vehicle manufacturing	32 000	32 300	32 700	32 370	31 700	31 500
Automotive components	62 700	69 500	72 100	74 100	75 000	74 500
Tyre	6 670	6 575	6 300	6 000	6 000	6 000
Motor trade & distribution	175 000	180 000	182 000	185 000	191 000	194 000

According to the Department of Trade and Industry (2005), the automotive industry is acknowledged as the second largest employer in South Africa. This is a key indicator of the value of South Africa's automotive industry and therefore it is important to keep the supply chain which is core to the industry as efficient and effective as possible. The problem of a lack of trust amongst supply chain partners can be detrimental to the success of the automotive industry. This research project therefore aims to establish how trust can be enhanced through information sharing and ICT. A number of policies exist that impact on the automotive sector and these will be discussed in the next section.

2.3 Automotive Policies

2.3.1 The Motor Industry Development Programme

The South African automotive industry has undergone major policy reforms over the last few decades. In the past, the South African automotive industry was heavily protected from outside competition. The last forty years has seen an evolvement in South Africa's policy of support for developing the nation's automotive sector. The major objectives have been to develop a globally integrated and competitive local motor

vehicle and component industry; to stabilise long-term employment levels in the industry; improve the sector's trade balance; as well as to contribute to the country's economic development.

Because of the trade boycotts and sanctions that South Africa faced during apartheid, there were high costs and an uncompetitive production base where exports were dominated by primary products. A report by the Department of Trade and Industry (2005) highlights that the motor industry was extremely inward-oriented and a wide variety of vehicles were produced in low volumes at somewhat high costs. In order to enhance competitiveness and increase value-added production and exports, a process of structural changes that resulted from the rather stagnant performance of the South African Automotive industry occurred.

Damonese and Simon (2004) state that the significant drivers of the development and performance of the local automotive industry in recent years have been changed government support and tariff liberalisation. The first automotive policy to be implemented was the Motor Industry Development Programme (MIDP). Since its inception, the MIDP had been subjected to two reviews - in 1999 and in 2002. The key element of these reviews was the certainty in the incentive scheme, with this taking the form of declining trade facilitation support and the gradual reduction of import tariffs. The South African industrial policy has a sectoral focus aimed at encouraging the exports of, and attracting investment and technology to those sectors that will drive industrial development in the country (Carim, 2004). The MIDP was the key tool to facilitate this in the automotive sector.

Initially, the strategy's emphasis was on import substitution which was strongly influenced by protectionism and included the local content policy. The late 1980s saw an introduction of the structural adjustment program for the motor industry that primarily focused on the objective of saving foreign currency and enhancing automotive exports and this was in line with the country's progress toward trade liberalisation.

In the mid-1990s, the Motor Industry Development Programme (MIDP) was initiated in compliance with the General Agreement on Tariffs and Trade (GATT) and the World Trade Organisation (WTO). Premeditated efforts by the South African government were

therefore required to further structural changes to the domestic industry through a programme of tariff reduction and export promotion by opening up the economy to international competition. Lowering tariffs and becoming an export-oriented industry has been the main focus for establishing an internationally competitive automotive industry.

The main aim of the MIDP is making the South African automotive sector internationally competitive through phased global integration, increasing the volume and scale of local production, expanding exports, and modernising and upgrading the industry. The MIDP has provided the Original Equipment Manufacturers (OEMs) the opportunity to scale down on the number of models produced locally and to import models, which were less economically viable to produce. This in turn allowed the OEMs to concentrate on economically viable models which resulted in greater opportunities to benefit from economies of scale. According to the Department of Trade and Industry (2004), the development of the MIDP is geared towards enhancing export possibilities for vehicle manufacturers and component producers through a number of government support mechanisms that reduce their import liabilities. The MIDP was intended to achieve a number of these objectives of which the core are enhancing component exports, international competitiveness, stabilising long-term employment and attracting foreign investment.

Positive publicity in recent years has been received for past developments in the motor industry. To begin with, and most importantly, this is as a consequence of rapid export expansion, initially of components and later of vehicles. Considerable foreign direct investment (FDI) in assembly plants and component production is the second development that the motor industry has been a recipient of. In recent years, the drivers of the development and performance of the local automotive industry have been trade liberalisation, globalisation of markets and government support (NAAMSA, 2004).

The basic idea of an import substitution and export promotion strategy is that protection is necessary for most developing countries at some point in order to establish an internal routine that generates increasing welfare, as maintained by Chenery and Srinivasan (1989). They also maintain that exports enable the importation of capital goods

necessary for investment, and prevent balance of payments problems, which seem to plague many developing countries. Flatters (2002) highlights that a successful automotive industry is often seen as an emblem of success financially, and in developing countries it resembles a sign of mastery of modern technologies.

History has shown that the overall regulatory regime in South Africa is essential in determining the actions of automotive organisations. High tariffs were placed on Completely Built Up vehicles (CBUs) in the past, which acted as a magnet to a large number of initially foreign OEMs to institute assembly plants in the domestic market when combined with a rapidly growing market. Although these operations were in many cases highly profitable, they were very small in international terms with correspondingly high unit costs. Production was aimed solely at the domestic market. South African assembly plants were kept isolated from the global production networks of the parent companies except as markets for completely knocked down (CKD) packs (Black, 1998; Black & Bhanisi, 2006). The next section will discuss the objectives of the MIDP.

2.3.2 Objectives of the MIDP

One of South Africa's main strategies was to become an internationally competitive economy focused on lowering tariffs and on becoming export-orientated. The MIDP has been recognised around the world as a successful and innovative national strategy, designed to develop automotive manufacturing and to expose the domestic market to the new environment of globalisation. The export market has created a lifeline for the automotive industry whose existence was not warranted by the low volumes demanded by the domestic market alone (Department of Trade and Industry, 2004). Some of the main goals of the MIDP as highlighted by NAAMSA (2004) are:

1. The development of an internationally competitive and growing automotive industry in South Africa;
2. The enhancement of automotive exports and international competitiveness;
3. To make a greater contribution to the economic growth of the country by increasing production and achieving an improved sectoral trade balance;

4. To attract foreign investment;
5. To provide sustainable employment through increased production;
6. To provide high quality affordable vehicles to the South African public;
7. The development of learning capabilities through globalisation initiatives, by exchanging ideas and expertise; and
8. To create a better balance between the industry's foreign exchange usage and foreign exchange earnings.

These objectives were to be achieved by encouraging a phased integration into the global automotive industry as well as increasing production volume through export expansion and gradual rationalisation of models. Encouraging the modernisation and upgrading of the automotive industry would help to promote higher productivity and facilitate the global integration process. The key features of this programme are detailed in the section below.

2.3.3 Key Features of the MIDP

The MIDP is in essence an expansion of the previous industry policies (Phase 1-VI) in terms of export facilitation. The automotive industry can, through its import-export complementation scheme, earn export credits, which can be used to offset import duties. The domestic vehicle assembly should however be on the basis of completely knocked down (CKD) components as a precondition to participate in the programme. The objective is to create and/or sustain employment, to reduce import duty liabilities and to improve on the automotive trade balance. Other features built into the MIDP are the gradual phasing down of tariffs for both completely built-up vehicles and components. Other government support schemes include a Duty Fee Allowance (DFA) and a Small Vehicle Incentive (SVI) scheme.

Since the implementation of the MIDP, South Africa has seen rapid growth in the automotive sector, based on a speedy rise in global exports of CBUs, especially after 1998. The Automotive Investment Scheme (AIS) has since replaced the MIDP, and is discussed in the next section.

2.3.4 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 investment in new and replacement automotive models, as well as investment 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.

2.4 Challenges faced by the SA Automotive Industry

The exchange rate has a major effect on South Africa's automotive industry (Fransé, 2006). This is mainly because the capability of producing a component in South Africa depends heavily on the rate of exchange. Time and again the unstable Rand value can result in components being imported rather than locally produced, and this affects the local content portion of completed products by lowering them (Fransé, 2006). This is one of the major reasons why local content incentives were included in the APDP.

According to Ford Motor Company, (2005) the other challenges that are faced by the automotive industry include the growth of Asian competitors, inadequate production capacity, price pressures imposed by multinational partners in order to retain business,

high oil and raw material prices, skill shortages and a somewhat volatile work force. A need to adopt lean manufacturing principles and just-in-time approaches in order to be competitive has resulted due to the influence of the Asian manufacturers. This has posed as a big 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).

Through the implementation of lean manufacturing principles, the Asian manufacturers have managed to reduce costs considerably and have therefore caused worry for the continued feasibility of South Africa's automotive sector (Fransé, 2006). This means that trust and information sharing is important to allow organisations to operate efficiently and effectively. This manufacturing approach is particularly important, as this can improve the effectiveness and efficiency of supply chain operations.

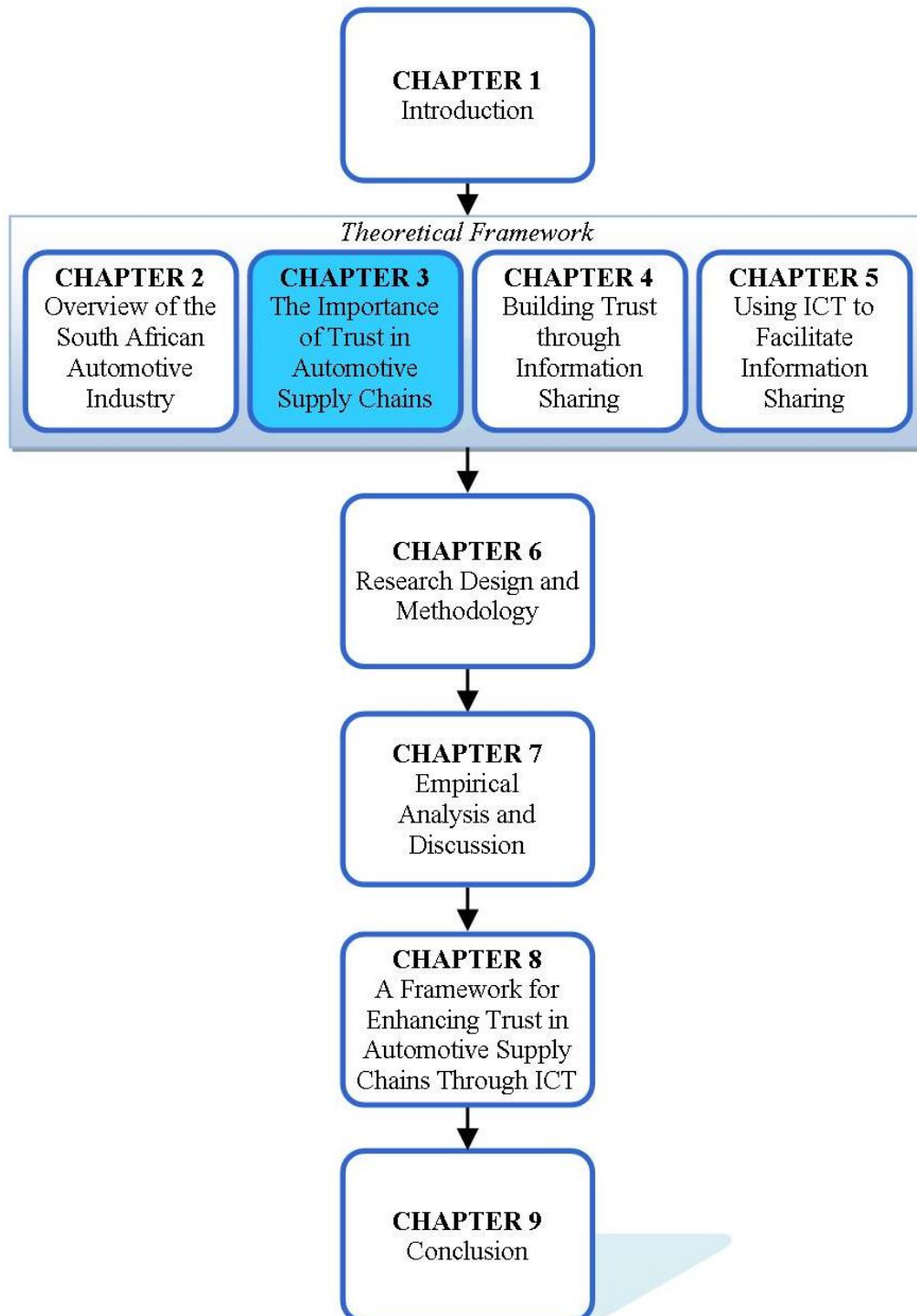
2.5 Conclusion

The literature has highlighted the importance of the automotive industry to the economy of the country, one of the major reasons why this is so is that the automotive industry is acknowledged as the second largest employer in South Africa, and therefore it is important to keep the supply chain which is core to the industry as efficient and effective as possible. The problem of a lack of trust amongst supply chain partners can detriment the success of the automotive industry. It is therefore vital to keep the supply chain efficient and effective through improved information sharing which will enhance trust.

The objective 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, the nature of the South African automotive industry and factors that impact on the efficiency and effectiveness of supply chains in this industry were discussed. The automotive policies that have contributed to the success of the automotive industry were also discussed, although there are challenges that still need to be overcome in order to ensure continued success. These challenges were explained in this chapter.

To overcome these challenges, trust and information sharing are important to improve the efficiency and the effectiveness of the supply chain operations. Trust is a major component that is very important to this research project. The aim for this project is to ensure that supply chain partners utilise ICT for improved information sharing and enhance trust so as to have an efficient and effective supply chain. The next chapter will explain the notion of trust in the supply chain, its importance and effect in the supply chain as well as the Game Theory (Prisoner's Dilemma) and how it is applicable to this study.

Chapter 3: The Importance of Trust in Automotive Supply Chains



3.1 Introduction

The previous chapter gave an overview of the SA Automotive Industry, its importance to the South African economy and the automotive policies which affect the production of vehicles in South Africa, as well as the problems and challenges that are currently being faced. As this industry is very important to the economy of the country, its continued success is critical. Some issues pertaining to mistrust among supply chain partners and a lack of information sharing threaten the efficiency and the effectiveness of the supply chain as a whole. This study therefore aims to develop a framework that can enhance trust and improve information sharing through the use of ICT. This chapter focuses on the trust aspect in the supply chain context.

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.

The establishment of at least a basic level of trust is vital, and is extremely difficult to achieve. Das and Teng (1998) explore the issue of managing relational risk in co-operative alliances. Mayer, Davis and Schoorman (1995) document this in their trust model. They highlight three factors that are critical in building trust or perceived trustworthiness to be ability, benevolence and integrity. A fourth moderating influence is the trustor's propensity to trust (Mayer, Davis, & Schoorman, 1995). Willingness to act in the face of perceived risk was shown to be influenced by the presence of trust. These models will be explained in more detail in this chapter to gain a better understanding and their importance for this study.

In this chapter, the importance of trust will be explored, in particular within automotive supply chains, before a definition of trust is established. Trust development and forms of trust will also be explained based on Mayer, Davis and Schoorman's trust model and

McKnight, Choudhury and Kacmar's Initial Trust Model. The role of trust in inter-organisational relationships precedes the discussion of the relevance of the Prisoner's Dilemma. The chapter concludes by explaining the relationship between trust, information and controls in the supply chain.

3.2 Importance of Trust

The importance of trust has been illustrated in Information Systems (IS) research, for example, in technology adoption (Resatsch, Sandner, Leimeistern, & Krcmar, 2008; Gefen, Karahanna, & Straub, 2003), virtual organisations (Leimeister, Ebner, & Krcmar, 2005) and e-commerce (Gefen & Straub, 2004). Trust is an important root of acceptance in the cited examples. Thus, the most important tasks in trust research according to Leimeister, Ebner, and Krcmar, (2005); Gefen, Karahanna, and Straub, (2003) are trust building, trust support and the classification of aspects that are necessary for the formation of trust.

According to Morgan & Hunt (1994), the importance of trust has been the foundation of the evolving fields of risk and relationship management. Handfield and Bechtel (2004) explain that for inter-organisational alliances and networks to be successful, they are dependent upon the development of relational capital, the basis of which is trust. For trust to develop among the supply chain partners, Cheung (2006) believes that involved organisations should create mutual commitments which are built over numerous interpersonal meetings. Conversely, Kautonen, (2006) views trust as a pre-condition of cooperation since partners need some assertion that the other parties will not defect. Thus, trust is an essential element of employing relationship management approaches in supply chain management.

Trust is said to have a direct effect on work group process and performance, and in Kautonens' (2006) findings, it is demonstrated that enhanced coordination and greater efficiency are found in a high-trust group and as a result improved performance is achieved. Transaction costs are not only reduced because of high trust between parties, but this also permits joint projects of various kinds, and provides a basis for expanded moral relations in business (Ghosh & Fedorowicz, 2008).

Trust has been argued to be critical in all economic exchanges (Granovetter, 1995), and it is also stressed as an important factor in the development and success of inter-organisational relationships (Karahannas & Jones, 1999; Handfield & Nichols, 2004). Previous studies indicate that high levels of information sharing positively influence the development of long-term relationships, trust and overall satisfaction (Dyer & Chu, 2003; Gulati, 1995; Sako, 1998). Practitioners often point to the lack of trust as a major factor contributing to the failure of alliances (Parkhe, 1998). A lack of trust coincides with sentiments of suspicion and scepticism regarding the actions and intentions of the business partner (Gefen & Straub, 2004). It is therefore important ensure that trust is enhanced in inter-organisational relationships to ensure efficiency and effectiveness of the supply chain.

Furthermore, researchers distinguish between diverse conceptualisations of trust. Zaheer, McEvily, and Perrone, (1998) differentiate between interpersonal and inter-organisational trust, and argue that both levels can influence each other. Holland and Lockett (1998) focus on international inter-organisational relationships, and perceive trust as the degree of confidence the partners have regarding the reliability and integrity of each other. Hart and Saunders (1997) emphasise the relationship between culture and trust, and argue that Japanese automotive suppliers have a higher level and more complex conceptualisation of trust than American automotive suppliers. The different types and conceptualisations result in part from the adoption of different theoretical backgrounds and form disagreement on the scope of trust.

Numerous researchers have proposed that trust is essential for interpersonal and group behaviour, and yet this concept has never been precisely defined. Hosmer (1995) explains that a lack of clarity in the definition of trust has led to an overall picture of confusion, ambiguity, conflicting interpretations and absence of reliable principles. The following section outlines some of the definitions of trust from previous research that assisted in identifying and developing the definition of trust that was applied in this study.

3.3 Defining Trust

In order to identify how inter-organisational relationships develop, it is important to understand the concept of trust. It is very difficult though to state an actual definition of trust as it is a diffuse concept which is defined in many different ways, depending on the field of study which can either be sociological, economical, anthropological or psychological (Skjott-Larsen & Schary, 2007). Despite the attention paid to the role of trust in organisations, trust remains a subtle concept which means different things to different people. There is therefore a need to clarify the concept of trust so that an appropriate definition can be applied to this study.

Trust may be defined as a mutual expectation that partners will not exploit the vulnerabilities created by cooperation (Ketchen & Hult, 2007). In this analysis, the choice over whether to trust or not can be determined by the understanding of the party's intent and possible behaviour. Resatsch, Sandner, Leimeistern and Krcmar (2008) suggest that the interpretation of whether vulnerabilities have been exploited or not, whether one has been taken advantage of, depends on one's understanding of what behaviour is acceptable. The authors further explain that trust is important and useful, mainly in facilitating cooperation in uncertain environments. Therefore, one can conclude that if there were perfect information and foresight, trust would have no role to play in facilitating coordination between supply chains. Trust enables one party to narrow down the set of possible actions by the other party by excluding the actions which are regarded to be unacceptable.

Sako and Helper (1998) state that trust "*is an expectation held by an agent that its trading partner will behave in a mutually acceptable manner*". The trustor's expectation in this illustration lessens the supposed doubt about the trustee's actions and in turn increases the conviction of these actions. Morgan and Hunt (1994) underline the confidence in the exchange partner's reliability and integrity as an important aspect of trust. Finally Ben-Ner and Putterman (2001) argue that trust can be interpreted as an attitude towards taking risky decisions.

Mayer, Davis and Schoorman (1995) defined 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 the other party". Being vulnerable is said to be a risk in itself, even though it cannot be concluded that trust is a risk but it is the willingness to take risk (Lin, Song, & Lo, 2003).

Two additional views of trust were provided by Ring and Van de Ven (1994). Confidence, or risk in the predictability of the other party's actions is the basis of the first, and the second view is based on confidence in the other party's goodwill. The authors argued that reliance on trust by organisations can be expected to emerge between business partners when they have successfully completed transactions in the past and they perceive one another as complying with norms of equity. Ring and Van de Ven (1994) emphasised the evolvement of inter-organisational relationships that was found to be relevant for this study as the researcher seeks to examine the evolvement of inter-organisational trust in supply chain relationships.

There is no standard definition for trust, but for the purposes of this study, the definition by Bradach & Eccles (1989) will be used, which is, "*trust is an exception that alleviates the fear that one's exchange partner will act opportunistically.*" Williamson (2000) refers to opportunism as the incomplete or distorted disclosure of information, especially to calculated efforts to mislead, distort, disguise, complicate, or otherwise confuse. Sako (1998) also describes opportunism as the 'dark side' of inter-organisational relationships. According to Batt (2003), some of the examples of devious actions include withholding or misrepresenting information, avoiding or failing to see through vows and commitments, as well as misusing the technology that belongs to a partner organisation. Numerous authors including Handfield and Nichols, (2004), Ring, Hendricks and Singhal, (2005); and Nooteboom, (1996) came up with an assertion that for effective association between supply chain partners as well as for improved performance, trust is vital as they consider it as a driving force in building relationships.

This notion will be used in this research project as trust is essential to supply chain relationships to improve efficiency and effectiveness of the supply chain. This study seeks to investigate how trust can be enhanced through information sharing and ICT. The development of trust in this context will be discussed in the next section.

3.4 Trust Development

Several key trust models have emerged in literature in recent years. Two of these models are discussed in this section, namely: Mayer, Davis and Schoorman's (1995) Trust Model and McKnight, Choudhury and Kacmar's (2002) Initial Trust Model.

3.4.1 Mayer, Davis and Schoorman's Trust Model

A model of organisational trust was proposed by Mayer, Davis, and Schoorman (1995) which indicates that risk will moderate the relationship between trust and trust behaviour. These authors integrated research from various disciplines to define the characteristics of the trustor, the trustee, and the role of risk. Although quite a number of factors were proposed, they concluded that there are three determinants of a trustee's trustworthiness which are ability, integrity and benevolence. Mayer, Davis, and Schoorman (1995) also argue that trust develops as a function of the trustor's propensity to trust, the extent to which the trustee perceives the trustor as trustworthy, and the trustor's perception of situational risk. The authors suggest that when risk is made out to be low, trust will most likely end up in trust behaviour and that when risk is high, better levels of trust will be needed. The model is illustrated diagrammatically below:

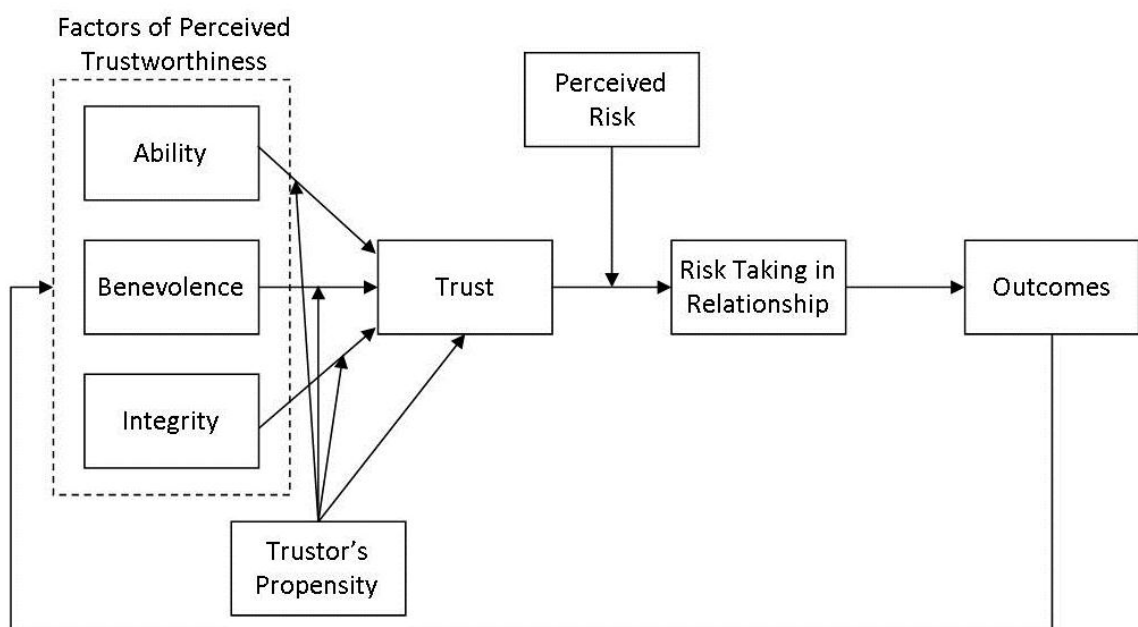


Figure 3.1: Mayer, Davis and Schoorman's Trust Model (Mayer, Davis, & Schoorman, 1995)

The determinants of trustworthiness can be defined as follows:

1. **Ability:** is that group of skills, competencies and characteristics that enable the trustee to have influence within a specific domain (Söllner, Hoffmann, Hirdes, Rudakova, Leimeister, & Leimeister, 2010). Ability is more inclined to competence, which, relates to cognitive trust based on objective knowledge of the other party in the supply chain.
2. **Benevolence:** these beliefs refer to the extent to which one party or his proxy is believed to do good, as well as to show some sensitivity to the needs of the other party and not to take economic advantage of them (Mayer, Davis, & Schoorman, 1995). It relates more to the ethics and moral judgement of the supply chain partners.
3. **Integrity:** refers to a customer's perception that the trustee adheres to a set of principles that the customer finds acceptable (Mayer, Davis, & Schoorman, 1995). In the supply chain, integrity would be an agent's attitude towards honoring its commitments, and is affected by the perceived probability that an interaction will be repeated.

The model of trust development developed by Mayer, Davis, & Schoorman, (1995) may not be applicable in all scenarios. In particular, one considers a situation in which the supply chain partners are geographically distant from each other and must rely solely on technology to communicate. In these situations trust may be particularly important because monitoring is more difficult. Trust may also be difficult to develop because co-workers rarely have opportunities to interact face-to-face and rely more heavily on technology to mediate their interactions.

It is therefore important to consider Rusman, Van Bruggen and Valcke'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, Choudhury and Kacmar's (2002) Initial Trust Model, points to additional trust determinants and is discussed below.

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

McKnight, Choudhury and Kacmar'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, Davis and Schoorman (1995) model. The initial trust referred to by this model is trust in an unfamiliar partner, where the trustor has no prior knowledge of, or interactions with, the trustee (Li, Valacich, & Hess, 2004). Li, Valacich and Hess (2004) believe this model to be one of the most cited models in literature. This model is depicted in Figure 3.2 below.

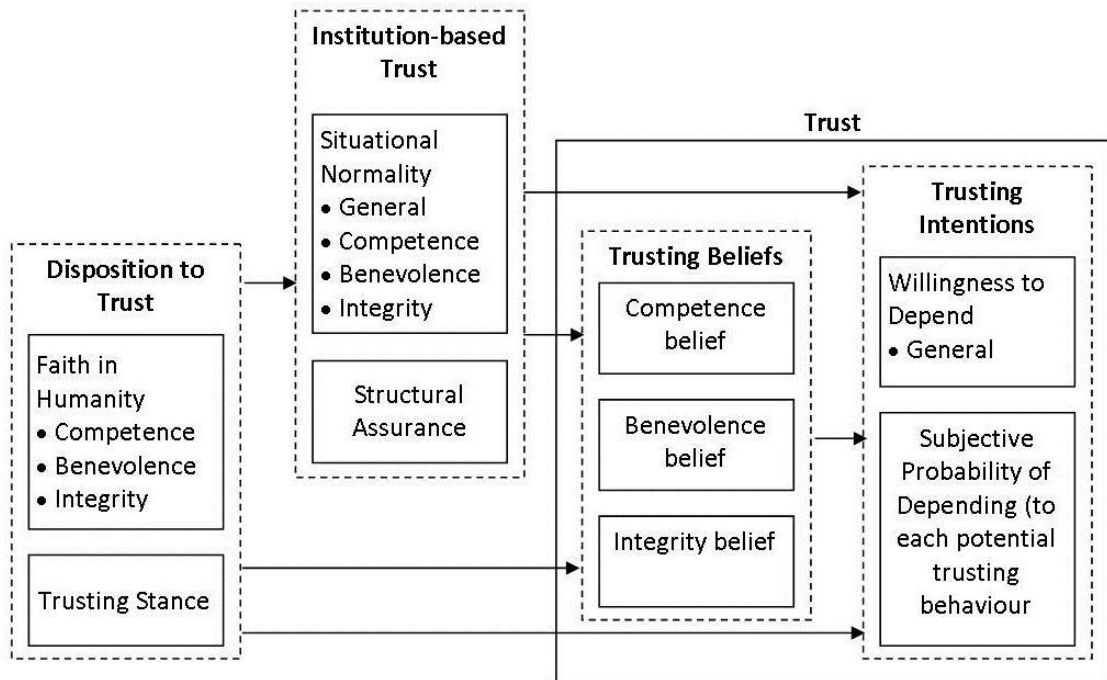


Figure 3.2: Initial Trust Model (McKnight, Choudhury, & Kacmar, 2002)

In this model, trust is divided in two components, namely trusting beliefs and trusting intentions:

1. **Trusting Beliefs** refers to the trustor's belief that the trustee has attributes beneficial to the trustor (Li, Valacich, & Hess, 2004). These attributes are based on Mayer, Davis and Schoorman's (1995) factors of perceived

trustworthiness discussed previously. The three categories of beliefs that constitute Trusting Belief 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 Intentions***, which is determined by trusting beliefs, is defined as the trustor's willingness to depend on the trustee (Li, Valacich, & Hess, 2004). This trusting intention can be equated to Mayer, Davis and Schoorman'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, Choudhury and Kacmar (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 on: (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, Choudhury and Kacmar'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 (which are discussed later in this chapter). Additionally, components suggested by Mayer, Davis and Schoorman (1995) were confirmed by McKnight, Choudhury and Kacmar's (2002) empirical study. Different forms of trust have been identified in these two models and they will be reviewed in the next section.

3.5 Forms of Trust

Three forms of trust are defined by Williamson (1993) as personal, calculative and institutional trust. Although personal relationships across organisational boundaries become a building block for other relationships, Williamson (1993) decided that personal trust is not relevant in business. The penalties of acting opportunistically exceeding the expected benefits are the basis of calculative trust (Hart & Saunders, 1997). It is based on an assumption that each party calculates the costs and benefits, and institutional trust relates to the specific environment of the transaction. Thus, one can conclude that trust is founded on the assumption that the other party acts from self-interest by not acting opportunistically. A different conception of trust was proposed by Sako (1998), who identified three types:

3.5.1 Competence Trust

This refers to the ability of a chain member to perform a task that it says it can perform (Ghosh & Fedorowicz, 2008). Technical, operational, human and financial abilities are some of the aspects that are covered by competence trust. It builds up when the skills required to carry out a task exist across partners (Paul & McDaniel, 2004). This is in line with Mayer, Davis and Schoorman's ability characteristic. In some cases, a buyer may entrust a supplier to carry out a task that the buyer himself has the ability to carry out. In other cases, he may entrust a specialist supplier to carry out tasks whose technicalities lie outside his comprehension (Söllner, *et.al*, 2010). The level of search undertaken by one party for those skills before selecting the right partner to enter into

such a relationship is the other factor that contributes to the development of competence trust (Ghosh & Fedorowicz, 2008).

3.5.2 Contractual Trust

This type of trust refers to an expectation that a trustee can be relied upon to maintain the ethical standard and carry out a verbal or written promise which is spelt out in detail (Sako, 1998). This can be aligned to the integrity aspect of Mayer, Davis and Schoorman's model. Contractual trust may be based on bilaterally agreed rules between trading partners or a more universal standard or law (Ireland & Webb, 2007). An example is illustrated in an article from the Harvard Business Review (2003) and it states that suppliers normally agree to produce and deliver ordered goods on the basis of written, or in some cases orally communicated orders, in the expectation that they will be paid for work done within an agreed period of time after delivery. A payment period may be agreed bilaterally or may follow an industry norm if one exists.

3.5.3 Calculative Trust

This type of trust develops in the building phase of a business relationship and it is an ongoing, market-oriented, economic calculation for assessing the benefits and costs that can be derived from creating and sustaining a relationship (Paul & McDaniel, 2004). One can easily make an assessment of a partner's likely cooperation based on the partner's qualities and social constraints (Attaran, 2004). The common thread connecting the different opinions of the magnitudes of trust as highlighted by Fawcett, Magnan and McCarter (2008) is that the two aspects of trust relate to belief in partners' ability to deliver on promises and a partner's benevolence towards the partnership.

In order to expand more on the concept of trust, the categorisation of trust, founded on the reasons for trusting is useful in furthering the understanding of the concept of trust. One way of discovering the connection between the different types of trust is to classify them in terms of a hierarchy of trust (Akkermans & van Doremalen, 2004). Contractual trust and competence trust may be considered as fundamentals for two organisations to engage in business over a period of time, while calculative trust aids the quality of business relationship (Fawcett, Magnan, & McCarter, 2008). Attaran (2004) concludes

that this hierarchy may be thought of as a gradual bottom-up development in the resemblance of beliefs and norms about what is acceptable as required in trust relations.

Uncertain and unpredictable environments make it necessary to rely on trust, but it is also precisely in these circumstances that trust may be abused (Ketchen & Hult, 2007). In other words, a trust-based system is not free of problems as there are pitfalls that can be associated with this. One such pitfall is the danger of being taken advantage of due to vulnerabilities created by trusting behaviour (Resatsch, Sandner, Leimeister, & Krcmar, 2008). For example, a car manufacturer may trust a supplier to deliver daily on a just-in-time basis, but the resulting low inventory levels give the supplier the power to potentially stop the car manufacturer's production by intentionally withholding delivery (Handfield, Krause, Scannell, & Monczka, 2000). Therefore as explained by Söllner and Leimeister (2010a) an important factor that should be considered is what mechanisms are available to safeguard trusting actors from opportunists abusing their trust. Trust in inter-organisational relationships will be explained in the following section.

3.6 Trust in Inter-Organisational Relationships

A two dimensional perspective on trust is proposed by Nooteboom (1996), who states that trust "*may concern either a partner's ability to perform according to agreements (competence trust) or their intentions to do so (goodwill trust)*". Todeva & Knoke (2002) share the same sentiments with their two-faceted view on inter-organisational trust which suggests that the facets vary "*in relation to their virtual importance on the objective or subjective elements in the relationship which could also be referred to as the rational dimension and the emotional dimension*".

According to Sinha (2004), information sharing among supply chain partners is one of the most important factors affecting the development of trust. Trust may incorporate a partner's willingness to perform according to agreements, or the intention to do so. Spekman and Davis (2004) highlight that if the party is not competent to act or if the party chooses not to act, very high risks exist. Opportunism, where one supply chain acts in its own self-interest to the detriment of others may also result from a lack of trust (Skjott-Larsen & Schary, 2007).

In the literature, trust has been recognised as a complex concept which plays a fundamental role in supply chain relationships. Sahay (2003) highlights that supply chain managers are not able to foster trust in their partnerships with the various channel members across the supply chain despite the best of intentions. It is therefore important that the role of trust in supply chains be explained.

Trust plays a crucial role in facilitating the implementation of relationship management and organisational changes (Sako, 1998). Trust is a major component in building a cooperative relationship between partners as it encourages openness between parties. Stjernstrom and Bengtsson (2004) and Johnson (2004) suggest that relationships benefit from increasing trust. Hines (1996) argues though that trust is an outcome rather than a cause of successful supply chain collaboration in automotive supply chains. Similarly, Rousseau (1998) states that both risk and interdependence are necessary conditions for trust to prevail. Inter-organisational relationships are critical to the successful coordination of supply chains and improvements in the performance of suppliers' production capabilities (Handfield, Krause, Scannell, & Monczka, 2000). The supply chain relationship is an important channel for communicating customer requirements to suppliers and achieving longer term goals of production (Handfield & Bechtel, 2004).

A survey of automotive parts suppliers was conducted in 1993-1994 with the sponsorship of the International Motor Vehicle Programme (IMVP) with the intention of finding out the nature of trust in supplier relations (Lazaric & Lorenz, 1998). The survey was based on responses from 671 companies in the USA, 472 companies in Japan and 268 companies in Europe. This survey supported the notion that high trust co-exists with much information sharing. The survey asked suppliers what kind of information they received from their fellow supply chain partners as well as the kind of information that they provided to them. The results showed that in all the three regions, Japan, USA and Europe, the information flow from suppliers to their supply chain partners had different links to trust depending on the type of trust. The conclusions showed that firstly, calculative trust is associated with more information sharing, perhaps indicating suppliers' willingness to disclose somewhat confidential information to their partners once this type of trust is established. Secondly, suppliers' competence trust of their fellow supply chain partners is associated with "less" information provided

by suppliers (Lazaric & Lorenz, 1998). This correlation between trust and information sharing indicates that suppliers' provision of information to other suppliers on its own is associated with an increase in suppliers' trust of the other suppliers (Söllner, *et al*, 2010).

In concluding the survey above, it was discovered that trust between organisations depends on mutual awareness. It is the beliefs about how information is used which matters in maintaining a fine balance between a trusting relationship and a distrustful, monitoring relationship. In order to maintain a good trusting relationship, supply chain partners need to learn to share information and trust the information that they get from other suppliers. Game Theory, in particular the Prisoner's Dilemma is very important in understanding the importance of trust and hence it will be discussed in the next section.

3.7 Game Theory (Prisoner's Dilemma) and Trust

Game Theory has been described as a collection of tools for predicting outcomes for a group of interacting agents where an action of a single agent directly affects the payoffs of the other participating agents (Ketchen & Hult, 2007). A key element of game theory is trying to predict others' actions (Hosmer, 1995). Hennem and Arda (2008) explain that game theory provides a mathematical background for modelling systems as well as generating solutions in competitive or conflicting situations. The basic principle of the game theory is that each player involved acts in the most advantageous way possible to accomplish their individual goal, considering that the others play in the same manner. If however the individual goal of each player is solely to take full advantage of his gain or to reduce his loss, Hennem and Arda (2008) highlight that the agreements obtained by negotiation may be weak and will not generally guarantee global optimality for the whole supply chain, particularly when external demand is high.

An example of game theory and trust is highlighted by Lee & Whang, (2002). The authors explain that during a period of shortage, which frequently occurs in an industry upturn, buyers tend to order more than they really need from a supplier, because they anticipate the consequences of the shortage. Since all buyers do so, this strongly inflates the incoming order level. Since the suppliers know that this is happening, they tend to downscale all incoming demand levels. This can be prevented from happening if the

buyer can trust the supplier to interpret this order information correctly and if the supplier can trust the buyer to provide him with correct demand figures (Sterman, 2000; Akkermans & van Doremalen, 2004; Lee & Whang, 2002).

The concept of trust which derives from game theory is pertinent in this respect. The famous “prisoners’ dilemma” illustrates the need for a theory of trust in order to explain how agents can overcome the strong incentives to defect and so reap the benefits of mutual cooperation. It shows that cooperative behaviour is superior to self-seeking behaviour. Berg, Christensen, and Ressel, (1995) studied a single round trust game in which player A decides how much of the show-up fee to send to an anonymous counterpart player B. The amount of money triples when it is passed. Player B then decides if and how much money to return to player A. The authors found that, in contradiction of the non-cooperation prediction of game theory, player A tends to send money to player B because of the trust that exists between them.

In inter-organisational relationships, trust goes hand in hand with access to each other’s information (Harvard Business Review, 2003). It is how much information is used which matters in developing trust or mistrust. An example illustrated by Hendricks and Singhal (2005) suggests that if the supplier believes that the buyer demands to see the supplier’s internal quality records only to assign blame to the supplier for the latest delivery batch, then trust is not likely to develop. However, if the supplier expects the same information to be used by the customer to help it improve its quality assurance system, then the supplier is likely to come to trust its customer. Thus according to Gefen, Karahanna, and Straub (2003) trust does not consist in turning a blind eye to the state of a relationship, and it can occur with intense monitoring. It has been asserted by Ketchen and Hult (2007) that, “*a slight amount of suspicion, however that is determined, a kind of alert but not distracting guardedness may be facilitative*”, in developing trust. Therefore trust without monitoring may bring out fulfilment in a hierarchical command relationship. As this study is concerned with how trust can be enhanced through information sharing, this section is very important for this study. Through effective information sharing in the supply chain, trust can be built amongst supply chain partners. In building inter-organisational relationships, controls play a vital

role. The relationship between trust, information and control will be explained in the section following.

3.8 Trust, Information and Control in Supply Chains

Control can be defined as “a regulatory process by which the elements of a system are made more predictable through the establishment of standards in the pursuit of some desired objective or state” (Das & Teng, 1998). This definition was based on Leifer and Mills (1996). Structures are created by control mechanisms which permit the trustor to depend on the trustee with no deliberation of the trustworthiness of the trustee or anticipations of sharing. These control mechanisms decrease the ambiguity about the trustee’s actions by placing controls on the behaviours and outputs of the employees of the trustee. The diagram below shows the confidence in partner cooperation:

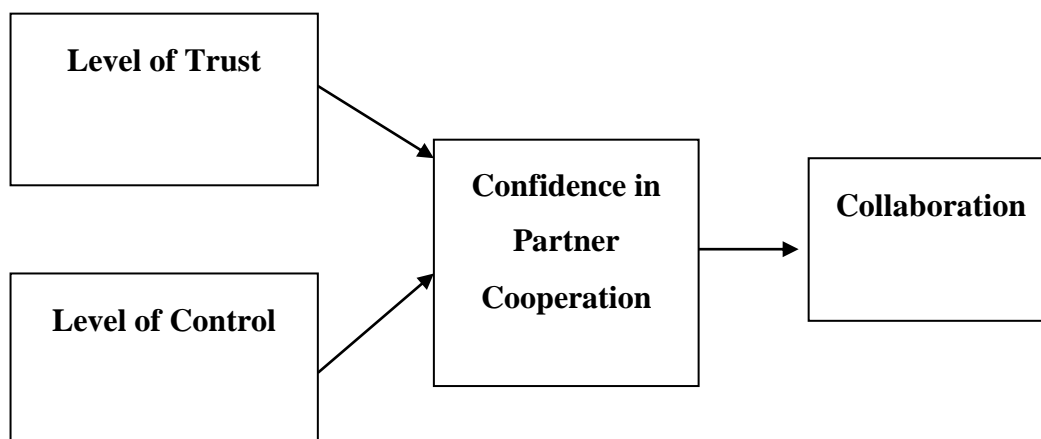


Figure 3.3: Das & Teng's Trust Model (Das & Teng, 1998)

As illustrated in Figure 3.3, confidence in partner cooperation is determined by both trust and control. For this study, the definition of cooperation which was proposed by Kopczak and Johnson (2007) will be used, and they define cooperation as “the willingness and ability of a partner organisation to pursue mutually compatible interests.” Das and Teng (1998) highlight that the absence of cooperation in partner organisations may result in opportunistic actions such as distortion of information, misleading other partners and cheating. Trust and control can be both challenging and expensive to institute. In their conclusion, the authors state that trust and control act as

supplements as they can function as a way to boost the confidence on the likely behaviour of the trustee.

An argument was put forward by Tomkins (2001) that information sharing is facilitated by management control mechanisms. Less information control is needed as trust becomes further established in later stages. Trust between the supply chain partners will be damaged if a certain level of management control appears. In order for supply chain relationships to flourish, trust has to be present.

3.9 Conclusion

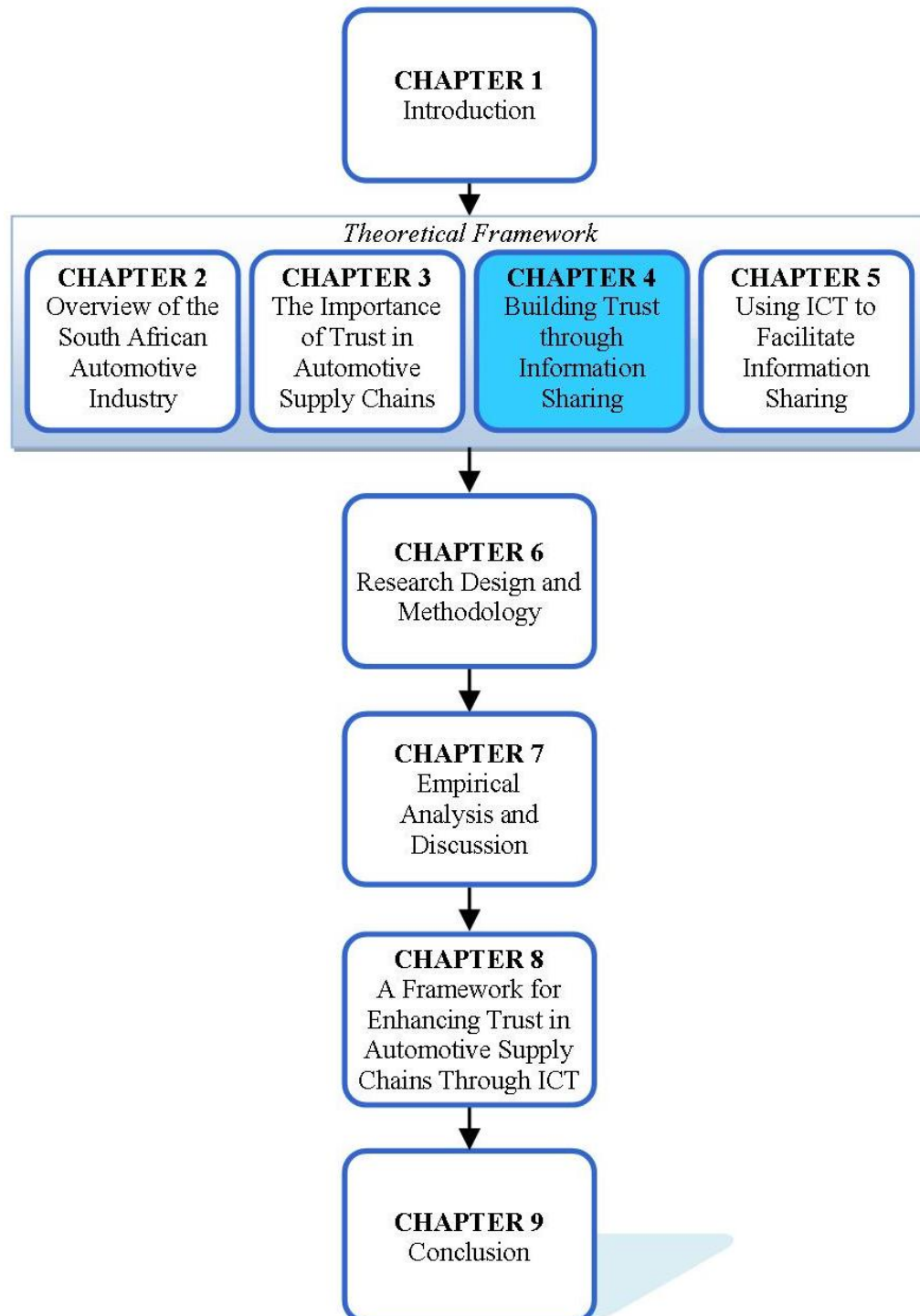
Continued commitment to communication as well as sharing information are the dependants of building trust among supply chain partners (Söllner, Hoffmann, Hirdes, Rudakova, Leimeister, & Leimeister, 2010). A lack of obligation to share information and honour trust between supply chain partners creates a critical barrier to success in the supply chain. Trust is a core enabler of sustainable supply chain relationships. Trust has the potential to improve cooperation and confidence among organisations who are working together within the supply chain. By working together, organisations can achieve much more than the sum of their individual efforts. According to Gibson and Manuel (2003), there are two conditions that are necessary for building trust and they are risk and interdependence. Risk is determined by the extent of uncertainty that exists among the supply chain partners concerning the other partners' intent to act appropriately. For partners to exhibit trust and trustworthiness, a minimal level of risk is required. Conversely, high levels of risk are capable of restraining trust.

Interdependence relates to the extent to which partners depend on the actions of others to complete their tasks. With regard to global supply chains, partners tend to work on large and important projects resulting in a certain level of interdependence among partner's tasks and responsibilities. On the other hand, partners will also have some flexibility about with whom they interrelate. Trust involves high levels of constant and regular communication which is more likely to happen when interdependence is high (Gibson & Manuel, 2003). Morgan and Hunt (1994) in researching the role of trust and commitment in relationship building within organisational networks recognised the

importance of resource sharing as the basis upon which enduring relationships are built. They concluded that in strong relationships, exchanging resources is vital.

Trust is usually viewed as the driving force behind collaboration (Handfield & Nichols, 2004). Within the outline of supply chain management, trust has a vast potential for improvement. A number of authors have also highlighted that the most critical factor of cooperation for organisations is trust. The appropriate utilisation of ICTs can enhance information sharing which will boost trust with other supply chain partners. While Chapter 3 provided a broad understanding of the importance of trust and trust related issues in the supply chain, Chapter 4 will discuss how trust can be built through information sharing.

Chapter 4: Building Trust Through Information Sharing



4.1 Introduction

In Chapter 3 the importance of trust was discussed as well as defining trust and the definition that is going to be applicable for the purposes of this study. Information sharing is a very important characteristic of harmonisation between partners in a supply chain as it is instrumental in establishing trust in inter-organisational relationships. Information sharing can enhance supply chain efficiency by reducing inventories and smoothing production. Supply chain efficiency is essential as today's competition is no longer between organisations, but between supply chains. This chapter discusses the potential benefits of information sharing, noting that these benefits may be shared unequally amongst supply chain partners. This chapter is also going to focus on how information builds trust in supply chain relationships.

Constant enhancements in information and communication technology (ICT), especially the development of internet-based computing and communications allow for organisations to interact with their various supply chain partners as well as to integrate their supply chains (Lee & Whang, 2000). Global visibility across the supply chain may be gained if the different supply chain managers work together and stop optimisation of individual silos, through information sharing. Fawcett and Magnan (2008) state that information sharing relates to undertakings that disseminate useful information amongst many individuals who include people, systems or organisational units in an open environment.

Information sharing results can be greatly improved by answering four questions which should be considered when sharing information: 1) what to share, 2) whom to share with, 3) how to share and 4) when to share (Kantor, 2005). Some of the benefits that have been realised are avoiding overload or deficiency of information, reducing sharing cost, and being more responsive. However, this is greatly affected by the lack of integration and information sharing within the supply chains (Elmuti, 2002).

The aim of this chapter is to discuss the importance of information sharing to supply chains, improving information sharing, and classifying information in a supply chain. The relationship between connectivity, willingness and information sharing is important to any trust research project, and is thus discussed next. The barriers to effective

information sharing and the information sharing enablers which are conducive to trust formation are described in the section that follows. The Organisational Information Processing Theory (OIPT) which is an underlying theory for this research project will also be discussed. The chapter concludes with a brief overview of the use of technology for information sharing.

4.2 Importance of Information Sharing

Fawcett and Magnan (2008) state that supply chain efficiency is highly important since the competition today is no longer between organisations, but between supply chains. Since information sharing is always associated with some costs such as acquisition of information, and installation of information systems, as well as barriers like privacy of information, it is necessary that supply chain partners be educated on the importance of information sharing (Lau, 2007). Lau, (2007) highlights that more efficient supply chain decisions can be made and implemented if information is shared among supply chain partners.

In the case of complete information sharing, the main problem is establishing physical and logical channels of information exchange (Fawcett, Osterhaus, Magnan, Brau, & McCarter, 2007). The complete information sharing applies only to information needed for supply chain configuration, decision making and implementation of decisions. Cachon and Lariviere (2001) highlight that information sharing is basic to effective coordination in supply chains. Information sharing has the potential to lessen the need for inventory, which results in the supply chain achieving better performance with regards to service level and financial returns (Angulo & Nachtmann, 2004). Mentzer, (2004) also describe information sharing as one of the enablers of partnering implementation and they state that collection, creation, management, and communication of information are critical to the efficiency, effectiveness, and competitive advantage of any supply chain.

If properly implemented, information sharing can facilitate coordination among the different organisations in the supply chain, and thus can be beneficial to individual organisations as well as the supply chain as a whole. Getting the right information at the right time is important and this can only be achieved through information sharing. Quite

a number of benefits can be realised from sharing information, and they include: enhanced integration of supply chain partners, improved management of information and enhanced trust enabled by the use of ICT. These are each discussed in the sections that follow.

4.2.1 Enhanced integration of supply chain partners

A completely integrated supply chain can be accomplished when information is shared within the supply chain (Angulo & Nachtmann, 2004). There will be an increase in the integration of business processes and material flow among trading partners if information is shared within the supply chain. This will result in a considerable improvement in the supply chain's operations. According to (Lau, 2007) innovative use of technology can increase greatly the competitive advantage of the supply chain through changing the cost as well as value equation.

4.2.2 Improved management of information within supply chains

Disruptions in the supply chain may result if the information in the supply chain is not managed properly, therefore jeopardising the performance of the supply network as a whole. However, supply chain members can be able to make sound decisions as well as maximise the profitability of the entire supply chain if information is well managed (Boone & Ganeshan, 2002).

A survey was undertaken in a Japanese automobile company on how the level of complexity of management processes can considerably deter the agility of supply chain partners. The results established that sharing of information can improve management within the supply chain partners as well as across the whole supply chain. The effectiveness of information sharing between supply chain partners can be enhanced if information is shared, which will enable organisations to create an environment where they are able to control the business data and processes that they share with partners (Chatfield, Kim, Harrison, & Hayya, 2004).

4.2.3 Enhancing trust through ICT

One of the most important prerequisites for information sharing is the existence of appropriate ICT 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 ICT can be established in so far as ICT 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 ICT in inter-organisational relationships is discussed in-depth in Chapter Five.

4.3 Improving information sharing in supply chain networks

Huang & Lau (2004) illustrate that information sharing in the supply chain perspective refers to the degree to which significant and branded information is available to the different supply chain partners. This shared information can either be tactical which involves purchasing, operations scheduling, and logistics or strategic which is basically long-term corporate objectives, marketing, and customer information (Shapiro, 2007). Some of the positive outcomes on the importance of formal and informal information sharing between trading partners are that visibility is boosted due to effective information sharing and uncertainty is reduced (Shapiro, 2007).

The extent to which information is shared in a supply chain can influence the relationships that exist among the supply chain partners directly, which will result in supply chain inadequacies being eliminated if the extent to which information is shared creates opportunities for organisations to work collaboratively to remove these inefficiencies (Kulp & Lee, 2004). As a result, other opportunities are created across the supply chain if the players have the ability to access important information.

An example is highlighted by Li, (2002) that when additional supply chain information becomes available, the supply chains can modify the existing actions or plan future operations due to the advantage of increased visibility. Lee and Oakes (1996) presented an analytical model to evaluate the benefits of information sharing and replenishment co-ordination to each partner in a supply chain. They established that:

1. The retailer would not benefit much from sharing information, although suppliers would benefit in that it would provide cost savings and inventory reduction.

2. Combining information sharing with replenishment co-ordination would result in cost savings and inventory reduction for the retailer and the supplier.
3. The underlying demand process would significantly influence the magnitude of cost savings and inventory reductions associated with information sharing and replenishment co-ordination.

Inadequate or insufficient information sharing limits an organisation's ability to leverage otherwise supportive relationships to accomplish this (Karaesmen & Buzacott, 2002). Lewis and Talalayevsky (2000) state that it is essential that organisations and their supply chain partners possess suitable, viable inter-organisational information systems if they are to maintain the capability to react promptly and effectively to changing customer needs and expectations due to the rapid advances in technology and global information infrastructure. Five specific dimensions of information sharing were identified by Mohr and Sohi (1995) as timeliness, accuracy, adequacy, completeness, and information credibility. Information sharing within the supply chain is necessary for assisting members to identify critical issues regarding their suppliers (Bhatt, (2000); Crocitto & Youssef, (2004).

Raghunathan (2004) reports that a supplier's willingness to share information is one of the key criteria in prominent Japanese automakers' selection of their suppliers. Humphreys, Li, and Chan, (2004) and Krause and Ellram, (1997) also highlight that results from empirical research illustrate that organisations that are successful in supplier development efforts effectively share information in a timely manner and frequently with their suppliers. The organisation should form a partnership with its partner suppliers and share information with them.

An argument that once arose between Ford Motor Company and Bridgestone Tyres regarding the recall of tires for the Ford Sports Utility Vehicles suggests an information breakdown between the supplier (Bridgestone Tyres) and the manufacturer (Ford Motors) (Amiri, 2006). Due to a breakdown in communication and lack of understanding of the expectations from both parties, poor quality products were produced. This could have been avoided had the two organisations shared information.

The manufacturers can benefit from the information that is made available by the suppliers because the manufactures can respond promptly to order information and the key is completing the orders competently. More efficient supply chain decisions can be made and implemented if information is shared among supply chain partners.

If organisations understand the benefits that information sharing can bring, they can be motivated to share information with the other supply chain partners. Organisations require enhanced information flow as well as quicker access to the required information if they are to survive in the present evolving global market. This is emphasised by Suhong and Binshan (2006): *“To facilitate quality information sharing across supply chains, an understanding of the factors influencing information sharing is needed, so that a strategy may be developed to overcome the barriers preventing information sharing and encourage seamless information flow in supply chains.”*

To facilitate collaboration among the supply chain partners, it is very important for the supply chain organisations to establish an exceptionally receptive supply chain where large quantities of information can be shared. The next section will discuss the types of information that are necessary for a complex supply chain network such as those identified in the automotive industry.

4.4 Classification of Information in a supply chain

Information in a supply chain can be classified into different categories namely strategic or tactical; logistical; or relating to consumers (Mentzer, 2004). The various types of information shared and their potential benefits are discussed in detail by Lee and Whang (2000). If a supply chain organisation shares the ordering status with the other partners, it will result in the reduction of labour costs and improve the quality of customer service. Information is categorised into six categories by Huang and Gangopadhyay (2004) relating to product, process, resource, inventory, order, and planning and this is illustrated in the table below:

Table 4.1: Classification of production information (Huang, Lau et al. 2004)

Category	Production Information	Category	Production Information
Product	Product Structure	Resource	Capacity
Process	Material Lead Time		Capacity Variance
	Lead Time Variance	Order	Demand
	Order Transfer Lead Time		Demand Variance
	Process Cost		Order Batch Size
	Quality		Order Due Date
	Shipment		Demand Correlation
	Set-up Cost	Planning	Demand Forecast
Inventory	Inventory Level		Order Schedule
	Holding Cost		Forecasting Model
	Backlog Cost		Time Fence
	Service Level		

Product information includes the characteristics of products manufactured and the production process. An example of product structure is a bill-of-materials (BOM) which may include cost data. However, product information is not an actively researched category in information sharing in a supply chain. Process information includes the business processes in a supply chain that actually add value in fulfilling the customers' demand. General processes in the supply chain are ordering, production and shipment.

Planning information in a supply chain includes demand forecasts and order schedule. Finding effective techniques of forecasting and sharing the data obtained is important. Inventory information includes on-hand inventory, backlogs, and work-in-process inventories with the level of inventory, unit cost, and policy used. Order information includes demand information from the end customer to suppliers and the size and date

of the order. Within the information available in the supply chain, the most important information to be shared is demand and inventory information. By sharing either demand information or inventory level, the entire supply chain can expect to reduce and find optimal amount of inventory that lead reduce of total cost of the chain.

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 further information. The next section looks at connectivity and willingness as well as information sharing capability.

4.5 Connectivity, Willingness and Information Sharing Capability

Fawcett and Magnan (2008) state that connectivity creates the capability to share information. Nonetheless, people make the decisions regarding what will be shared and when. Fawcett, Osterhaus, Magnan, Brau, and McCarter, (2007) state that the old saying, “*information is power*” holds true in today’s business world. This results in many individuals to be unwilling to share information that they perceive may place their organisations at a competitive disadvantage.

In spite of whether these perceptions are accurate, tremendous amounts of potentially useful information that could enhance supply chain decision making if shared, remains unavailable to decision makers (Huang & Lau, 2003). Lee and Whang, (2002) and Mendelson, (2000) reaffirm this by highlighting that an organisation’s willingness to share relevant information openly, honestly and frequently ultimately determines the extent of trust in the relationship. Huge investments in technology can be negated by an unwillingness to share needed information (Fawcett & Magnan, 2008).

As it is depicted in Figure 4.1 below, Fawcett, Osterhaus, Magnan, Brau, and McCarter, (2007) interview with various organisations led to the introduction of a two-by-two

connectivity willingness matrix. The results from the interview showed that organisations were simply unwilling to share certain types of information particularly in relationships that had at some point in the past acted opportunistically (Fawcett, Osterhaus, Magnan, Brau, & McCarter, 2007).

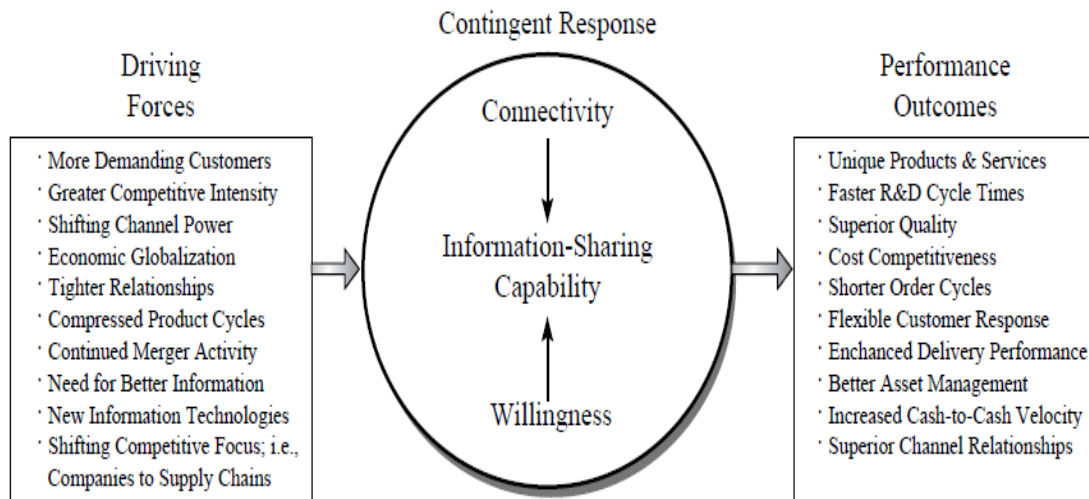


Figure 4.1: A contingency perspective of information sharing capability as a strategic enabler (Fawcett and Magnan, 2008)

Eventually, it became evident that the organisations that had been interviewed could be placed in one of four quadrants based on their position regarding ICT investments; and willingness to share needed decision-making information as indicated in Figure 4.2 below. The four issues briefly described in each quadrant are: the nature of the supply chain relationship, the state of connectivity, the state of willingness, and the expected outcome.

For example in quadrant IV where levels of connectivity and willingness are both high, relationships are strategic and built on high levels of trust; accurate data about joint decision-makings are shared in a timely manner; and opportunities are available for high levels of information sharing. This is relevant to this study as it indicates that high levels of connectivity and willingness to share information improve efficiency.

Connectivity	High	II <ul style="list-style-type: none"> • While closer relationship exists, partners resist open information sharing for fear of opportunistic behavior. • Technology links are in place to enhance coordination, but the information shared is incomplete or insufficient to support collaboration. • Order and inventory information is shared; however, partners hold closely more sensitive information including new product development plans, technology roadmaps, and market entry objectives. • Opportunities for high levels of unique collaboration are overlooked. 	IV <ul style="list-style-type: none"> • Relationship is strategic, built on high levels of trust and shared information. • Technology integration has been a high priority in the relationship, enabling high levels of connectivity. • All relevant decision-making information is shared on a frequent and timely basis. Information is accurate, honest, and open. • Opportunities for high levels of unique collaboration are identified and leveraged via a strong information-sharing capability.
	Low	I <ul style="list-style-type: none"> • Relationship is arm's length, lacks trust, and share's information reactively. • Insufficient resources are available or dedicated to information technology. • History of opportunistic behavior limits the willingness to share more information than is necessary. • Minimal information is shared, leading to missed opportunities to improve efficiencies and collaboration. 	III <ul style="list-style-type: none"> • Strategic relationship is desired, trust has been established, but information sharing does not yet support relationship goals. • Insufficient resources are available to create adequate technology linkages. • An effort is made to share information, however, information is often processed and communicated slowly and may be inaccurate. Decision makers may have difficulty making sense of the shared information. • Opportunities for high levels of unique collaboration are not readily identifiable and are not fully supported by the needed information.
		Low	High
		Willingness	

Figure 4.2: The Connectivity-Willingness Matrix

Information sharing can be hindered by a number of factors, and the next section thus explains the factors that inhibit information sharing in supply chains.

4.6 Barriers to effective information sharing

The value of information sharing is determined by several conditions. For example, Simchi-Levi and Zhao (2004) showed that when a manufacturer is under pressure, demand information sharing does not have any major benefit. Lee, So and Tang (2000)

found that demand information sharing has more value if demand is correlated over time, or variable.

The willingness to share information is impeded by a number of factors as highlighted by Fawcett and Magnan (2008). If sharing information is viewed as a possible interruption of the stability of power, then organisations are likely to be reluctant to share it (Fawcett, Osterhaus, Magnan, Brau, & McCarter, 2007). Another factor is the perceived confidentiality of the data (Hult, Ketchen, & Slater, 2004). If the organisations view the data as too confidential, then they believe that the use of data by other organisations can damage the sharing organisation. This correlates to the concern of trust between organisations, and the extent to which each party can confidently assume that data that is shared and used for the correct purposes.

It has been already established previously that the level of trust in the inter-organisational relationships can be enhanced through improving the information sharing amongst the supply chain partners. Various barriers exist to the effective sharing of information in the supply chain networks. Understanding these barriers is important so as to ensure that they are addressed so that there will be a free flow of information in the supply chain.

Yu & Yan, (2003) state that different kinds of information can be affected by the product's characteristics. By sharing product forecasts that have high demand unpredictability, positive benefits can be realised from sharing. The relationship that exists between supply chain partners also affects the choice of the sort of information that is shared (Fawcett & Magnan, 2008). These authors go on to give an example that inventories can be reduced without risking stock running out if production schedules are shared with part suppliers. In addition to this, customer service levels can get better if shipping information is shared with logistics agents. Information sharing schedules are determined by a particular situation (Mentzer 2004, Min *et al.* 2000). Fawcett, Osterhaus, Magnan, Brau, and McCarter, (2007) undertook interviews which identified four barriers to improved information sharing in the supply chain namely, the cost and difficulty of executing advanced systems, systems incompatibility, levels of connectivity and the aspect of willingness. These are discussed below.

4.6.1 The cost and difficulty of executing advanced systems

The cost and difficulty of executing advanced systems for sharing information was the most prominent challenge. Fawcett, Osterhaus, Magnan, Brau, and McCarter, (2007) concluded the research by stating that it was very difficult for organisations to keep everyone at the same level without the new “enterprise” systems. Thus, varying levels of information quality were achieved in the supply chain due to the varying systems used. The other problem that was identified by the authors was that time and money budgets were often exceeded by 50 to 100 percent and the systems often did not perform as advertised (Fawcett, Osterhaus, Magnan, Brau, & McCarter, (2007)). The implementation process was therefore described by some managers as an endless nightmare.

4.6.2 Systems Incompatibility

The second barrier was found to be systems incompatibility. Fawcett, Osterhaus, Magnan, Brau, and McCarter, (2007)) discuss that it is not rare for an organisation to receive customer orders through EDI only to end up manually re-entering the information into its own systems. This comes about because the systems do not relate to each other. The authors further go on to say that systems incompatibility aggravates the cost of connectivity.

4.6.3 Levels of Connectivity

Different levels of connectivity exist up and down the chain. Li (2002) describes this situation as the “*island of automation*” in the supply chain. It is very difficult for an organisation to control the full benefits of connectivity when it receives 100 percent of its orders electronically and transmits 80 percent or more of its orders to suppliers using fax or phone (Fawcett & Magnan, 2008). This in turn will limit the ability to drive collaboration through shared information until all the key players in the chain are connected.

4.6.4 Understanding the willingness dimension of information sharing

The last barrier that Fawcett, Osterhaus, Magnan, Brau, and McCarter, (2007) discovered from their interview was that managers do not understand the willingness

dimension of information sharing. The need therefore to invest in a culture that is conducive to sharing information is unimportant to the managers. Hence, it is anticipated that many managers are reluctant to share valued information. Information is tightly controlled as it is viewed as power, especially in the absence of trusting relationships (Fawcett & Magnan, 2008). The end result is that the implementation of advanced ICT is more difficult and it also holds back supply chain collaboration.

Several managers that took part in the interviews noted that their greatest problems in implementing “enterprise” systems was not technical impasses but was actually rooted in people. These managers stressed that it is a lot easier to resolve technical problems than it is to manage behavioural issues. Interviewed managers made it very clear that achieving needed levels of willingness to spur supply chain partnership is perhaps the most difficult challenge to better information sharing. It is therefore important to also understand the information sharing enablers that affect trust and they will be discussed in the next section.

4.7 Information sharing enablers affecting trust

A study was undertaken by Khurana, Mishra, Jain, and Singh (2010). The purpose of their study was to identify and classify the key criterion of information sharing enablers that influence trust based on their direct and indirect relationship. The authors discussed the role of the different factors that can aid in instilling trust in supply chains. They identified some key enablers of information sharing for building trust, which are discussed below.

4.7.1 Open and Transparent flow of information

Trust will be instilled in the supply chain if there is open communication among the supply chain members, whereby they share information open-mindedly without withholding any information. This will only be possible if the supply chain members understand that efficiency and effectiveness in the supply chain will result from sharing all the information that affects competitiveness. For successful management of the supply chain as well as for trust building, free and open flow of information is vital. Key to the success of the supply chain relationships is the ability of the supply chain partners to exchange truthful, significant and clear information openly and quickly.

4.7.2 Defined use of information

Before information is shared among the supply chain partners, the purpose of information sharing should be well defined. Khurana et.al (2010) highlight that an organisation will be more secure and share information easily if they are aware of the reason for information being requested by a partner organisation and if the source of the information will be aware of the possible use of the information that was requested. This in turn will build trust within the supply chain partners as the problems of information misuse are minimised (Fawcett & Williams, 2004).

4.7.3 Fair and equal treatment of chain members

According to Khurana, Mishra, Jain, and Singh, (2010), supply chain partners should not be treated arbitrarily during the process of information sharing and they should also be given equal opportunity and protection of their information shared wherever and whenever required. Korsgaard, Schweiger, and Sapienzo, (1995) discovered that the justice done with supply chain partners in sharing routine information results in more trust and commitment as well as the effective management of the supply chain.

4.7.4 Reliability of information

An important aspect of trust as highlighted by Morgan and Hunt (1994) is the confidence in reliability of information. The past experience of the supply chain partners in sharing the information is the key element to reliable trust (Lau, 2007). Repeated and reliable interaction among the supply chain members is considered to be a major element for developing trust as highlighted by Angulo and Nachtmann (2004). Regular associations among the supply chain partners and duration of business association leads to enhanced levels of confidence to build trust (Fawcett & Magnan, 2008). A greater sense of trust and commitment will be yielded among the supply chain partners if the previous communications from another supply chain partner have been regular and of high quality in terms of relevancy, timeliness and reliability (Khurana, Mishra, Jain, & Singh, 2010).

4.7.5 Confidence in truthfulness of information

When attempting to build trust between supply chain partners, an important factor that has been identified is sharing of secrets openly and confidence in the truthfulness of information (Murphy, 2002; Sahay, 2004). Supply chain partners stand a better chance of building trust amongst each other if they provide information truthfully.

4.7.6 Undistorted Communication

A necessity for trust in the supply chains is open communication devoid of alteration or concealing the facts and figures. Inefficiencies and excessive inventories within the supply chain partners can result from distorting information. Regular and truthful information is part of the process of building trust amongst the supply chain partners for effective supply chain management.

4.7.7 Respect for the confidentiality of information

It is important for an organisation to guard against the threat of revealing information to unauthorised users and confidentiality is the one that protects organisations from this. A unified environment among the supply chain partners induces the confidentiality of information in the supply chain. Depending on the type of information, confidentiality of information means that supply chain members should not disseminate the information they receive to other chain members. According to Wong and Sohal (2002), the confidentiality of information among supply chain members is important for mutual trust as well as fostering long-term relationships. It is the responsibility of the chain members to ensure that the information is protected from inappropriate abuse and unintentional revelations. If the supply chain members suspect that confidentiality will not be maintained within the supply chain which will result in mistrust among them, information sharing will not be effective as the supply chain members will not provide the information in true sense.

4.7.8 Sincerity in providing the information

It is expected that the supply chain members will not withhold any relevant information from each other during the process of information sharing (Heide & John, 1990). It is also understood that the supply chain partners develop standards to volunteer

information to each other. By providing requested information peacefully, without any delays or losses, supply chain members provide the information is sincerity.

As the Organisational Information Processing Theory is a key theory underlying this research and is related to the balance between sharing information and providing means for this sharing (for example in the form of ICT), it is relevant to this study, and is discussed in the next section.

4.8 The Organisational Information Processing Theory

The organisational information processing theory suggests that an organisation's culture influences how willing its people are to share information (Al-Tameem, 2004; McKinnon, Harrison, Chow, & Wu, 2004; Constant, Kiesler, & Sproull, 1994). This theory was first proposed by Galbraith (1973), and is diagrammatically depicted in Figure 4.3. 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.

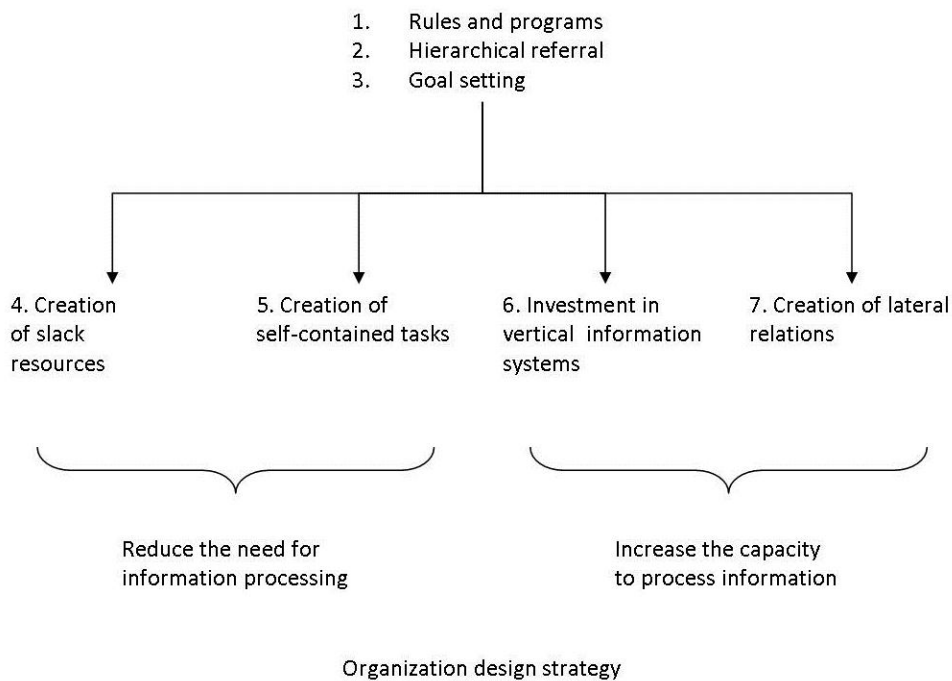


Figure 4.3: Diagrammatic Representation of the Organisational Information Processing Theory (Galbraith, 1973)

ICT plays a vital role in facilitating information sharing among supply chain partners. The technology that is needed for information sharing is briefly discussed in the following section.

4.9 Technology needed for Information Sharing

ICT has had a substantial impact on supply chains by reducing information delays, and multiple data entries. Electronic Data Interchange (EDI) has been employed in many organisations as a major tool for information sharing (Suhong & Binshan, 2006). As Internet and e-commerce technology continue to evolve, quite a number of studies have been done which highlight how such technology can improve supply chain performance, especially on information sharing (Cachon & Fisher, 2000; Boone & Ganeshan, 2002; Huang & Lau, 2004; Khurana, Mishra, Jain, & Singh, 2010).

Given the wide range of technologies that are available for information sharing like Internet, ERP, Data Warehousing, barcode technology and Extensible Mark-up Language (XML), among others, it is vague which technology is mainly appropriate in terms of cost effectiveness and efficiency for facilitating the sharing of production information in the supply chain. These technologies will be explained in detail in the next chapter.

4.10 Conclusion

Strong preliminary evidence from the literature illustrates that information sharing can bring major benefits for supply chains. Improved technologies make information sharing easy. Sharing of information can improve interactions among organisations in supply chains. As a result of reasons such as information privacy of the organisations, complexity of the problem as well as costs that are associated with the adoption of inter-organisational information systems, it is not easy to attain full information sharing for problem solving in real supply chains.

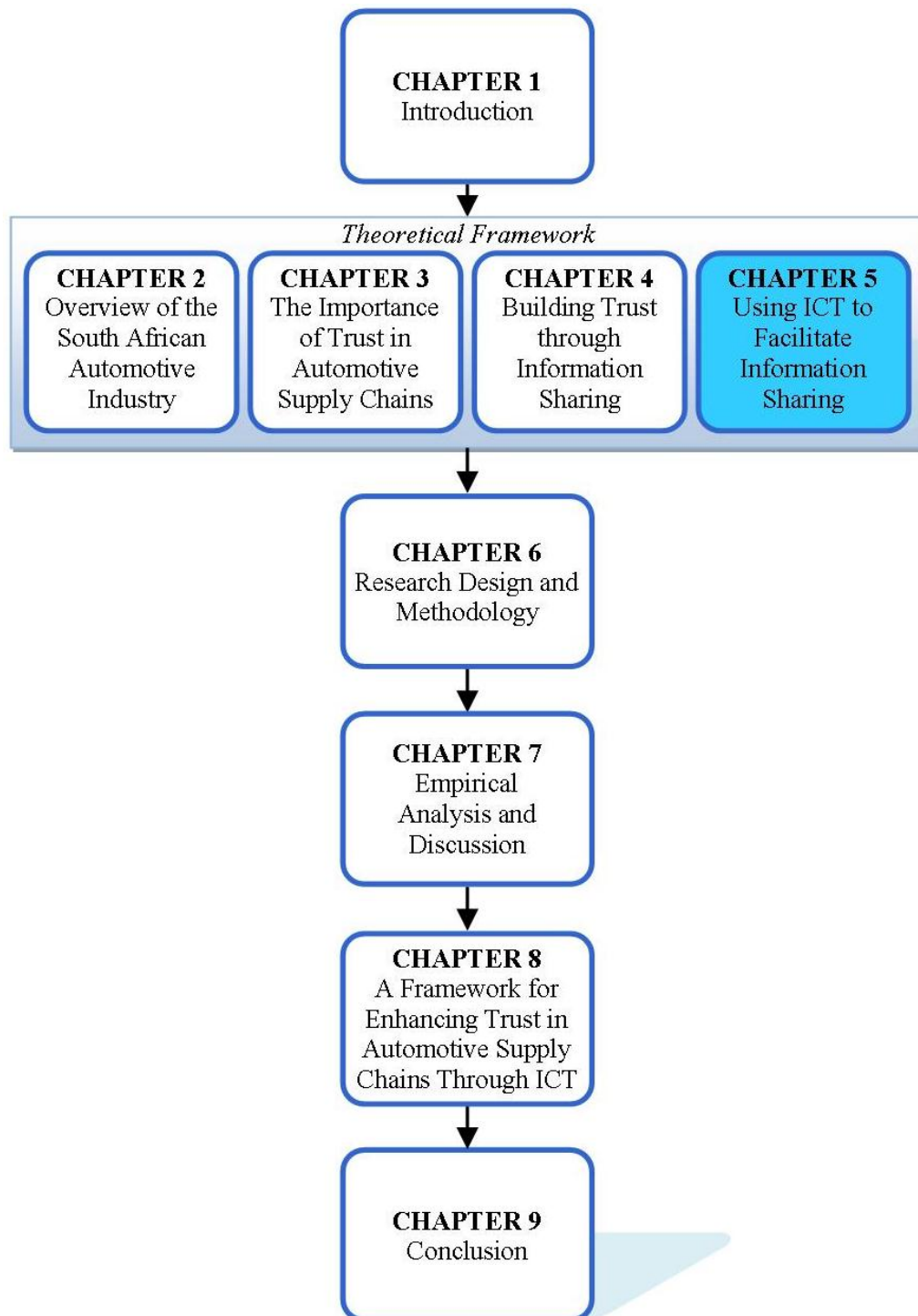
In this chapter, the Organisational Information Processing Theory (OIPT), which is a supporting theory for this research project, was described. The OIPT identifies a trade-off required between information processing needs and capabilities. This is relevant in the supply chain context as it points to the need to balance information shared and the support structures, usually ICT, 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 in the supply chain. These benefits can be equated to the benefits of trust in inter-organisational relationships discussed in Chapter Three.

The different technologies that are available to supply chain partners for information sharing were also discussed. With the aid of these ICTs, partners in the supply chain can reduce barriers and costs of sharing information, and ultimately build trust. The next chapter discusses the use of ICT for facilitating information sharing.

Chapter 5: Using ICT to Facilitate Information Sharing



5.1 Introduction

The previous chapter discussed information sharing and its importance in the supply chain as well as the barriers to information sharing. Information and Communication Technology (ICT) can be used to enhance information sharing and improve the efficiency and the effectiveness of the supply chain as it is an important factor in enhancing trust. This chapter discusses ICT used to facilitate information sharing. For each stage and at every level in the supply chain, information is required and developments in ICT make it easier to obtain this information. One of the key enablers of Supply Chain Management (SCM) is the integration of processes based on cooperation and coordination in the supply chain (Amiri, 2006).

Supply chains in the automotive industry involve a complex network of component suppliers and assembly operations. As a result those supply chains have many suppliers that they communicate with and that ship material to a central location. It is therefore very important that these supply chains share information that is vital for trust enhancement. In general, the automotive industry is well equipped with ICT infrastructure although it is not being used sufficiently for information sharing. ICT is both an essential tool and facilitator for the integration process and ultimately for SCM. The impact of ICT on organisational systems has been classified into three categories by Christiaanse and Kumar (2000) namely speeding up activities, provision of knowledgeable and independent decision making processes, as well as allowing disseminated efforts through teamwork.

ICT has particularly been made out as an enabler for information sharing which organisations in the supply chain can use for eliminating the so called bullwhip-effect in supply chain management (Hong-e & Long, 2002). It would be very difficult for the management of supply chains, with information as its core, to be realised without the support of an extremely advanced information and communication technology network (Liu 2007). ICT has the potential to reduce costs, and effectively bring increased profits if it is used appropriately. The aim of the research project is to develop a framework that can enhance information sharing through the use of ICT. Since ICT is an enabler for

information sharing, it will greatly improve the communication among the supply chain partners and eventually they will end up having trusting relationships.

This chapter therefore seeks to explore ICT in the supply chain and how it can be beneficial to the supply chain partners to enhance trust through improved information sharing. This chapter will evaluate the role of ICT in the supply chain and the impact of ICTs on supply chains. Obstacles to ICT use for information sharing in supply chains and the objectives of ICT in SCM will also be explained. The chapter concludes with an overview of the various ICTs available for use to share information in a supply chain.

5.2 Information and Communication Technology (ICT) in SCM

Negative effects of uncertainty can in theory be mitigated when one organisation can use the information of other organisations in the supply chain thus trust is established. Technologies that enable communication therefore play a critical and profound role in the way an organisations' activities, which can either be internal or external, are coordinated, how commerce is conducted, how people and machines communicate, what defines communities and how they interact, and how and when goods are made and delivered. The information and communication technologies (ICT) foster the integration of business processes across the supply chain by facilitating the information flows, which are necessary for coordinating a business activity. Dewett and Jones, (2001) state that ICT are focused mainly on acquiring and sharing information in order to create knowledge for the different actors involved that are using this distributed knowledge base. Many of the characteristics of ICT seem to be just the right answer for successful supply chain relationships. Inter-organisational integration and coordination via information and communication technology, therefore, has become a key to improved supply chain performance in the automotive industry.

A major problem that has been experienced in SCM has been coordination amongst the many independent suppliers in the supply chain (Fredanhall, 2001). In order for the automotive manufacturers to operate, they depend on a substantial network of suppliers. The ability of ICT to provide coordination and decision support capabilities makes it possible to understand and act on the growing need for information in the supply chain.

Technologies such as the Internet present new possibilities in restructuring the supply chains for better performance (Christiaanse & Kumar, 2000). The perception, methods and applications involved in ICT are constantly evolving rapidly almost on a day-to-day basis.

Chen, Yang, and Chia Li, (2007) define ICT as “*a medium concerned with the **storage, retrieval, manipulation, transmission or receipt of digital data.***” In essence, ICT is also concerned with the way these dissimilar uses can collaborate. Cohen, Salomon, & Nijkamp (2002) define ICT as a family of electronic technologies and services used to process, store and disseminate information, facilitating the performance of information-related human activities, provided by, and serving the institutional and business sectors as well as the public-at-large. Heeks (2009) argues that ICT can generate new market opportunities. ICTs can help directly create new micro enterprises for the poor which involves setting up of internet kiosks and selling of mobile phone calls.

Against this background and for the purpose of the current discussion, ICT will be defined as a concept which refers to any technological instrument that can enhance inter-organisational relationships in SA automotive supply chains. Kotler and Keller (2005) explain that to continue growing, organisations need to develop their own core competencies and design superior supply chains by strengthening partnerships with suppliers, retailers, distributors, and customers. Providing meaningful products or services to customers in the context of a technology driven competitive business environment is important to the success of supply chains (Bowersox, Closs, & Stank, 2000). It is important to know the ICTs that are available to the supply chain partners and they are illustrated in the figure on the next page. They will be explained in detail in Section 5.6.

New ways of coordinating supply chain relationships have been enhanced by the use of ICT (Lee & Whang, 2002). The main objective in supply chain management is to manage all the activities that are associated with the flow of products and services from the beginning of the manufacturing cycle through to the end-user (Auramo, Kauremaa, & Tanskanen, 2005). The challenge therefore is to manage this process in such a way as to establish mutual partnerships with the supply chain partners as well as to explore

ways in which the management of supplier relationships can be used to gain competitive advantage in the industry. ICT supports internal operations and also collaboration between organisations in a supply chain (Andersen, 2001).

Figure 5.1 below shows some of the technologies that are available to supply chain partners. By utilising high speed data networks and databases, organisations can share data to better manage the supply chain. The effective use of this technology is a key aspect of the automotive supply chain's success as ICT plays a pivotal role in an organisation's ability to provide the information that is necessary to manage and control effective supply chain relationships (Barut, Faisst, & Kanet, 2002). The demands of our global economy are forcing organisations and entire supply chains to adopt more flexible and responsive modes of operation.

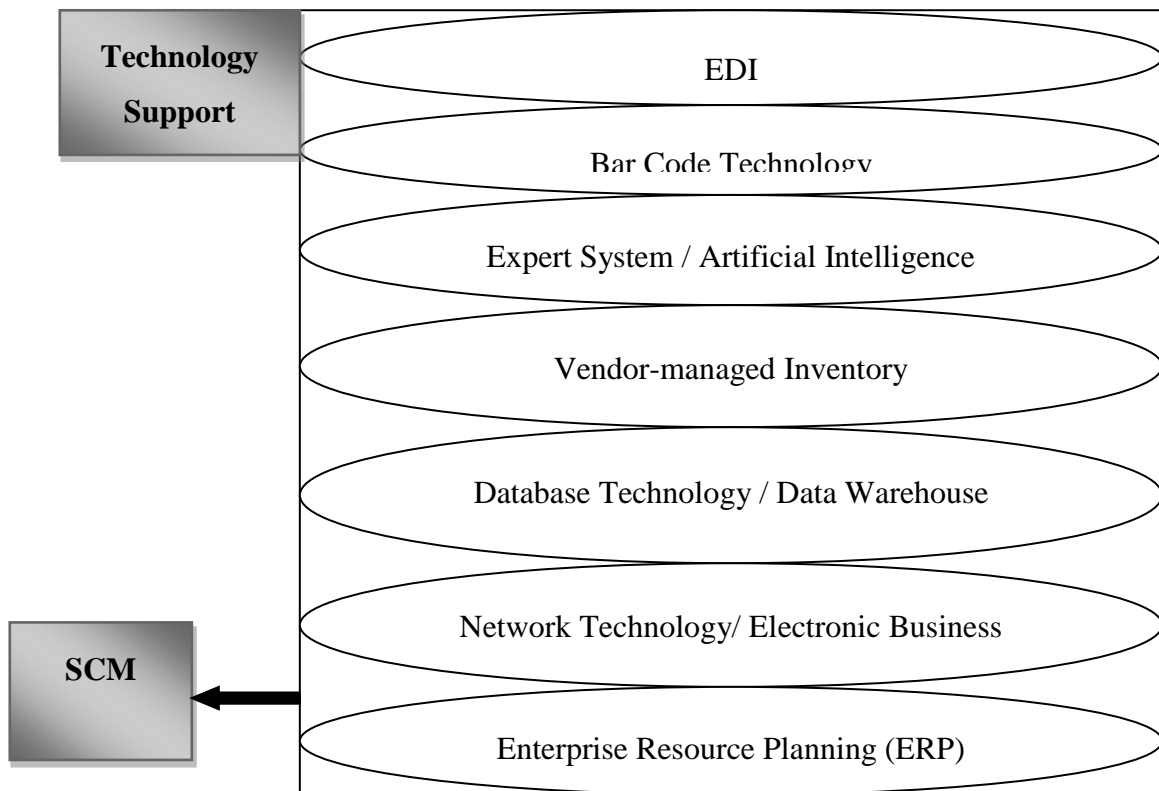


Figure 5.1: ICTs available to supply chains

Barrat (2005) highlights that each supplier in the supply chain is dependent on each other, and yet, they do not cooperate very closely with each other. The goal is to get everyone in the supply chain onto a common platform of logistics transactions and information systems for greater inter-organisational transparency which will lead to

faster response times. In order to achieve this goal, ICT systems must be able to support strategic, tactical and operational activities both internally in an organisation and externally in a supply chain (Boone, Drake, Bohler, & Craighead, 2007). Lee and Whang (2001) point out that the use of ICT impacts supply chain integration on four critical dimensions, one of them being information integration.

The elements that are involved in information integration are information sharing and transparency as well as direct and real time accessibility of information. Wilcocks and Sauer (2000) argue that steady increments of information sharing produce a positive increase in the local and global performance of the supply chain. They emphasise that when one organisation can use the information of other organisations in the supply chain, the negative effects of uncertainty can in theory be mitigated. The benefits thereof will be early problem detection, faster response, trust building and reduced bullwhip effect. The bullwhip effect in supply chains occurs when changes in consumer demand causes the organisations in a supply chain to order more goods to meet the new demand.

To encourage inter-organisational coordination and collaboration, it is necessary for the other organisations in the supply chain to recognise that the application of ICT would benefit not only the organisation advocating the use of such technologies across supply chain partners. In particular, supply chain managers should ensure that the other partners involved recognise the implementation of new technology as being not merely an added burden in terms of effort and cost, but actually translating into benefits that outweigh the additional cost. The information and communication technologies (ICT) foster the integration of business processes across the supply chain by facilitating the information flows, which are necessary for coordinating a business activity (Chen & Paulraj, 2004).

ICTs are focused mainly on acquiring and sharing information in order to create knowledge for the different actors involved that are using this distributed knowledge base (Dawson, 2002). Many of the characteristics of ICT seem to be just the right answer for a successful Supply Chain Management strategy. What has become a key to improved supply chain performance according to Christiaanse and Kumar (2000) is inter-organisational integration and coordination using information technology. It is

therefore important for this study to understand the impact of ICT on automotive supply chains. This is described in the section that follows.

5.3 The Impact of ICTs on Supply Chains

The primary assumption underlying the development and application of ICTs to the supply chains is that customers will have access to information that will reduce their risk in purchasing and hence, their cognitive dissonance. Thus, information and the manner in which it is utilised by the buyer to influence their behaviour become increasingly important in determining market performance. Indeed as Sheth and Sisodia (1997) argued, technological advancements will allow consumers to control a far greater amount of the information and communication flow in the exchange process than ever before. As supply chain partners can gain access to a wider range of information, for example on products and services, they can check product features, compare prices, amongst many others thus reducing the risk usually associated with information dissemination decisions. While the impact of ICTs, in so far as it enables information sharing which has been shown previously to enhance trust, has been discussed previously in this research project, the obstacles to the use of ICT from information sharing do need to be considered.

5.4 Obstacles to ICT use for information sharing

Although information sharing is important in SCM, high investment in ICT tools seems to be the obstacle for effective information sharing. This is because organisations may need to incur substantial cost of adopting inter-organisational information systems (IOS) in order to share information.

Huang & Lau, (2003) further explains that in addition to acquisition cost, lack of trust or unwillingness to share information due to privacy of the information and insufficient or lack of information could also affect the effectiveness of information sharing. ICT tools such as 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 (Raghunathan, 2003).

ICT facilitates SCM by improving integration and coordination of physical flow as well as the various information flow in the supply chain. This includes information such as demand, capacity, inventory, and scheduling in the supply chain. It facilitates information sharing. However, ICT may have little value unless firms capitalise on ICT to share information among supply chain partners.

To enhance supply chain performance, the issue of the intensity and the extent or the depth of the information sharing ought to be emphasised (Barut, Faisst, & Kanet, 2002). ICT permits improved coordination of supply chain by optimising information associated with the flow of physical goods in the supply chain. ICT enables timely information, like demand information to be communicated and accessed quickly across the supply chain. Decision making pertaining to supplier selection, price and quantity in the supply chain can be enhanced. On top of that, time based performance can also be improved. Most importantly ICT permits data to be accessed simultaneously and directly from multiple locations in supply chain (Lewis & Talalayevsky, 2005).

Despite the fact that information sharing is emphasised and called for in the literature, Fang et al. (2008) conclude that there is no centralised trust system for sharing information within the global supply network, nor are there trusted third parties readily available to all supply chain partners. A Fawcett and Magnan (2002) study also found little evidence of information sharing and Ballou (2007) suggests that this is because of the organisation's concern about the practice.

Structural obstacles, competitive issues and motivation of profit (Hsiao & Shieh, 2006) and value in ownership issues (Childerhouse, Hermiz, Mason-Jones, Popp, & Towill, 2003) are additional concerns. The most important concern identified in the literature is data security (D'Aubeterre, Singh, & Iyer, 2008; Johnson, 2008).

Ultimately, the self-interest of supply chain partners needs to be considered simultaneously with attempts to maximise the value-creation opportunities in the total supply chain. Overall, these information sharing and coordination challenges have not yet been fully met in practice (Legner & Schemm, 2008). Given the exposure to organisations involved in sharing sensitive financial information with potentially multiple partners, many of them are often not directly linked to a specific firm sharing

the information and thus less likely to be trusted (D'Aubeterre, Singh, & Iyer, 2008). The objectives of ICT in SCM will be discussed in the next section.

5.5 Objectives of ICT in Supply Chain Management

The objectives of ICT 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, and
4. Enabling collaboration with other supply chain partners.

These aims are all significant to this research project as they institute the importance of information sharing through ICT. ICTs are very important in the supply chains as they reduce the friction in transactions between supply chain partners through cost-effective information flow. ICT also plays a vital role in supporting the collaboration and coordination of supply chains through information sharing (Amiri, 2006).

As this study aims to investigate the enhancement of trust in supply chain relationships through the use of ICT, the impact of ICT which is providing a channel of communication through which information can be shared is of great value. In line with the Prisoners' Dilemma that was discussed in the previous chapters, information sharing leads to trust in supply chain partners. It is vital to understand the functional roles of ICT in the supply chain. Expanding on the conventional views of the functional roles of ICT in supply chain management, the following classification from Agarwal and Shankar (2002) can be adopted:

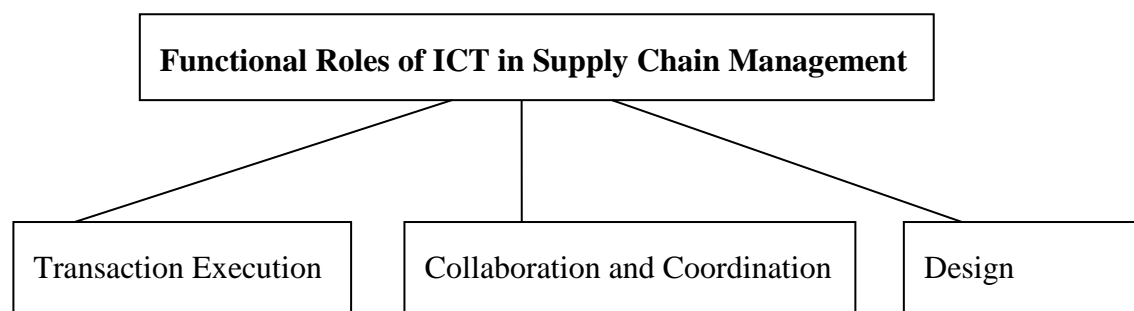


Figure 5.2: The functional role of ICT in supply chain management (Agarwal and Shankar, 2002)

Cross (2000) explains that reducing the friction in transactions between supply chain partners through cost-effective information flow is the most distinctive role of ICT in SCM. On the contrary, (Amiri, 2006) highlight that ICT is more importantly viewed to have a role in supporting the collaboration and coordination of supply chains through information sharing. ICT is also viewed as one of the key cures for the bullwhip effect in supply chains. The analytical power of computers is used to provide assistance to managerial decisions and hence ICT is said to be used for decision support in the supply chains.

The role of ICT in the supply chain has been discussed by many authors (Wang, Huang, Wang, & Chen, 2010, Rabren, 2010; Fawcett, Magnan, & McCarter, 2008; Chen & Paulraj, 2004; Lin & Tseng, 2006; Zhang, Tan, Robb, & Zheng, 2006; Sander & Premus, 2005; Bhatt & Troutt, 2005; Disney & Towill, 2003; Raghunathan, 2003; Bhatt, 2001 and Yu & Yan, 2003). ICT could make available real time information sharing among supply chain partners. ICT allows quick communication among supply chain partners and enables the sharing of large quantity and quality of information on both tactical and strategic operations. This is important for this research project, as it is a key focus for the study.

Widespread information system support is essential to capture and communicate information within the organisation and across the supply chain. The willingness to share information would be more efficient with the support of ICT capability. Seemingly high levels of ICT investment is related to the level of information sharing (Fawcett, Wallin, Alfred, & Magnan, 2009). Data integration and communication network flexibility can shorten product time cycle, increase design alternatives and produce higher quality products. Information regarding new products can be disseminated quickly across the supply chain (Bhatt & Troutt, 2005).

ICT is essential to ensure that the organisation is able to obtain the necessary information required in order to improve supply chain performance (Lin & Tseng, 2006). Quality of information can be leveraged to design processes or products that can fulfil customer expectations. Organisations should lessen dependence on forecast and

share real time information to guide daily operational operations (Bowersox, Closs, & Stank, 2000). Information integration via the electronic transactions and communications among the organisations must be emphasised within and across the supply chains (Chen & Paulraj, 2004). Adoption of e-business enables firms to share information and improve decision making more effectively (Hsieh et al., 2006). This is reaffirmed by Chen, Yang, and Chia Li, (2007) who state that quality of information exchanged can be further enhanced if both supplier and customer fully trust each other and there is no conflict between both parties. Supply chain partners may be more willing to share the demand or planning information with their fellow suppliers instead of assumptions being about supplier requirements if there is trust and collaboration of supply chain partners (Bowersox, Closs, & Stank, 2000). This is in line with the objective of this study which is to enhance trust through ICT.

The next section will discuss the information and communication technologies that are available to the automotive supply chains and their advantages as illustrated by Figure 5.1. The objective of the study is to establish how trust can be enhanced through ICT; therefore it is critical to understand the different types of ICTs that are available to the supply chain partners.

5.6 Communication Technologies Enabling Information Sharing

Figure 5.1 (provided earlier in this chapter), illustrates some of the communication technologies that are available to the supply chains to enable information sharing. These are each described in the sections that follow.

5.6.1 Electronic Data Interchange (EDI)

EDI is the organisation-to-organisation, computer-to-computer exchange of business data in a structured format that can be processed by a machine (Coyle, Bardi, & Langley, 2003). It eliminates paperwork related to various business processes such as, purchase orders, pricing, order status, scheduling, shipping, receiving, invoice payments, contracts, production data, marketing, sales and others. It also eliminates multiple data entry and improves the speed and accuracy of information. The need for EDI was realised in the 1960's as a way to reduce expensive communication means,

time consuming paperwork and thus to remain competitive in the industry. Many supply chain alliances are dependent on EDI to facilitate interactions and coordination of transactions.

EDI has proven to be beneficial to businesses as ICT improves quality of information, operational efficiency, and customer service, reduces transaction cost and enhances firms ability to compete (Iacovou et al., 1995). EDI enables the transfer of data in an agreed electronic format, such as invoices, bills and, purchased orders, from one company's computer to another company's computer. EDI can enhance suppliers' delivery performance which will improve the performance of supply chain (Lee, Padmanabhan, & Whang, The bullwhip effect in supply chains, 1997a).

EDI can facilitate the timeliness of information transmission as ICT speeds up the information flow in the supply chain (Mason-Jones and Towill, 1997). EDI has been noted as an important tool in information sharing (Bhatt, 2001; Lee, Padmanabhan, & Whang, 1997a). Besides, the information generated from the ICT of which decision making is based upon has an influence over the information quality (Ragunathan, 1999). Alternatively, ICT could improve information quality which leads to improvement in decision quality and performance (Ragunathan, 1999). Without effective ICT tools, such as EDI, communication in supply chain would be delayed and accurate information would not be possible.

5.6.2 Bar code Technology

This type of technology is very important to the supply chain as it enables the rapid collection of information. It incorporates code-editing technology, code-shaped designing technology, quick recognition technology and computer management technology which are all necessary technologies for understanding computer management and electrical data exchanging (Liu, 2007). Utilising bar code technology helps to resolve the data entering and data collection problems which in turn can greatly improve the efficiency of the flow as well as to provide support for the management of the supply chain.

5.6.3 Expert system/ artificial intelligence

Expert systems are computer programs that mimic human logic to solve problems (Cagliano, Caniato, & Spina, 2003). They use the experience of one or more experts in some problem domain, codify it, and apply that problem-solving expertise to make useful inferences for the user of the system (Boone, Drake, Bohler, & Craighead, 2007). Expert systems are useful in ensuring consistency of decision making in an environment of well-defined problems like the supply chain environment. One of the major technical problems that have been established in the supply chain is decision making and it is unavoidable. The barrier between material flow and information flow can be eliminated effectively with the application of expert systems as well as artificial intelligence, resulting in improved information sharing and cooperation between organisations. This improves the efficiency of the supply chain as a whole.

5.6.4 Vendor-managed Inventory (VMI)

Vendor–managed inventory (VMI) is a tool that permits the supplier or upstream supply chain members to have access to information pertaining to the inventory level of the manufacturer or downstream supply chain members. In a traditional supply chain, each entity such as manufacturer, supplier and retailer acts independently with regard to ordering and inventory control. In a VMI supply chain, demand and inventory information is shared between suppliers and customers. In this sense bullwhip effect tend to be higher in a traditional supply chain. VMI speeds up the decision making process and reduces delays in information flow which would result in improved supply chain performance. VMI is also capable of responding to volatile changes in demand due to price variations or as well as order variation as a result of price discounts (Disney and Towill, 2003).

Using EDI to support Vendor-Managed Inventory (VMI) strategy does not only eliminate bullwhip effect but also enhances the overall performance of supply chain (Yu, Yan, & Cheng, 2001). VMI is an inventory planning and fulfilment technique in which a supplier is responsible for monitoring and restocking customer inventory at the appropriate time to maintain predefined levels. The vendor is given access to current customer inventory, forecast and sales order information and initiates replenishment as

required. VMI links suppliers directly to a manufacturing base and then EDI is applied to generate material “pull” signals. By using VMI, suppliers would be able to have access to buying company’s demand, which allows supplier to improve ICTs ordering for supplies and production scheduling besides reducing inventory level in the supply chain (Wisner, Leong, & Tan, 2005).

5.6.5 Database Technology/ data warehousing technology

Data Warehouse (DW) provides a combination of many different databases across an entire enterprise or supply chain which aids management in decision making process. The system enables the integration of data and effective management of information from various sources in a single place. Organisations that apply data warehousing would be able to have accessibility to a wide variety of data. For example, information with regards to sales or trend reports in a particular location or region can be obtained. Data stored can be used for reporting and information analysis. Hence, data warehousing provides fast and cost effective management information requirements.

The ability of the supply chain partners to retrieve, manage and track the flow of the relevant information across the chain from a data warehouse has also been greatly enhanced by the rapid growth of ICT (Kulp, Lee, & Ofek, 2005). Large volume of information can be transferred smoothly and inexpensively in real time, enabling supply chain members to optimise effective strategies which are critical to the success of the supply chain. To react quickly to supply chain uncertainty and enhance customer satisfaction, ICT is essential for organisations to develop capable information systems. This will enable firms to gather and exchange information with supply chain partners (Bowersox, Closs, & Stank, 2000). Evolution of ICT has lowered the transaction cost and eased the information movement which facilitates better decision making and improved the time base performance (Lewis and Talalayevsky, 2005).

Current flows of information around most supply chains are still far from ideal and the problems of information distortion and magnification of order information abound (Lee & Whang, 2000). Many systems block rapid data transference to where ICT is really needed (Lee & Whang, 2000). A recent study of information sharing impact on the bull whip effect found that the effect was lessened when information was shared (Hsiao &

Shieh, 2006), and novel ways of improving coordination and prediction based on internal information markets have been proposed (Fang, Guo, & Winston, 2008).

5.6.6 Network technology/ electronic business

The Internet can offer many possibilities for effective information sharing that can in turn enable seamless flow of transactions in the supply chain. It can also facilitate relationships by its ability to transfer information (Wagner, Fillis, & Johansson 2003). The Internet provides the opportunity for demand data and supply capacity data to be visible to all companies within a manufacturing supply chain. Consequently, organisations can be in a position to anticipate demand fluctuations and to respond accordingly. The Internet has given organisations even greater tools for tightly orchestrating relationships across the entire supply chain and creating strategic partnerships and operational linkages with a dynamic web of large and small firms spanning all continents. Internet-enabled shared information helps break down organisational policies and functional fences, helping supply chain alliance members develop a common understanding of the competitive environment (Boyson, Corsi, & Verbraeck, 1999). In short, the availability of the Internet and the associated technologies provide the opportunity to make further significant, even radical, improvements to break down functional barriers and enhance the flow of information.

Frohlich (2002) looked at ICT from the Internet dimension. Internet technology has significantly enabled VMI, Electronic Fund Transfer (EFT), and collaborative planning, forecasting and replenishment (CPFR) (McCormack and Kasper, 2002). EFT permits the electronic transfer of money or funds across the supply chain without any paper money changing hands. Hence, this facilitates fast payment of goods and supplies between buyer and seller. Besides, smoothing the coordination of cash flow in the supply chain, ICT is required in managing the movement of physical goods along the supply chain. ICT tools such as Distribution Requirement Planning (DRP) provides a linkage between warehouse operations and transportation requirement. DRP reconciles demand forecast against inventory and transportation capacity.

Internet also enables integration of supply chain with lower cost, offers rich content and supports linking of supply chain partners located from long distance. Internet provides

direct connectivity to anyone over a Local Area Network (LAN) or Internet Service Provider (ISP) using a common set of communications protocols (O'Brien and Marakas, 2006). ICT has enabled inter-organisational communication across organisations in the supply chain besides contributing to significant impact on company's performance (Sanders & Premus, 2005)

Many researchers agree that ICT reduce cost of coordination. Lack of coordination will result in the supply chain holding inefficiencies in the form of inventory buffers, under-utilised capacity, and obsolescence of products or lost sales. The degree to which two activities are coordinated is limited by the cost of coordinating the activities. In other words, if the cost of coordination is higher than the cost of inefficiencies, the organisation is better off not coordinating. The trade-off between cost of coordination and cost of inefficiencies in the system determines the extent to which activities in the supply chain are coordinated. Coordination flows support the integration of business activities through information sharing.

5.6.7 Enterprise Resource Planning

Shapiro, (2007) explains that 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. In essence, ERP systems incorporate all business applications to offer a central system for decision-making. ERP systems are fairly robust in providing real-time information, and thus are able to communicate information about operational changes to supply chain members with little delay (Wisner, Tan, & Leong, 2005). As a result, if ERP systems are implemented across the supply chain and are properly used by all supply chain members, information sharing and trust can be enhanced in the supply chain.

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 IT implementations in supply chains.

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-in 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 the smaller companies.

These limitations to ERP implementation are significantly similar to the barriers for IT implementation in supply chains discussed previously. 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.

5.7 Conclusion

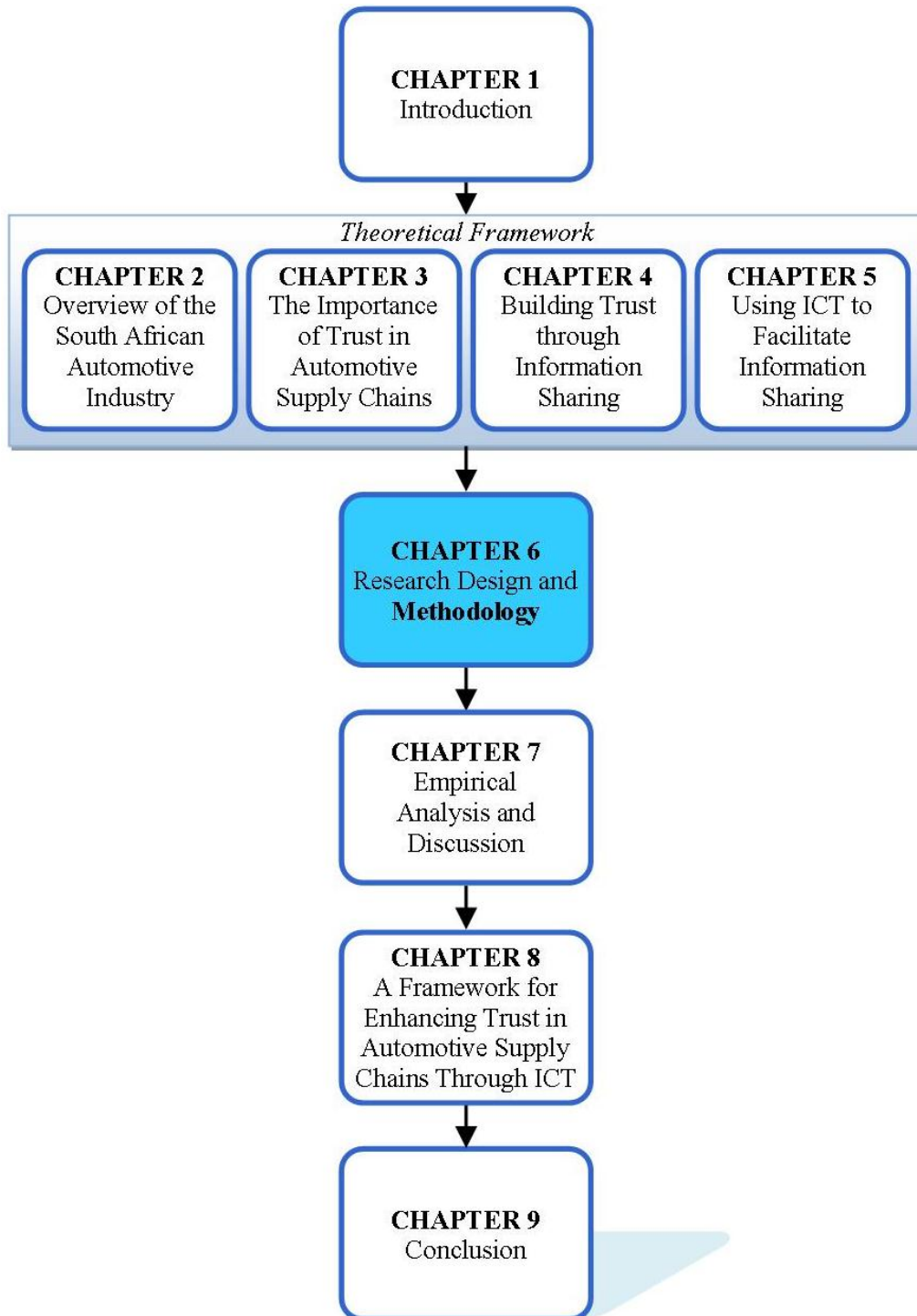
From the literature review it has been noted that information sharing which enhances decision making is the most important impact ICT has in the supply chain. This is an essential observation for this research project which is exploring the improvement of trust in supply chain relationships. Information sharing is significant in the establishment of trust as explained in Chapter Four. Thus the use of ICT in this regard is important.

Modern information technology provides supply chains with the opportunity for the development of enterprise management. ICT will also enable supply chain partners to gain competitive advantage which will result from the coordinated ability among the whole supply chain as well as the sharing of basic resources which depends on information sharing.

A number of possible intra-organisational systems that can be put into practice in order to make sure that there is optimal information flow in the supply chain have been explained in the literature review above. Information sharing encourages coordination and reduces uncertainty in the supply chain. As concluded by Cashmore and Lyall (1991), information imparts authority and benefit above its owner, but that these were realised only if the possessor utilised the information as it was not adequate just to own it, it was the use to which it was put that is important. This notion would also apply in the supply chains. If one supplier knows vital information that could be useful to the other supply chain partners and does not share it, the information becomes useless. Thus it is important for supply chain partners in the automotive industry to share information.

The next chapter focuses on the research methodology used for this study. The methodology details the empirical work needed to explore the use of ICT to enhance trust in automotive supply chains.

Chapter 6: Research Design and Methodology



6.1 Introduction

As ICT is influential in facilitating good trusting relationships amongst supply chain partners, in particular information sharing, it is fitting to make sure that ICT is leveraged for maximum benefit. The objective of this research project therefore is to create a framework that can be utilised to enhance inter-organisational trust in automotive supply chains through the effective use of ICT. The previous chapters have comprehensively discussed the introduction to the study, an overview of the South African automotive industry and a literature review of trust and information sharing in automotive supply chains, which is the background that builds the foundation and relevance of this research study.

It was established that because of the mistrust amongst the supply chain partners, information sharing is disrupted. This is as a result of a lack of sound decision making due to insufficient information. Therefore a lack of trust and information sharing are major contributors to the inefficiency and ineffectiveness of the supply chain. As information sharing is facilitated by ICT, this is a key enabler for trust formation.

This chapter thus examines a more detailed approach of the research process that was followed in collecting, measuring and analysing data for this study. Careful consideration went into selecting the appropriate research methodology to achieve the objective of this study. This research project will employ qualitative methods for data collection and assumes an Interpretative approach. The method used to collect the primary data for this research project was a web-based questionnaire. The research design will then summarise the manner in which the investigation was conducted to obtain answers to the research questions. On the contrary, the research method describes the means, methods and tools that will be used in the process of acquiring knowledge.

This chapter details the selected research methodology for this study. The relevant research paradigm is described firstly which will be followed by the selected research methodology and research format. Following this, a detailed discussion of the primary and secondary data collection methods will be provided as well as the population of the study and data analysis methods. The chapter concludes with an overview of how this research project can be evaluated for quality.

6.2 Research Paradigm

Dainty (2007) emphasises that in conducting research, it is important to construct a philosophical position and orientation towards the inquiry. A suggestion is made by McCallin (2003) that early in the research process, one must review the philosophical background and consider the paradigm of enquiry. According to Johnson and Christensen (2008) a paradigm is a perspective based on a set of assumptions, concepts, and values that are held and practised by a community of researchers. It is also defined by Guba and Lincoln (1994: 106) as, “*the basic belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways.*”

The definition of research paradigms therefore requires the consideration of ontology, epistemology and methodology. The form and nature of reality, that is a theory of what exists and how it exists is what ontology is concerned with. Epistemology on the other hand is about the nature of knowledge and considers the relationship between the person who knows and what can be known (Schwandt, 2001). With regards to methodology, Clough and Nutbrown (2002) view its task as uncovering and justifying “*research assumptions as far and as practicably as possible, and in doing so to locate the claims which the research makes within the traditions of enquiry which use it.*” Amaratunga and Baldry (2001) affirm this by stating that ignoring such issues can have a detrimental effect on the quality of the research.

The bases for this study are the underlying theoretical paradigms which influence the reasoning and approach taken in this study. Oates (2006) suggests that different philosophical paradigms have differing views about the nature of the world and the way in which unique knowledge about it can be acquired. The research paradigm is also an indication of which school of thought (principles) the study is aligned to. Quite a number of philosophical paradigms exist; but for the purposes of this study the philosophical framework was narrowed down to the choice between Positivism and Interpretivism.

Throughout the history of philosophy and science, the study of knowledge has always been controversial, leading to a lack of clarity and numerous positions along a

continuum with two extremes: knowledge is ascribed a purely objective or a purely subjective existence (Sousa & Hendricks, 2006). Positivism and interpretivism have been the subject of a long-standing debate in science, with many authors aligning positivism with quantitative research, and interpretivism with qualitative research (Dainty, 2007). However Guba and Lincoln (1994) argue that this position is somewhat misleading as *“both qualitative and quantitative methods may be used appropriately with any research paradigm.”* Essentially, positivism is concerned with explaining human behaviour, while interpretivism places emphasis on understanding it.

Because of the subjective nature of this research project, an interpretivist approach will be followed as the main focus of the project is on the ways of enhancing inter-organisational trust through ICT in automotive supply chains. The research methodology and why it was chosen will be discussed in the next section.

6.3 Research Methodology

In response to the identified research questions the aim of this study is to develop a framework which can help SA automotive supply chains in the automotive industry to ICT for improved information sharing and to boost trust when ICT is adopted. This framework is derived from a review and combination of existing theories and models, discussed in the literature review phase of this study, and adapted to the automotive supply chain context.

The first section of the study involved identifying and discussing in detail theories and opinions from different authors in the identified research area. The existence of the identified problem is validated from reviewing current literature, and fundamental principles which contribute towards the development of the proposed framework are discussed. Once the review of related literature was completed, the next step focused on the development and deployment of the data collection tool which was used to answer the research question and to address the purpose of this study. This study used a web-based questionnaire that comprised of both structured questions using scaled response options as well as open-ended questions. This instrument will be discussed further in a section to follow. The results then prompted the development of a framework which represents the proposed solution to the objectives of the study.

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 the ability to 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 for this study. This is in line with the interpretive paradigm selected for this research project.

There are many different types of research formats namely:

1. ***Descriptive research:*** this type of research is described by Marais and Moutton (1996) as how variables relate to one another based on information gathered through data gathering methods. It provides a knowledge base when little is known about a phenomenon or when such things as clarification of a situation, classification of information, or description of subject characteristics will aid refinement of the research problem, formulation of hypotheses, or design of data collection and analysis procedures.
2. ***Causal research:*** this type of research focuses mainly on the effect that variables have on one another (Cooper & Emory, 1996). Causal research

is designed to determine whether a change in one variable likely caused an observed change in another.

3. ***Explanatory research:*** focuses mainly on relatively unknown fields with the aim of achieving certain objectives (Marais & Mouton, 1996) which include gathering information and insights, undertaking a preliminary research on which to base a more structured study, stating central concepts and constructs, determining priorities for future research as well as development of a hypothesis.

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

The logic of research can be classified as either inductive or deductive. Creswell (2003) explains that Deductive research entails the development of a theoretical structure that is then tested empirically whilst Inductive reasoning involves the development of proposals from empirical observations, where generalised conclusions are achieved. Inductive reasoning will be the approach in this research project. In this instance, the researcher starts with particular observations, or formulated research questions, from which patterns are identified.

The data collection methods employed in this research are described in the next section.

6.4 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 which 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 web-based questionnaires as primary data, and literature review as secondary data. These methods are described in detail in the sections that follow.

6.4.1 Primary Data Collection Methods

The primary data collection method for this study was a 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 questionnaire was designed using a structured 4-point Likert-type scale. On the Likert scale, 1 stands for strongly disagree and 4 for strongly agree. The questionnaire did not include a neutral response option as it would not have provided the answers that were necessary in answering the research problem.

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, Strydom, Fouche, & Delport, 2005). Limitations include: a potentially high non-response rate, answers left out or questions incorrectly interpreted (De Vos, Strydom, Fouche, & Delport, 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; and 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, Strydom, Fouche, & Delport, 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. The questionnaire was sent to the managers, middle managers and supervisors in procurement, logistics and production departments in the various supply chains.

50 responses were received. Prior to this, a pilot study was conducted to test the suitability of the research instrument. The purpose of this pilot study was to ensure that the questionnaire was a good research instrument. The pilot study made use of a

number of colleagues. 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 findings of the questionnaire are described in detail in Chapter Seven.

6.4.2 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 questionnaires is described in the next section.

6.5 Sample and population

Zimkund (2003) defines a population as a complete group of entities sharing a common set of characteristics. For this study, the population will be all the automotive supply chains in the Eastern Cape. Zimkund (2003) expresses that the process of sampling involves any procedure using a small number of items or parts of the whole population to make conclusions regarding the whole population. A sampling frame or list of population elements is where the sample is drawn from. Sampling techniques can be divided into probability and non-probability samples.

For probability samples, each population element has a known chance for being included in the sample. It is not necessary that the probabilities of selection be equal, only that one can specify the probabilities. With non-probability samples, in contrast,

there is no way of estimating the probability that any population element will be included in the sample, and thus there is no way of ensuring that the sample is representative of the population. All non-probability samples rely on personal judgement somewhere in the process, and although these judgement samples may yield good estimates of a population characteristic, they do not permit an objective evaluation of the adequacy of the sample. It is only when the elements have been selected with known probabilities that one can evaluate the precision of a sample result (Gefen, Karahanna, & Straub, 2003). The classification of sampling techniques is illustrated in the figure below:

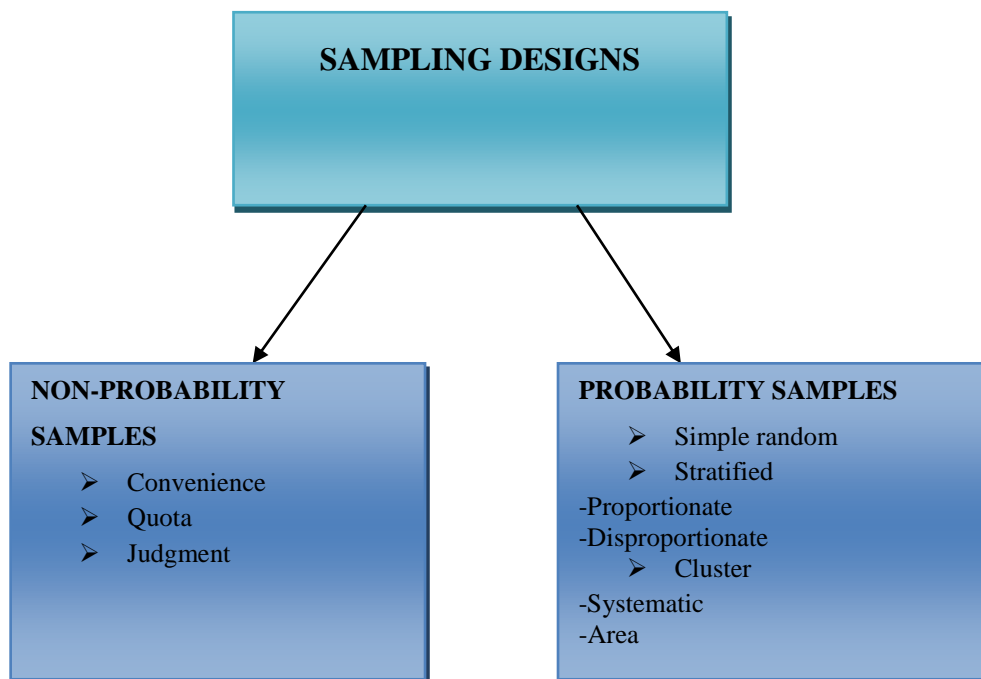


Figure 6.1: Sampling Designs

Both probability and non-probability sampling plans can be further divided by type. Non-probability samples, for instance, can be classified as convenience, judgment, or quota, whereas probability samples can be simple, random, stratified, or cluster samples as indicated in the figure above. For this study, the non-probability method of convenience sampling was applied. Next section illustrates how the collected data was analysed.

6.6 Data Analysis

All research leads to the analysis and interpretation of data collected during the study. Mouton (2006) explains that the analysis stage involves the breaking up of data into manageable themes, trends and relationships. In order to identify trends as well as to identify and categorise the responses based on the themes derived in the literature, the data collected was analysed. The qualitative and quantitative data gathered from the literature survey, questionnaires, and websites observations was grouped according to the various research questions.

To assess the responses from the questionnaire, Dillon's (1993:60) steps in processing data were followed, which are shown in Figure 6.2 below. These are explained in detail below:

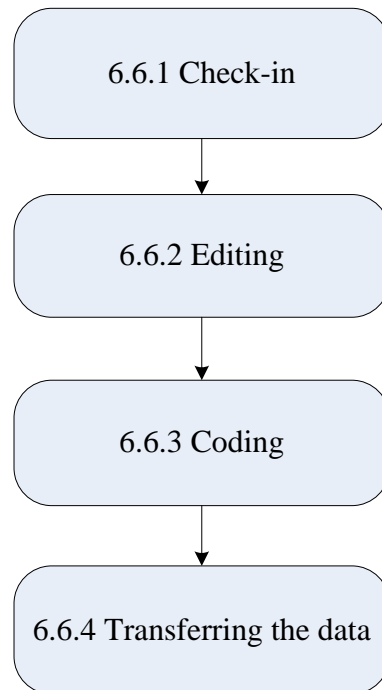


Figure 6.2: Data Analysis Process

6.6.1 Check-in

The first step in the check-in procedure was to check for acceptable questionnaires and this was done by inspecting all questionnaires received from the field. A questionnaire was said to be acceptable for use if it was completed fully, and all the instructions for completion were followed, and if there were no pages missing.

6.6.2 Editing

In this step, the questionnaires were re-evaluated for maximum accuracy. A set of editing instructions were used to ensure consistency.

6.6.3 Coding

To help identify patterns from the questions which provided a list of options to choose from, a coding system was developed which allowed for the effortless identification of patterns which can be easily interpreted. Responses to the semi structured questions were grouped according to a visible pattern of common themes.

6.6.4 Transferring the data

This step involved the physical transfer of the data from the questionnaires to an excel spreadsheet. This Excel spreadsheet was used to document all responses from the questionnaire. Responses to structured questions were provided through the application of descriptive statistics only; no Chi-square or t-tests were conducted. Responses to the open-ended questions were shown on tables to reflect direct responses.

This study therefore adopted the above-mentioned process in order to present a qualitative analysis of the collected data. The next section discusses the research evaluation.

6.7 Research Evaluation

A set of equivalent criteria for positivist and interpretivist research is provided by Oates (2006). The interpretivist criteria which are applicable to this research involve trustworthiness, confirmability, dependability, credibility and transferability. These are defined below.

1. *Trustworthiness*: the information provided by the respondents was honest and hence contributes to this attribute of the study.
2. *Confirmability*: This criterion has been met through the use of survey undertaken to confirm the outcome of the research. The use of the questionnaire findings confirmed the theoretical findings. This led to the development of the research framework.

3. *Dependability*: Dependability is established through the use of literature from recognised authors. The use of established theories and models which have been established and tested in numerous research projects adds 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, Davis and Schoorman's (1995) Proposed Model of Trust and Das and Teng's model of trust
4. *Credibility*: Credibility has been achieved through the use of data that was collected from various supply chain personnel who are directly involved in the supply chain.
5. *Transferability*: Transferability has been achieved as the research framework can be applied to other inter-organisational settings with similar characteristics.

The research project can therefore be considered credible through the application of these five criteria, which are evaluated in Chapter 9.

6.8 Ethical Considerations

During the study, confidential information was collected and due to the nature and sensitivity of the information the researcher adhered to a strict confidentiality code in order to protect the privacy of organisations.

6.9 Conclusion

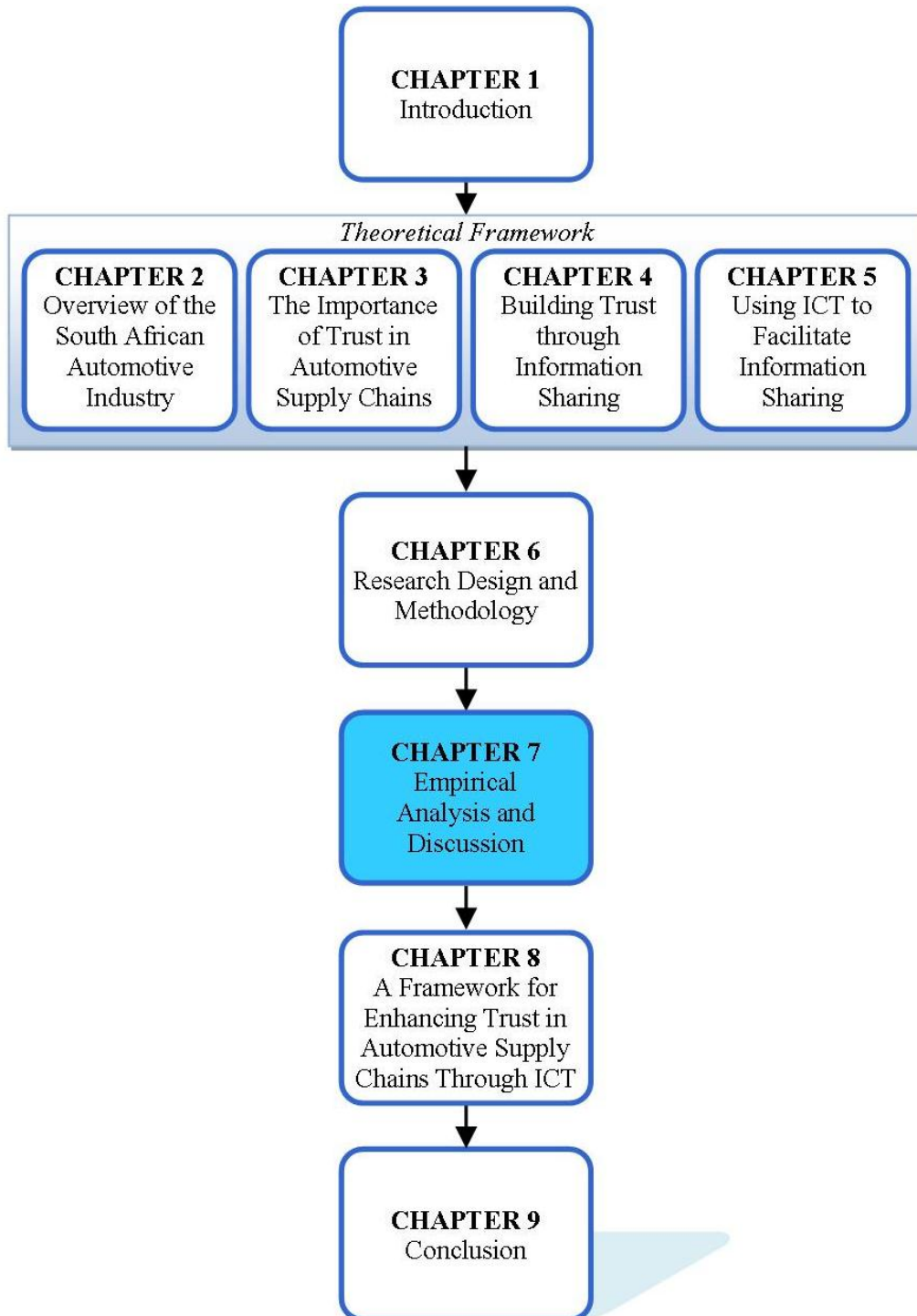
Outlined in this chapter were the research paradigm, methodology and data collection methods. The research methodology applicable was described, namely the qualitative approach as this is consistent with the interpretivist paradigm adopted for the study.

The research format was promoted as having a descriptive purpose and making use of inductive reasoning. The data collection methods employed were described and justified. The primary data collection methods are case studies and web-based questionnaires. 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 web-based questionnaire are described in Chapter Seven.

Chapter 7: Empirical Analysis and Discussion



7.1 Introduction

The purpose of this chapter is to discuss the result of the semi-structured questionnaire responded by 50 participants. Prior to the commencement of the research study the importance, basis and intention of the study were provided to the respondents. Moreover, the respondents were also given the assurance that all the data they gave was used for the purpose of the research and the identities of the respondents were kept confidential. Supply chain partners have to make ICTs an integral part of their businesses in order to compete effectively in the global marketplace. Different authors provide differing explanations for how ICTs can improve the trust-information sharing relationship among supply chain partners. While the secondary data used in this study provides an insight into the different theories and strategies in this field, the questions asked from the participants of this study are aimed at gaining an understanding into the impact of ICT on trust and information sharing in South African Automotive Supply Chains.

The data collected in this study was analysed in order to draw meaning from it. By comparing, evaluating and identifying trends from the primary data collected together with the secondary data, illustrations were made that were used to meet the objective of this study. The objective of this study is to develop causal framework to ensure that a balance between trust and information sharing is maintained when using ICT to manage supply chain relationships in the SA automotive industry.

In the process of analysing the data collected, careful consideration was given to identifying questions from the questionnaire that would make the most or least contribution in meeting the objective of this study. This will ensure that the findings and recommendations made are based on the most relevant data collected. Equal value during analysis was given to all contributions made by the participants. The following sections provide details of the criteria used for comparing data, and an in-depth discussion of the findings from the analysis of data. The next section introduces the participating individuals.

7.2 Response Rate

A total of 70 supply chain organisations were invited to participate in the study. Fifty respondents from various levels of the automotive supply chain and organisations completed the questionnaire representing a 51% response rate. Saunders, Lewis, and Thornhill, (2007) indicate that during one of the mail questionnaires they undertook, the response rate was 52%. Nevertheless, the authors point out that the type of questionnaire will affect the number of people who respond and that a response rate of 30% for questionnaires that are emailed would be reasonable. Babbie and Mouton (2001:261) maintain that a response rate of 50% can be regarded as being adequate for analysis and reporting. It can be said that the response rate was satisfactory, taking into account the difficulty to find organisations willing to share their information.

The questionnaire (cf. Appendix A) which served as the main primary data collection instrument for this study, consisted of 14 questions. The questions comprised information about the organisation in general; the factors that affect trust, barriers to information sharing and ICT use to enhance information sharing and trust. These questions were generated from the findings of the literature which have highlighted the problems that are currently being faced by supply chain organisations with regard to trust and information sharing as well as how ICT plays a role in fostering trust. The questionnaire targeted supply chain managers, logistics managers, coordinators, and any employees involved in the supply chain. The collected data was grouped according to the information needed to address the research questions; this allowed for a more structured approach during the data analysis phase of the study. Open-ended and closed questions were used in the questionnaire. The questions were categorised as follows:

1. General background information about the business,
2. Factors affecting trust,
3. Barriers to information sharing, and
4. ICT use to enhance information sharing and trust.

The participants' responses have been displayed using combinations of table summaries and graphs. The review of relevant literature conducted in Chapters 2, 3, 4 and 5

provided a baseline against which the findings of this study were compared. The literature review also acted as a guide to provide direction for this study. The main aim of this chapter is to explore what was discovered in the review of literature phase compared to what was revealed by the primary data collection process (questionnaire) of this study.

The following section illustrates the background of participating organisations as provided by the various respondents.

7.3 Background of Participating Organisations

A total number of fifty respondents responded from various automotive supply chain organisations to illustrate their perspective on the impacts of ICT on trust and information sharing. A high concentration of the responses was from 1st, 2nd and 3rd tier suppliers although the invitation to participate was extended to all tier suppliers in the supply chain across the Eastern Cape. The researcher assured the participants that the information they provided would be kept anonymous during the analysis stage of the study, therefore no business names have been included. Specific questions providing a general background of the participating businesses were asked in the questionnaire. The next section will discuss the results from the questionnaire.

The table below shows the positions of all the respondents in their various organisations. The most responses were acquired from supply chain managers who contributed to twenty percent (20%) of responses. Ten percent (10%) of the respondents were logistics managers. Logistics and supply chain managers as well as operations managers contributed to eight percent (8%) of the responses respectively. Manufacturing managers are six percent (6%) of the total respondents. On the other hand, 4% of the respondents came from Procurement managers; the same was acquired from managing directors as well as sales managers. Lastly, there was a two percent (2%) response rate respectively from a Store's manager, a line manager, a logistics coordinator, a coordinator (Supply Chain Management), a CEO, sales director, a marketing manager, a national sales manager, a sales executive, a general manager marketing and technical, group sales and marketing manager, key accounts manager, plant manager, site

manager, logistics administrator, business development director, commodity buyer and a senior general manager.

Table 7.1: Positions of Respondents

Position	Total Number of Respondents	Percentage (%)
Logistics Manager	5	10
Logistics and Supply Chain Manager	4	8
Operations Manager	4	8
Supply Chain Manager	10	20
Procurement Manager	2	4
Managing Director	2	4
Stores Manager	1	2
Line Manager	1	2
Logistics Coordinator	1	2
Coordinator (Supply Chain Management)	1	2
CEO	1	2
Sales Director	1	2
Marketing Manager	1	2
Manufacturing Manager	3	6
National Sales Manager	1	2
Sales Executive	1	2
General Manager Marketing and Technical	1	2
Group sales and Marketing Manager	1	2
Key Accounts Manager	1	2
Plant Manager	1	2
Site Manager	1	2
Logistics Administrator	1	2
Business Development Director	1	2
Sales Manager	2	4
Commodity Buyer	1	2
Senior General Manager	1	2
Total	50	100

The study specifically targeted these respondents because they are innately involved in the synchronisation of the inter-organisational relationships. As discussed in the literature, there are many levels of suppliers exist in automotive supply chains. They are first tier, second tier, third tier and so on. Components are supplied directly to OEMs by first tier suppliers whilst second tier suppliers supply components or materials to the first tier suppliers. Third tier suppliers therefore supply second tier suppliers. This study

only asked suppliers up to third tier to participate in the study as they are ones most relevant. Table 7.2 below depicts the tier levels of the participating organisations.

Forty two percent (42%) of the respondents are 1st tier suppliers, forty two percent (42%) are 2nd tier suppliers. 3rd tier suppliers contributed to sixteen percent (16%) of the responses. The table below shows the level of the respondents' organisation in the supply chain as explained above.

Table 7.2: Level in Supply Chain

Level in Supply Chain	No. Of Respondents	Percentage (%)
Tier 1	21	42
Tier 2	21	42
Tier 3	8	16
Total	50	100

In South Africa there are eight OEMs that each have a complicated supplier network and they are Mercedes Benz (MBSA), Toyota, General Motors, Volkswagen, Ford, Fiat, BMW and Nissan. Regardless of being located in the Eastern Cape, there is a possibility that these suppliers may supply components to more than one of these OEMs located around South Africa.

Of the fifty respondents, 36% supplies Toyota, 34 % supplies General Motors, Volkswagen and Ford were supplied by 28% of the respondents respectively. 26 % supplies MBSA, 24% supplies Nissan. Fiat is supplied by 14% of the respondents and BMW is supplied by 14% of the respondents as well. The total number of respondents in this question was more than 50 due to the fact that an organisation can supply more than one OEM. This is illustrated by the table below:

Table 7.3: OEM Supplied

OEM Supplied	Number of Respondents	Percentage (%)
MBSA	13	26
Toyota	18	36
General Motors	17	34
Volkswagen	14	28
Ford	14	28
Fiat	7	14
BMW	7	14
Nissan	12	24

There are many raw materials that are required by the OEMs, so it was important to know what each supplier supplied so as to establish the supply chain relationship with fellow suppliers. 24% of the respondents supply engine and transmission parts whilst 16% of those that participated in the study supply body panels and trimmings, and 16% were in the “other” category which includes fuel tanks, air ducts, insulators, sealants, extruded rubber, PVC components, shock absorbers, foam pads (seating), plastics, mirror assemblies, control cables, and wiring harnesses. 14% supply brakes and suspensions, tyres and electrical spare parts were supplied by 12% of the respondents respectively. 8% of the organisations supply leather tanners and 6% of the representatives of the organisations that participated supplied foundries, 6% supply catalytic converters and components and the remaining 6% supply catalytic converter assemblies. This is illustrated by the table below:

Table 7.4: Raw Materials Supplied

Raw Material Supplied	Number of Respondents	Percentage (%)
Tyres	5	10
Foundries	2	5
Leather tanners	5	6.7
Catalytic converter components	2	5
Catalytic converter assemblers	2	5
Engine and transmission parts	10	20
Body panels and trimming	6	13.3
Electrical spares and part spares	5	10
Brakes and suspensions	6	11.7
Other	7	13.3
Total	50	100

In the table below, the supply frequency (how often an item is supplied) distribution among respondents is presented. This is important for the study as it indicates how many times the supplier gets in contact with the OEM, and hence the probable information sharing that is sufficient to create and uphold an inter-organisational relationship. About two fifths (40%) of respondents reported supplying on a weekly basis. 28 % supply every 5 days whilst 12% supply every 14 days and 12 % also supply daily. This is indicated by the table below:

Table 7.5: Supply Frequency

Supply Frequency	Number of Respondents	Percentage (%)
5 Days	14	28
7 Days	20	40
Once every 30 Days	2	4
14 Days	6	12
Daily	6	12
1Day	2	4
Total	50	100

The following sections discuss the findings from the questionnaire relevant to the secondary research questions.

7.4 Empirical Findings

This section of the study will provide the discussion and analysis of the perception of respondents relating to the three research questions stated in Chapter 1. This will provide a greater understanding of the challenges facing the supply chain partners in SA with regards to trust and information sharing, and the use of ICT in this regard

7.4.1 First Research Sub-question

What are the factors which influence trust in South African automotive supply chains?

This sub-question focuses on investigating the determinants of trust with other supply chain partners. One respondent could select more than one option on the questionnaire and hence the totals in some of the tables particularly tables 7.7 to 7.11 are more than

100%. A detailed discussion of the findings to the first research sub-question is provided below.

Good trusting relationship with supply chain partners

When the respondents were asked if they had a good trusting relationship with other supply chain partners, 32% disagreed, 36% strongly disagreed, 24% agreed and 8% strongly agreed. These results exhibit interesting relationships amongst the supply chain partners as the majority do not have good trusting relationships with the other supply chain partners. This is illustrated graphically below:

Table 7.6: Trust relationship with partner suppliers

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
Your organisation has a good trusting relationship with supply chain partners	32%	36%	8%	24%

68% of the respondents state that they do not have a good trusting relationship with supply chain partners; hence this figure serves to confirm the identified problem of this study that there is a high level of mistrust among supply chain partners which hinders supply chain efficiency and effectiveness.

Lack of trust and achieving desired results

It was discussed in the literature that a lack of trust impacts the supply chain negatively. This is confirmed by the results from the questionnaire as 60% of the respondents strongly agree that lack of trust with supply chain partners hinders the organisation from achieving desired results; with 11% agreeing, 3% strongly disagreeing and 5% agreeing (see table below). Therefore it can be concluded that trust is a major component in building a cooperative relationship between partners as it encourages openness between parties.

Table 7.7: Lack of trust and achieving desired results

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
Lack of trust with supply chain partners hinders your organisation from achieving desired results	3%	5%	11%	60%

Trusts of information provided by supply chain partners

In response to the question of whether their organisation trusts the information that is provided by supply chain partners 23% disagreed, 10% strongly disagreed, while 15% agreed and 2% strongly agreed. This is shown in the table below.

Table 7.8: Organisations’ perception on information shared by suppliers

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
Your organisation trusts the information that is provided by supply chain partners	23%	10%	15%	2%

This is a strong indication that partner suppliers do not have trust in each other as they cannot even trust the information that is shared by the others.

Confidence in supply chain partners

Though some respondents have confidence in all their supply chain partners, they represent only 12%. The overall impression is that from the respondents’ feedback 29% strongly disagree that they have confidence in their supply chain partners and at least 9% disagree as shown in the table below.

Table 7.9: Organisations’ confidence in partner suppliers

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
Your organisation has confidence in all its supply chain partners	29%	9%	10%	2%

Your organisation’s belief regarding how supply chain partner honesty influences the intention to share information with them

An overwhelming trend indicates that a greater number of respondents are of the opinion that their organisation’s belief regarding supply chain partner honesty influences the intention to share information. 24 % strongly agreed with this statement and 21 % agreed whilst only 2% strongly disagreed and 3% agreed. This clearly indicates the importance of how the organisations’ trust each other as it influences sharing information which will affect the supply chain negatively. This is illustrated below:

Table 7.10: Supplier partner honesty and information sharing

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
Your organisation’s belief regarding supply chain partner honesty influences the intention to share information with them	2%	3%	21%	24%

A long term relationship and its influence on the intention to share information

The results from the study show that regardless of how long the partners have known each other, 19% disagree that a long term relationship with supply chain partners

influences the intention to share information and 2% strongly disagree. In contrast, 12% strongly agree and 16% agree that the intention to share information is influenced by how long they would have known them based on the trust they invest in them (see table below). One can therefore conclude that trust is very important in order to influence effective information sharing.

Table 7.11: Long term relationships and intention to share information

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
A long term relationship with supply chain partners influences the intention to share information	2%	19%	16%	12%

In this section it was discovered that quite a number of organisations highlighted that trust is needed to overcome the psychological barrier imposed by the risk of sharing information via technologies. The researcher argues that trusting a partner to be benevolent should alleviate the organisation’s anxiety that the partner may abuse and or disclose information to a third party and that they will share accurate and useful information which is beneficial to supply chain performance (Levin & Cross, 2004). Such a belief will motivate the organisation to share important information.

This aim of this research project is to examine the optimal level of trust and information sharing in supply chain relationships, and the use of ICT in achieving this. In order for supply chain partners to have a good trust-information sharing relationship, it was important to find out from them the barriers to trust and information sharing in their supply chain relationships.

The highest aspects that they indicated as the barriers were a lack of trust and unwillingness to share information. This clearly illustrates that trust is vital for encouraging information sharing, and information sharing can be said to help in developing trust amongst the supply chain partners. The concept of trust which derives from game theory is pertinent in this respect. The famous “prisoners’ dilemma”

arguably illustrates the need for a theory of trust in order to explain how agents can overcome the strong incentives to defect and so reap the benefits of mutual cooperation.

If the supply chain partners trust each other, they will be able to share information freely and this would in turn enhance the trust level in the supply chain relationships. The findings from the survey illustrate how the supply chain partner is not willing to be susceptible in the relationship with others by acknowledging the risk of information sharing. This clearly shows that there is a lack of trust in the supply chain relationships which is being investigated. The next section will address the second research sub-question which addressed the information sharing aspect of the research study.

7.4.2 Second Research Sub-question

What are the barriers to effective information sharing in South African automotive supply chains?

This research sub-question focused on the importance of information sharing to supply chains, the barriers to effective information sharing and the benefits that can arise from effective information sharing with various supply chain partners. A summary of the findings to the second research sub-question is provided below.

Hindrances of effective information sharing

From the empirical findings, effective information sharing is hindered by

1. Poor communication between you and your suppliers;
2. Withholding valuable information;
3. Information privacy;
4. Willingness to share information;
5. Sharing information is a possible interruption of the stability of power;
6. Perceived confidentiality of the information;
7. Cost and difficulty of executing advanced systems;

8. Systems incompatibility; and

9. Reputation of the supplier.

A respondent could select more than one option and hence the sum of the responses was more than 50. 25% of the respondents indicated that there is no willingness to share information, 18% said there is poor communication between their organisation and the supplier, 14% indicated that sharing information is a possible interruption of the stability of power; and 12% do not share information because of the perceived confidentiality of the information. Information sharing is also hindered by the cost and difficulty of executing advanced systems as is indicated by 8% of the respondents.

Due to systems incompatibility, 6% of the respondents have problems with sharing information and 6% of the respondents withhold valuable information. This is indicated in the table below which summarises the barriers to information sharing.

Table 7.12: Barriers to effective information sharing

Statement	Frequency	Percentage
Poor communication between you and your suppliers	9	18
Withholding valuable information	3	6
Information privacy	5	10
Willingness to share information	13	25
Sharing information is a possible interruption of the stability of power	7	14
Perceived confidentiality of the information	6	12
Cost and difficulty of executing advanced systems	4	8
Systems incompatibility	3	6
Total	50	100

The barrier that most affects the supply chain partners is willingness to share information and this can result in a lack of trust as established in the previous section. The supply chain partners also strongly believe that sharing information is a possible interruption of the stability of power.

Level and quality of information sharing

The table below provides the distribution of the perception of respondents regarding the level and quality of information sharing among supply chain partners. In this regard, 76% of the respondents disagreed that there is willingness to share information with other supply chain members. 72% disagreed that there is frequent and regular communication among supply chain members.

With regards to the respect for the confidentiality of information among the supply chain members, 62% disagreed that there is respect for confidentiality of information. The respondents strongly agreed that there is adequate infrastructure support for information sharing, although it is not utilised effectively. 62% disagreed that they share information that might be useful to all the supply chain partners to establish business planning while 28% agreed. 54% disagreed with the statement that their organisation and partner suppliers share information that might be useful to all of them to establish business planning.

Table 7.13: Level and quality of information sharing among supply chain partners

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
There is willingness to share information with other supply chain members	36%	40%	2%	22%
There is frequent and regular communication among supply chain members	34%	38%	4%	24%
There is respect for the confidentiality of information among the supply chain members	30%	32%	4%	34%
There is adequate infrastructure support for information sharing	10%	42%	4%	44%
Your organisation and partner suppliers share information that might be useful to all of them to establish business planning	22%	50%	6%	22%
Your organisation keeps partner suppliers informed about events or changes that may affect the business	14%	40%	10%	32%

This section was designed to find out the aspects that hinder effective information sharing, as well as the level and quality of communication between supply chain partners. In summary information can be shared if there is frequent and regular communication. Trust can then be gained amongst supply chain members if there is respect for the confidentiality of information among the supply chain members. The questionnaire findings contained in this section raise areas of concern, one such area being there is adequate infrastructure support for information sharing but it is not utilised effectively. This is dealt with in the third sub-question.

Secondly, from the questionnaire it is evident that organisations and partner suppliers are aware of the importance of revealing some information to partner suppliers; however the organisation and partner suppliers do not share the information that might be useful to all of them to establish business planning. This signifies a lack of trust and

confidence in the suppliers. In response to the question about what type of information the respondent organisations share with other suppliers, the table below summarises their responses:

Table 7.14: Information shared by suppliers

Information Shared	Frequency	Percentage
Strategic	2	4
Logistical	8	16
Tactical	2	4
Product-related	15	30
Inventory information	8	16
Order information	8	17
Process information	5	9
Information relating to customers	1	2
Other	1	2
Total	50	100

Information that is shared the most is product-related information with 30% of the respondents. The reasons that were supplied for sharing this type of information include facilitating the ordering and delivery of the correct parts in the shortest time possible. The one reason was that they do not keep a lot of stock as most parts are ordered when needed hence it is important that this information be communicated so as to uphold promises made to clients and to deliver. 17 % of the respondents shared order information, the reason mentioned was that since suppliers order their material from the

respondent organisation, it is important that they are informed about any promotions available on the product, availability of product and estimated time of arrival of the product. Other reasons included

1. For completing the order,
2. To be able to know when to order stock and not overstock a particular product,
3. To keep track of delivery deadlines,
4. Reduced product costs,
5. Strategic reasons,
6. For shorter lead times,
7. For reduced inventory levels,
8. To determine how much to order from supplier, and
9. It is part of the business process

Other respondents mentioned that they do not share information at all even when they are supposed to because they are afraid they will be taken advantage of. The benefits of investments in connectivity can therefore be negated by the unwillingness to share information. One can therefore conclude that a culturally imbedded willingness to share information should strengthen the importance of ICT linkages by increasing the quality, amount and timeliness of the information that is shared. The next section will explore findings that address the third research sub-question pertaining to how ICT can enhance information sharing and trust in the supply chain.

7.4.3 Third Research Sub-question

How can ICT enhance information sharing and thereby enhance trust in South

This research project proposes a framework to boost the level of trust in supply chain relationships through the use of ICT. The respondents were asked questions that aimed at establishing the technologies used for information sharing and their effectiveness in

order to ensure coordination of the entire supply chain. The survey results indicate that most of the respondents disagreed that adequate ICT linkages exist with partner suppliers and that current ICT does not satisfy supply chain communication requirements as most of the organisations are not linked electronically with other supply chain partners to share information of mutual interest. The questionnaire findings further emphasise that ICT such as the Internet, intranet, software application packages and decision support systems can be applied to facilitate information sharing with partners, and optimisation of supply chain performance.

The figure below illustrates the channels that the respondent organisations use to communicate and or share information with suppliers:

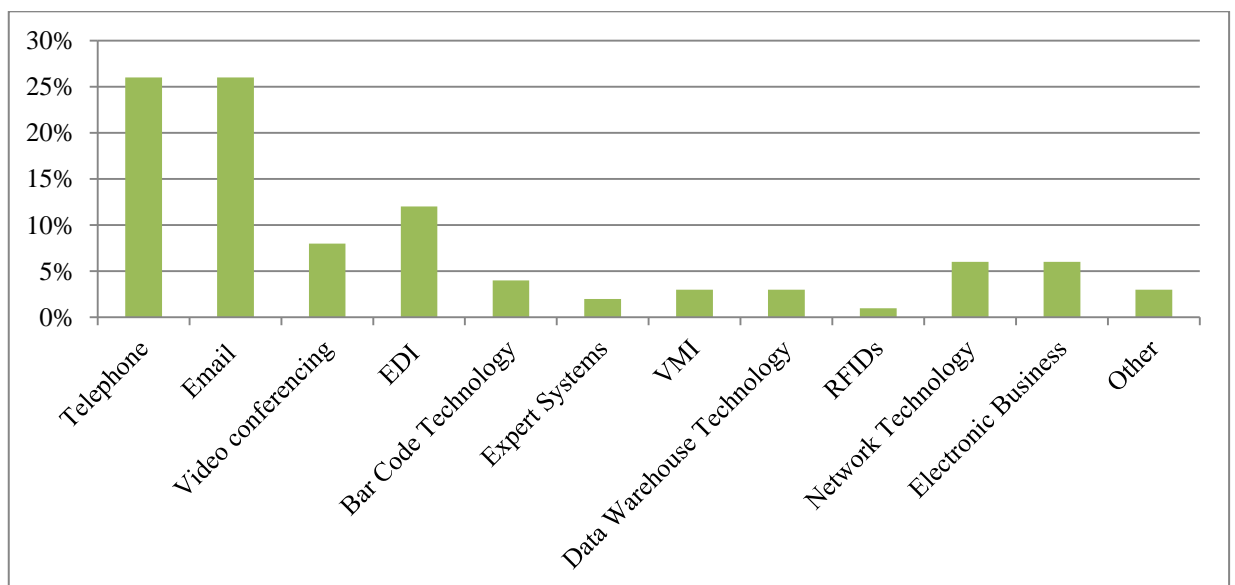


Figure 7.1: Communication Technologies currently utilised

ICT will enable supply chain partners to trade goods, share information, and integrate processes, thereby reshaping the inter-organisational dynamics and resulting in more efficient supply chain. Electronic integration of data and the automation of business practices have the potential to drive costs down and built sales. ICT has an important influence on coordination structure between supply chain organisations. The use of ICT may have a positive effect on coordination, and this in turn can lower coordination costs and enables more effective and more efficient coordination processes, more

coordination processes, and new coordination structures. It can be concluded that ICT will improve integration which is a prerequisite for effective sharing and utilisation of information between different organisations in the chain.

7.5 Conclusion

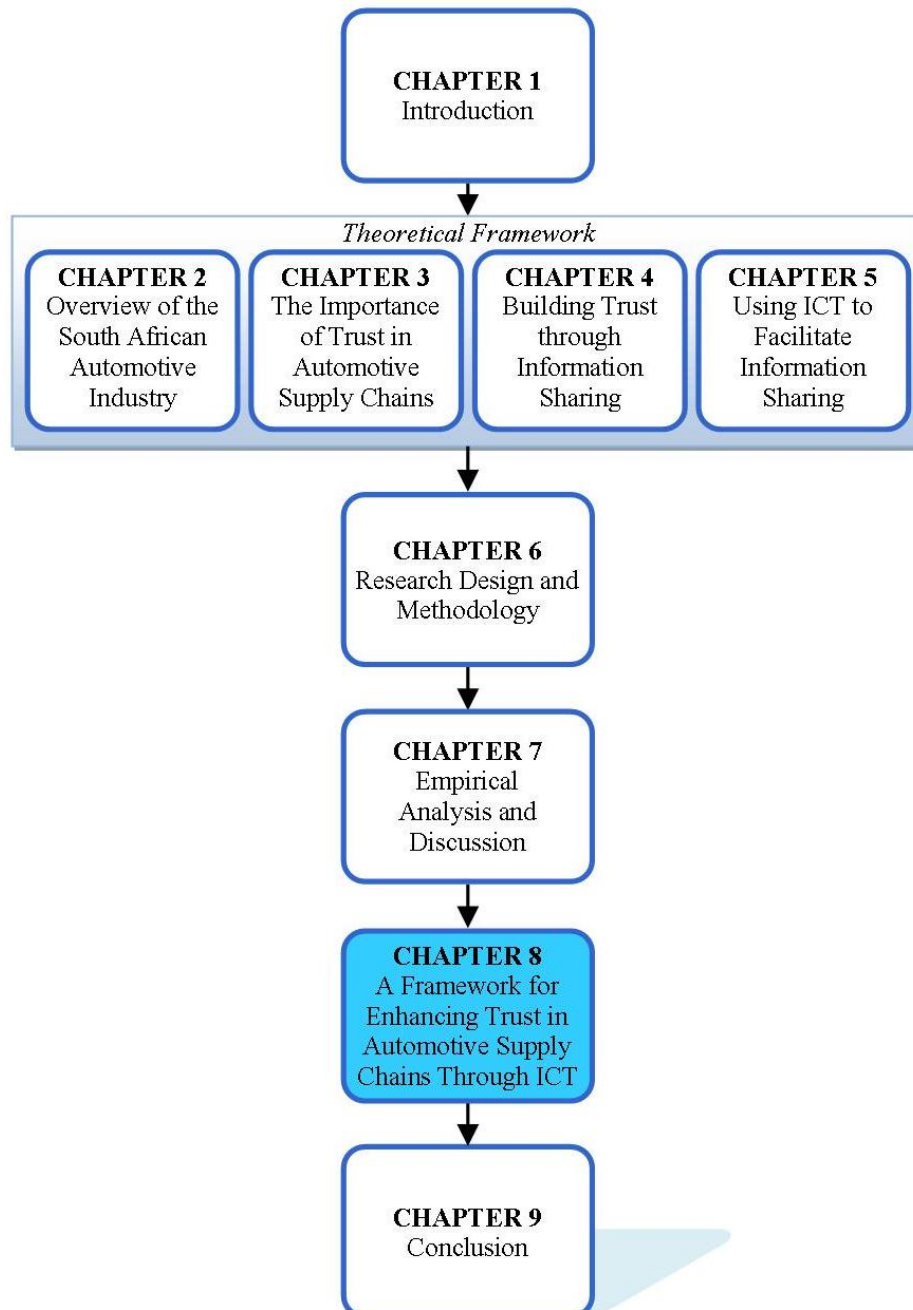
These findings from the survey are consistent with the literature survey findings discussed in Chapter Three and Chapter Four and Chapter 5. Information sharing is hindered if there are no open lines of communication between supply chain partners. An important observation made from the results is that the supply chain partners' view of weakening power through sharing information. This aspect hinders the trust relationship between supply chain partners.

In Chapter 7 the results and findings from the primary data collected, and the literature review were summarised, analysed and discussed. Conclusions drawn from these discussions confirmed that a problem definitely exists in the area of information sharing because of a lack of trust among the supply chain partners. A detailed discussion of the research instrument was included, and how this instrument was refined in the pilot study. Data was analysed and grouped into three categories for discussion.

This chapter has dealt with the research findings and results by analysing the findings according to the three research sub-questions identified in this study. Firstly, the findings provided a sound idea of the factors influencing trust in the SA automotive supply chains. Secondly, barriers to information sharing in the supply chain were discussed. Finally, the chapter discussed how ICT can enhance information sharing in the supply chain so as to build trust. The research sub-questions were derived in an attempt to answer the main research question.

The following chapter illustrates the framework that can be used by supply chain partners to enhance trust in the supply chain through the use of ICT which is the primary objective of this research project. The basis of this framework is the literature survey findings and the primary data discussed in this chapter.

Chapter 8: A Framework for Enhancing Trust in Automotive Supply Chains Through ICT



8.1 Introduction

This chapter discusses the framework for ensuring a balance between trust and information sharing in automotive supply chains through ICT. The research framework 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 insufficient information sharing are viewed as contributing factors to the ineffectiveness and inefficiency of a supply chain's operations, and the resultant negative effect on supply chain efficiency and effectiveness is described by introducing the proposed framework and explains each element of the framework.

8.2 The Proposed Framework

A lack of trust and information sharing is a big challenge to inter-organisational relationships in the automotive supply chain (Ittman, 2002). According to Petersen, Ragatz and Monczka (2005), inter-organisational relationships must be emphasised in order to develop superior supply chain networks. The performance of the supply chain is ultimately greatly improved by strong inter-organisational relationships. As such it is very important for SA automotive supply chains to foster trust and information sharing to enhance their productivity and improve the inter-organisational relationships.

In order to enhance trust in a supply chain relationship, information flow should be enhanced, for example by implementing integrated information systems to improve information flow and reduce uncertainty in the supply chain relationship (Premkumar, Ramamurthy & Saunders, 2005). Currently due to the competitive nature of the automotive industry, information flow is restricted. Gao and Lee (2005) explain that inappropriate trust in information provided by forecasting technologies can lead to incorrect decisions, which in turn may signal intent to compete with other supply chain partners. Mistrust in these supply chain relationships would be the end result. Game Theory and some key models like Fawcett's Connectivity-Willingness Matrix, Mayer and Davis's Trust model as well as Das and Teng's framework on trust, control and risk

in strategic alliances were fundamental to the development of the framework described below.

The following framework (Figure 8.1) has been developed to accomplish the research objectives for this study. The six key components of the framework, namely: a matrix depicting the use of ICT to support supply chain relationships; connectivity, information sharing capability and willingness, which determine the level of information sharing in the supply chain relationship; ability, benevolence and integrity as trust determinants; the resultant improved information sharing, collaboration and coordination; trust, confidence and control which improve supply chain management and ultimately result in efficient and effective supply chain relationships. These are described in detail in the sections that follow.

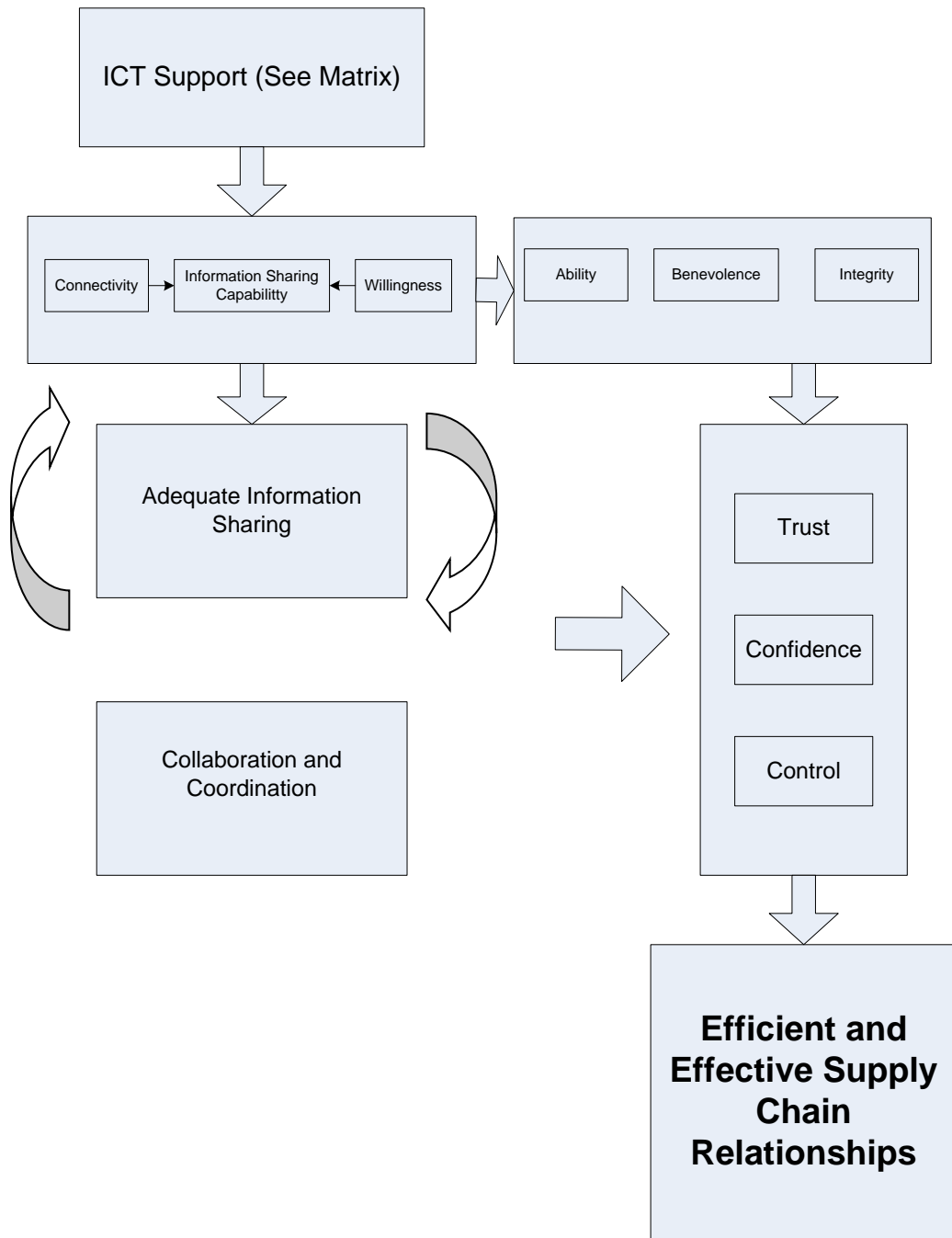


Figure 8.1: Framework to ensure that a balance between trust and information sharing is maintained when using ICT

8.2.1 ICT Support Matrix

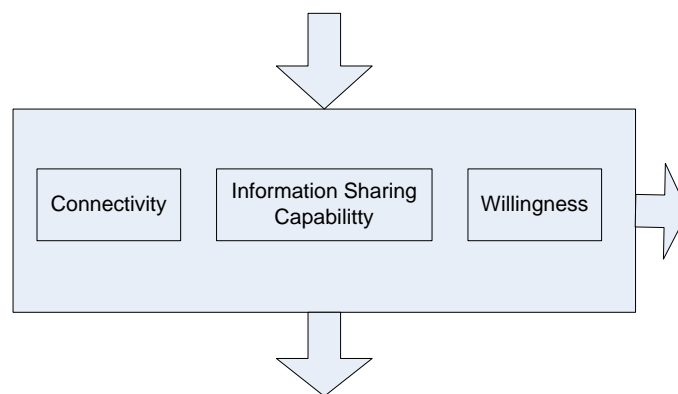
	EDI	Barcode Technology	Expert Systems	VMI	Data Warehouse Technology	Enterprise Resource Planning	Network Technology/Electronic
Too much paperwork related to business processes	✓	✓		✓			
Multiple data entry	✓	✓		✓	✓	✓	✓
Data collection		✓					
Barrier between information flow and material flow			✓			✓	✓
Delays in information flow		✓		✓			
Information distortion and magnification of order information	✓		✓		✓		
Disintegration of the supply chain partners			✓			✓	✓

While collaborating with supply chain partners may enhance the chain's performance, sharing information is not without risk. A prominent role is played by ICT in connecting different corporate organisations to enable information sharing (Auramo, Kauremaa, & Tanskanen, 2005). The matrix illustrates some of the communication technologies that are available to the supply chains to enable information sharing by negating the effect of the listed barriers to information sharing. This is based on literature findings and confirmed through empirical data collected.

From the literature it was noted that, Information and communication technologies play an essential role in SCM as they facilitate organisations to collect, analyse, and disseminate information among members of the chain with the aim of improving decision making (Dong, Xu, & Zhu, 2009). Providing managers with relevant, accurate, and timely information and connecting them across functional and organisational boundaries reduces temporal and spatial distance enabling them to make better, more collaborative decisions. Chesbrough and Teece (2002) explain that the goal of enabling individuals anywhere in the chain to seamlessly interact with one another is becoming a technological possibility.

However, few of the organisations that participated in the questionnaire stated that they have not successfully exploited investments in ICT to accomplish enhanced performance and sustainable competitive advantage. Even though these organisations have purchased advanced technologies, they have not used them to communicate and share information with partner suppliers. While connectivity allows better coordination, a culture of willingness to share information is essential to fully take advantage of this capability. Connectivity, information sharing capability and willingness are therefore explained in the next section.

8.2.2 Connectivity, information sharing capability and Willingness



From the literature, the role of information sharing capability is viewed in two dimensions namely willingness and connectivity towards operational and competitive performance improvement. Fawcett and Magnan (2008) state that connectivity creates the capability to share information. Nonetheless, people make the decisions regarding what will be shared and when. This results in many individuals to be unwilling to share information that they perceive may place their organisations at a competitive disadvantage. In spite of whether these perceptions are accurate, tremendous amounts of potentially useful information that could enhance supply chain decision making if shared, remains unavailable to decision makers (Huang & Lau, 2003). Mendelson, (2000) reaffirms this by highlighting that an organisation's willingness to share relevant information openly, honestly and frequently ultimately determines the extent of sharing that takes place.

As indicated by Fawcett, Osterhaus, Magnan, Brau, & McCarter, (2007) in identifying two dimensions of successful integration; connectivity and willingness ICT is no way a

guarantee for a successful supply chain with efficient information flows although proven to be a powerful tool to boost innovation, leverage resources as well as manage partners (Dong, 2009).

Connectivity addresses the ICT aspect of actually being able to share and analyse information, and willingness refers to what extent supply chain partners actually make information available. Better decision making and higher levels of collaboration and coordination are possible when supply chain partners are connected. McGee, (2004) strengthens this notion by stating that ICT connections facilitate quick information sharing so that necessary adjustments to supply chain composition or roles performed by each member of the supply chain can be made. Although ICT enables connectivity, it does not guarantee proactive information sharing.

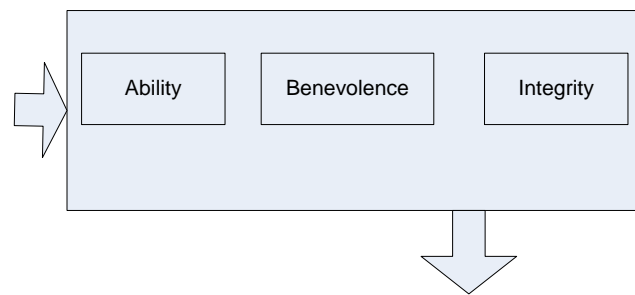
From the empirical findings, the following was noted with regards unwillingness to share information in a supply chain relationship:

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. An unwillingness to share information can thus work against the benefits of investments in connectivity. Willingness acts as a strong complement to an organisations' ability to connect. This is in line with the objective of this study which is for supply chain partners to utilise ICT for connectivity and information sharing. Information sharing will become effective thus increasing other suppliers' willingness to share information.
2. Additionally, from the questionnaire findings, it was established that the participants perceived a trusting relationship to not exist with supply chain partners. 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.

It can be concluded that sharing of information can improve interactions among organisations in supply chains and that in order to enhance trust in a supply chain relationship, information flow should be enhanced, for example by implementing integrated information systems to improve information flow and reduce uncertainty in the supply chain relationships. As established in the literature chapters, establishing information sharing results in the formation of trust, which is characterised by the three constructs: ability, benevolence and integrity, which are described below.

8.2.3 Ability, Benevolence and Integrity



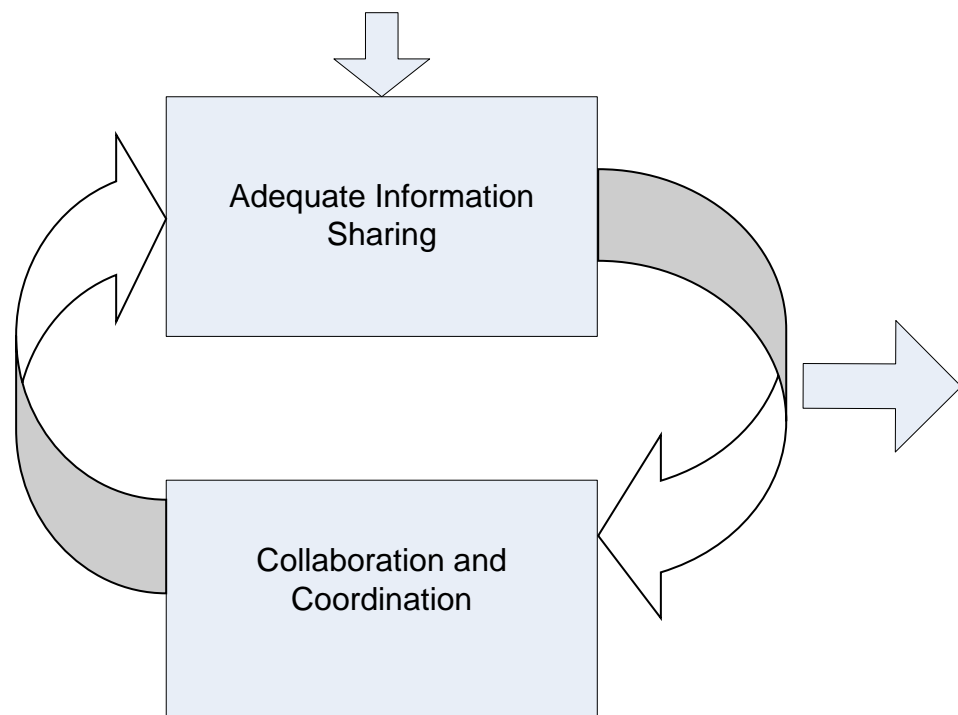
From the literature, it was established that trust is needed to overcome the psychological barrier imposed by the risk of sharing information via technologies. The researcher argues that trusting a partner to be benevolent should alleviate the organisation's anxiety that the partner may abuse and or disclose information to a third party and that they will share accurate and useful information which is beneficial to supply chain performance (Levin & Cross, 2004).

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. 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 framework. 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.

Based on consistency shown from being benevolent, integrity would improve as there will be credibility of communication which can be improved by connectivity, commitment to standards of fairness as well as the congruence of the other partner's word and deed. Adequate information sharing, collaboration and coordination are possible if connectivity and willingness exist in the supply chain. These attributes will be discussed in the following section.

8.2.4 Adequate Information Sharing, Collaboration and Coordination



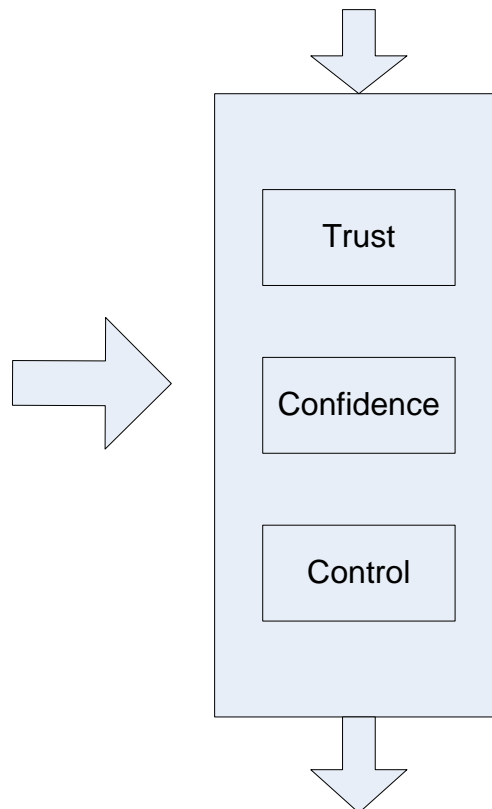
From the literature it was noted that, utilising ICT to share information in the supply chain can enable a unique collaboration capability that allows organisations to share

resources and coordinate efforts for improved efficiency and effectiveness, (Fawcett, Osterhaus, Magnan, Brau, & McCarter, 2007). Collaboration requires effective information sharing, and this is only possible if connectivity and willingness exist simultaneously.

The respondents were asked questions that aimed at establishing the technologies used for information sharing and their effectiveness in order to ensure coordination of the entire supply chain. The survey results indicate that most of the respondents disagreed that adequate ICT linkages exist with partner suppliers and that current ICT does not satisfy supply chain communication requirements as most of the organisations are not linked electronically with other supply chain partners to share information of mutual interest. The questionnaire findings further emphasise that ICT such as the Internet, intranet, software application packages and decision support systems can be applied to facilitate information sharing with partners, and optimisation of supply chain performance.

ICT will enable supply chain partners to trade goods, share information, and integrate processes, thereby reshaping the inter-organisational dynamics and resulting in more efficient collaborative supply chain. Electronic integration of data and the automation of business practices have the potential to drive costs down and built sales. ICT has an important influence on coordination structure between supply chain organisations. The use of ICT may have a positive effect on coordination, and this in turn can lower coordination costs and enables more effective and more efficient coordination processes, more coordination processes, and new coordination structures. It can be concluded that ICT will improve integration and collaboration which are a prerequisite for effective sharing and utilisation of information between different organisations in the chain. Collaboration and coordination have an effect on trust, confidence and control which are discussed in the next section.

8.2.5 Trust, Confidence and Control

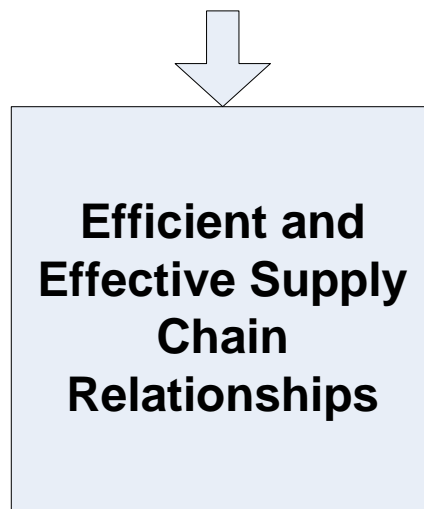


From the literature, the following was relevant to trust, confidence and control. Because the partners will end up pursuing mutually compatible interests in the supply chain as a result of connectivity which improves information sharing, collaboration and coordination, confidence among the partners will increase as they are able to realise that acting opportunistically will only detriment relationships with the other partners. As suggested by Das and Teng (2001) confidence comes from two sources namely trust and control. The supply chain partners need to trust each other in order to have confidence in reliability of information. Controls are needed to mitigate the risk of supply chain partners acting opportunistically in the relationship.

From the empirical findings, it was established that supply chain partners do not have confidence in each other. It has already been established from the literature that confidence is derived from a lack of trust and control. Constant and consistent communication among the supply chain partners is a key element for developing trust.

Regular communication among the supply chain partners leads to enhanced levels of confidence to build trust. If the previous communications from other supply chain partners have been regular and of high quality in terms of relevancy, timeliness and reliability, a greater sense of trust and commitment will be yielded among the supply chain partners. This would then result in efficient and effective supply chain relationships, which is the final element of this framework.

8.2.6 Efficient and Effective Supply Chain Relationships



In order for supply chain partners to have a good trust-information sharing relationship, it was important to find out from them the barriers to trust and information sharing in their supply chain relationships.

The highest aspects that they indicated as the barriers were a lack of trust and unwillingness to share information. This clearly illustrates that trust is vital for encouraging information sharing, and information sharing can be said to help in developing trust amongst the supply chain partners. The concept of trust which derives from game theory is pertinent in this respect. The famous “prisoners’ dilemma” arguably illustrates the need for a theory of trust in order to explain how agents can overcome the strong incentives to defect and so reap the benefits of mutual cooperation.

If the supply chain partners trust each other, they will be able to share information freely and this would in turn enhance the trust level in the supply chain relationships, resulting in efficient and effective supply chain relationships.

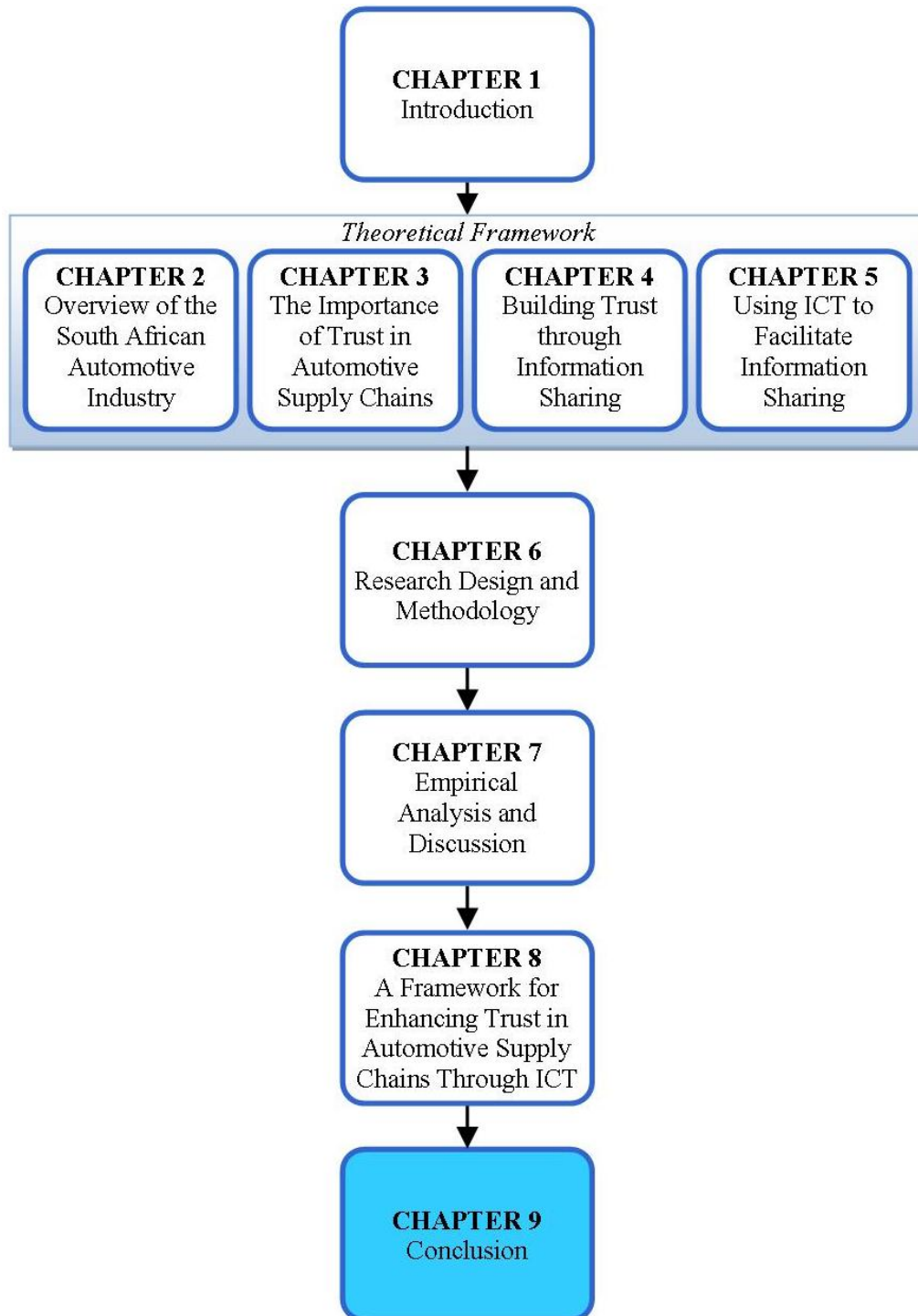
8.3 Conclusion

This framework was designed based on the results that were obtained from the questionnaire and the reviewed literature. The key finding of this study is that the sharing of information can improve interactions among organisations in supply chains by enhancing trust. With the aid of information and communication technologies, partners in the supply chain can reduce barriers and costs of sharing information.

The effective use of ICT is where the key to automotive suppliers' success mostly lies as ICT has emerged as a key enabler to help the organisations achieve greater coordination and collaboration with supply chain partners as well as to automate the supply chain process (Tummala, Johnson, & Phillips, 2006). The appropriate utilisation of information and communication technologies can enhance trust which will boost information sharing with other supply chain partners as illustrated by the proposed framework. This enhanced information sharing and trust results in more efficient and effective supply chain processes, which benefits all supply chain partners.

A summative conclusion of this research project will be presented in the next chapter. This concludes the research project by applying the knowledge gained from the research to the objectives of the study.

Chapter 9: Conclusion



9.1 Introduction

The preceding chapters provided the findings and recommendations of this study. The findings were presented in response to the research question and sub-questions, which constituted the framework within which the findings were discussed. This led to the proposal of a framework to ensure that a balance between trust and information sharing is maintained when using ICT to manage supply chain relationships in the South African automotive industry.

The theoretical framework for this study was discussed in Chapter 2, 3, 4, and 5. Chapter 6 highlighted the research design and methodology applied in the study. The findings and analysis were discussed in Chapter 7 and Chapter 8 provided the recommendations in the form of the framework. This chapter provides a brief discussion of the theoretical background of the study and the contribution made by this study. This is followed by a summary of the research project and begins by discussing each research question. The limitations and directions for future research are then outlined. This is followed by an evaluation of the research project and a brief conclusion.

9.2 Theoretical Framework

In order to be successful, an organisation must possess and share information about the different aspects of the supply chain. Advances in ICT have made this information sharing more convenient. Therefore, for activities to be coordinated, the different partners in a supply chain have to share information. Two key theories namely the Organisational Information Processing Theory and Game Theory were used to expand on the role of trust and information sharing. The Organisational Information Processing Theory identifies information processing needs and capabilities and the need to obtain optimal performance through a balance of these factors and Game theory highlights that only with free flow of information in the supply chain can effective decisions be made that are beneficial to all members of the supply chain.

Game theory has been described as a collection of tools for predicting outcomes for a group of interacting agents where an action of a single agent directly affects the payoffs of the other participating agents (Ketchen & Hult, 2007). A key element of game theory

is trying to predict others' actions (Hosmer, 1995). Hennem and Arda (2008) explain that game theory provides a mathematical background for modelling systems as well as generating solutions in competitive or conflicting situations. The basic principle of the game theory is that each player involved acts in the most advantageous way possible to accomplish their individual goal, considering that the others play in the same manner. If however the individual goal of each player is solely to take full advantage of his gain or to reduce his loss, Hennem and Arda (2008) highlight that the agreements obtained by negotiation may be weak and will not generally guarantee global optimality for the whole supply chain, particularly when external demand is high.

The concept of trust which derives from game theory is pertinent in this respect. The famous "prisoners' dilemma" arguably illustrates the need for a theory of trust in order to explain how agents can overcome the strong incentives to defect and so reap the benefits of mutual cooperation. It shows that cooperative behaviour is superior self-seeking behaviour as regards each players gain.

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 ICT, to share this information. This theory was discussed in detail in Chapter 4.

Three models of trust were used to illustrate this further, namely: Mayer, Davis and Schoorman's Trust model, McKnight, Choudhury and Kacmar's Initial Trust Model and Das and Teng's trust and control model. These will be discussed in detail in the next section. McKnight, Choudhury and Kacmar'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

To further affirm game theory, Mayer and Davis proposed that risk will moderate the relationship between trust and trust behaviour. Although quite a number of factors were proposed, they concluded that there are three determinants of a trustee's trustworthiness which are ability, integrity and benevolence. Mayer, Davis, and Schoorman (1995) also argue that trust develops as a function of the trustor's propensity to trust, the extent to

which the trustee perceives the trustor as trustworthy, and the trustor's perception of situational risk. The authors suggest that when risk is made out to be low, trust will most likely end up in trust behaviour and that when risk is high, better levels of trust will be needed. This same notion is applicable to automotive supply chains. The level of trust in supply chain relationships will be dependent upon the amount of risk that partners are willing to take.

McKnight, Choudhury and Kacmar's (2002) Initial Trust Model incorporates the concepts of trust from other disciplines, including the Mayer, Davis and Schoorman (1995) model. 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, Choudhury and Kacmar'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 which are explained in Das and Teng's trust and control model.

According to Das and Teng (1998) trust and control are the major determinants for confidence in partner cooperation. The definition of cooperation which was proposed by Kopczak & Johnson (2007) will be used, and they define cooperation as "*the willingness and ability of a partner organisation to pursue mutually compatible interests.*" Das and Teng (1998) highlight that absence of cooperation in partner organisations may result in opportunistic actions such as distortion of information, misleading other partners and cheating. Trust and control can be both challenging and expensive to institute. In their conclusion, the authors state that trust and control act as supplements as they can function as a way to boost the confidence on the likely behaviour of the trustee.

An argument was put forward by Tomkins (2001) that information sharing is facilitated by management control mechanisms. For information sharing to be effective, it is heavily dependent on trust which begins within the organisation and will eventually spread to supply chain partners (Kwon & Suh, 2004). This would result in the creation of positive expectations as well as the confidence about the supply chain partner's future behaviour, building trust in the process. In particular, there is likely a positive

association between information, control and trust. Less information control is needed as trust becomes further established in later stages. A non-linear relation can therefore be observed from the above. Trust between the supply chain partners will be damaged if a certain level of management control appears.

9.3 Summary of Research Findings

The problem identified in this research study is that in South African automotive supply chains there is poor information sharing which results in a high level of mistrust among supply chain partners. In order to address the research the problem, research questions were asked. This section will provide a summary of the research outcomes of this study against the research questions stated in Chapter 1. The sub-questions were used to collect information that would answer the main research question, namely:

How does ICT impact on the trust-information sharing relationship in South African automotive supply chains?

To answer the main research question three sub-questions were identified:

- 1. What are the factors influencing trust in South African automotive supply chains?*

The theory that was used to answer this research sub-question 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, and the components suggested in these models were discussed and compared in this chapter.

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 trust, confidence and control in the framework.

2. *What are the barriers to effective information sharing in South African automotive supply chains?*

Chapter 4 addressed the theory of this research question. 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 in the supply chain. These benefits can be equated to the benefits of trust in inter-organisational relationships discussed in Chapter Three.

This section from the findings was designed to find out the aspects that hinder effective information sharing, as well as the level and quality of communication between supply chain partners. In summary information can be shared if there is frequent and regular communication. Trust can then be gained amongst supply chain members if there is respect for the confidentiality of information among the supply chain members. The questionnaire findings contained in this section raise areas of concern, one such area being there is adequate infrastructure support for information sharing but it is not utilised effectively. This is dealt with in the third sub-question.

Secondly, from the questionnaire it is evident that organisations and partner suppliers are aware of the importance of revealing some information to partner suppliers; however the organisation and partner suppliers do not share the information that might be useful to all of them to establish business planning. This signifies a lack of trust and confidence in the suppliers.

3. *How can ICT enhance information sharing and thereby enhance trust 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 ICT has in the supply chain is related to the sharing of information which enhances decision making.

From the survey, the respondents were asked questions that aimed at establishing the technologies used for information sharing and their effectiveness in order to ensure coordination of the entire supply chain. The survey results indicate that most of the respondents disagreed that adequate ICT linkages exist with partner suppliers and that current ICT does not satisfy supply chain communication requirements as most of the organisations are not linked electronically with other supply chain partners to share information of mutual interest.

Below is a summary of the main findings based on the responses to the questionnaire and literature study. By addressing the three sub-questions, the overall objective would have been addressed as the three sub-questions are derived from the research objective. The research sub-questions were addressed in the literature review, and verified through the findings from the primary questionnaire data. Research sub-question one was addressed by establishing the challenges within the supply chain with regards to trust and how it affects the relationships with partner suppliers.

Research sub-question two was addressed by determining the barriers to effective information sharing. It was demonstrated that information sharing improves information flow, because it enables the partners in the supply chain to achieve better efficiency through improved coordination of their daily production, inventory control, logistics, and quality management effort.

Sub-question three described how with the aid of information and communication technologies, partners in the supply chain can reduce barriers and costs of sharing information. The appropriate utilisation of information and communication technologies can enhance trust which will boost information sharing with other supply chain partners. From this a framework was derived that can help improve information sharing through ICT and build trust in the process. The result will be an efficient and effective supply chain.

The main objective of this research project is to produce a framework that will ensure that a balance between trust and information sharing is maintained when using ICT to manage supply chain relationships in the SA automotive industry. This objective has been addressed through collectively addressing the research sub-questions.

9.4 Contribution made by this study

This study has developed a causal framework to ensure that a balance between trust and information sharing is maintained when using ICT to manage supply chain relationships in the SA automotive industry. The framework depicted in Figure 8.1 shows how supply chain partners can utilise ICTs to enhance information sharing and improve the main goals of the supply chain which are efficiency and effectiveness through the establishment of a trusting relationship.

The use of some of the information and communication technologies indicated in the matrix results in the connectivity of the supply chain, which ensures information can be shared. Several benefits can be realised from connectivity which include reduced environmental uncertainty, lower transaction costs as well as a more speedy reaction to environmental changes as a result of shared information. Technologies like barcodes, data warehouses, and data mining can allow supply chain partners to detect environmental trends. Quick information sharing is facilitated by the ICT connections. A unique collaboration capability can be enabled by utilising ICT and this will allow the organisations to share resources and coordinate efforts for improved performance. Some of the benefits that can be realised from collaboration include lower inventory levels, higher productivity, better quality, lower materials and manufacturing costs as well as shorter delivery lead times.

Based on consistency shown from being benevolent, integrity would improve as there will be credibility of communication, commitment to standards of fairness as well as the congruence of the other partner's word and deed. Because the partners will end up pursuing mutually compatible interests in the supply chain, confidence among the partners will increase as they are able to realise that acting opportunistically will detriment relationships with the other partners. Trust and control have a supplementary relationship. Trust is the high probability of a positive outcome from a partner in a risky situation and control is used by organisations to make the attainment of organisational goals more predictable, thus ensuring certain outcomes, for example by minimising uncertainty or risk. A greater sense of trust and commitment will be yielded among the

supply chain partners from regular and high level quality information sharing in terms of relevancy, timeliness and reliability.

The limitations of this study are outlined in the next section.

9.5 Limitations of the Study

This study attempts to address the lack of trust experienced between members of the automotive supply chains. A specific focus of this research project was on the interrelation between trust and information sharing and to establish the sharing of information to enhance trust regardless of the type of information.

9.6 Directions for Future Research

Further research can be undertaken to explore more factors that impact on information sharing and trust. In addition, research might also explore the relationships between information sharing and other performance measures in the supply chain, such as costs and customer services. This study can also be repeated with supply chains not aligned to the automotive industry.

9.7 Evaluation of the Research Project

In order to ensure the credibility and integrity of the research project, research evaluation is a necessary step. A set of equivalent criteria for positivist and interpretivist research are provided by Oates (2006) and they 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*: the information provided by the respondents was honest and hence contributes to this attribute of the study.
2. *Confirmability*: This criterion has been met through the use of survey undertaken to confirm the outcome of the research. The use of the questionnaire findings confirmed the theoretical findings. This led to the development of the research framework.
3. *Dependability*: Dependability is established through the use of literature from recognised authors. The use of established theories and models which have been established and tested in numerous research projects adds 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, Davis and Schoorman's (1995) Proposed Model of Trust and Das and Teng's model of trust
4. *Credibility*: Credibility has been achieved through the use of data that was collected from various supply chain personnel who are directly involved in the supply chain.
5. *Transferability*: Transferability has been achieved as the research framework can be applied to other inter-organisational settings with similar characteristics.

The research project can therefore be considered credible through the application of these five criteria

9.8 Conclusion

The aim of this study was to develop a framework to ensure that a balance between trust and information sharing is maintained when using ICT to manage supply chain relationships in the SA automotive industry. Data from 50 representatives from various

automotive supply chain organisations, as well as literature was collected and analysed and a framework was created based on the analysis findings. The strength of the proposed framework for automotive supply chains lies in its ability to encourage information sharing through the use of ICT to enhance trust.

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Abbreviations

AIS	Automotive Investment Scheme
APDP	Automotive Production and Development Programme
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
GDP	Gross Domestic Product
ICT	Information and Communication Technology
JIT	Just In Time
MIDP	Motor Industry Development Programme
OEM	Original Equipment Manufacturer
OIPT	Organisational Information Processing Theory
SCM	Supply Chain Management

Appendix A: Questionnaire

GENERAL INFORMATION

Dear Respondent

I am a student in the Department of Information Systems at the University of Fort Hare (East London Campus). I am currently conducting research for my MCom (Information Systems) under the supervision of Ms. Roxanne Piderit. The focus of my study is the impact of ICT on trust and information sharing in South African Automotive Supply Chains. The objective of this study aims to develop a causal model to ensure that a balance between trust and information sharing is maintained when using ICT to manage supply chain relationships in the SA automotive industry.

Instructions on the completion of this questionnaire will follow before each section. The questionnaire is designed to make completion as easy and fast as possible. Most of the questions can be answered by simply clicking on the appropriate option and the questionnaire can be accessed by clicking on the following hyperlink:

Note the following important points:

- This is an independent research study and participation is voluntary. Your responses will be treated as **strictly confidential** and the **anonymity** of companies and respondents is assured.
- No person or firm will have access to your completed questionnaire.

We look forward to your response.

Yours sincerely

Ms. C P Goche and Ms. R Piderit

SECTION 1

General Information

This section aims at obtaining the basic information of the respondent.

1.1 Position/title of person who completed the questionnaire:

1.2 What level is your organisation in the supply chain?

- 1st Tier Supplier
- 2nd Tier Supplier
- 3rd Tier Supplier

Other (Please Specify)

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1.3 Who do you supply?

- MBSA
- Toyota
- General Motors
- Volkswagen
- Ford
- Fiat
- BMW
- Nissan

1.4 What do you supply and how often?

What you supply	How often (in days or weeks)
<input type="checkbox"/> Tyres	

<input type="checkbox"/> Foundries	
<input type="checkbox"/> Leather tanners	
<input type="checkbox"/> Catalytic converter components	
<input type="checkbox"/> Catalytic converter assemblers	
<input type="checkbox"/> Engine and transmission parts	
<input type="checkbox"/> Body panels and trimming	
<input type="checkbox"/> Electrical spares and part spares	
<input type="checkbox"/> Brakes and suspensions	

SECTION 2

Factors influencing trust

This section focuses on investigating the determinants of trust with other supply chain partners.

2.1

	To what extent does the following describe your relationship with your supply chain partners?	Strongly Disagree	Disagree	Agree	Strongly Agree
1.	Your organisation has a good trusting relationship with key suppliers				
2.	Lack of trust with other supply chain members hinders your organisation from achieving desired results				
3.	Your organisation believes the information that is provided by partner suppliers				
4.	Your organisation has confidence in all its partner suppliers				
5.	Your organisation's belief regarding partner supplier's honesty influences the intention to share information with them				
6.	A long term relationship with partner suppliers influences the intention to				

	share information				
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SECTION 3

Barriers to Information Sharing

The main aim of this section is to find out the aspects that hinder effective information sharing, as well as the level and quality of communication between these supply chain partners.

3.1

	To what extent do you agree with the following statements as they relate to your organisation's supply chain?	Strongly Disagree	Disagree	Agree	Strongly Agree
1.	There is willingness to share information with other supply chain members				
2.	There is frequent and regular communication among supply chain members				
3.	There is respect for the confidentiality of information among the supply chain members				
4.	There is adequate infrastructure support for information sharing				
5.	Your organisation and partner suppliers share information that might be useful to all of them to establish business planning				
6.	Your organisation keeps partner suppliers informed about events or changes that may affect the business				

3.2 What communication channels does your organisation use to communicate and or share information with suppliers?

- Telephone
- Email
- Video conferencing
- EDI
- Bar Code Technology
- Expert Systems
- VMI
- Data Warehouse Technology
- RFIDs
- Network Technology
- Electronic Business

Other (Please Specify)

3.3 What type of information do you share with other suppliers? Please mention reasons if any why you share that type of information. (Please tick the relevant option(s))

Type of Information	Reason for sharing
<input type="checkbox"/> Strategic	
<input type="checkbox"/> Logistical	
<input type="checkbox"/> Tactical	
<input type="checkbox"/> Product-related	
<input type="checkbox"/> Inventory information	
<input type="checkbox"/> Order information	
<input type="checkbox"/> Process information	
<input type="checkbox"/> Information relating to customers	

Other (Please Specify)

3.4 Provide examples when you have withheld any information from your suppliers and provide reasons why.

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SECTION 4:

ICT Use to enhance Information Sharing and Trust

This section seeks to establish the technologies used for information sharing and their effectiveness in order to ensure coordination of the entire supply chain.

4.1

	Please indicate whether you agree or disagree with the following statements:	Strongly Disagree	Disagree	Agree	Strongly Agree
1.	Adequate ICT linkages exist with partner suppliers				
2.	Current ICT satisfy supply chain communication requirements				
3.	Your organisation is linked electronically with other supply chain partners to share information of mutual interest				

4.2 What supplier relationship problems and barriers does your organisation face with regards to trust and information sharing?

- Poor communication between you and your suppliers
- Lack of trust
- Withholding valuable information
- Information privacy
- Willingness to share information
- Reputation of the supplier

- Cost and difficulty of executing advanced systems
- Systems incompatibility
- Willingness to share information
- Sharing information is a possible interruption of the stability of power
- Perceived confidentiality of the information
- Mistrust of other supply chain partners

Other (Please Specify)

4.3 How do you feel ICT impacts on the trust-information sharing relationship with other suppliers?