BEYOND SUPPLY CHAIN MANAGEMENT: INVESTIGATING THE EXTENT OF BARRIERS TO INTERNET USAGE WITHIN SOUTH AFRICAN ORGANISATIONS' SUPPLY CHAINS.

JESSICA FRASER

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DECLARATION

I hereby declare that:

BEYOND SUPPLY CHAIN MANAGEMENT: INVESTIGATING THE EXTENT OF BARRIERS TO INTERNET USAGE WITHIN SOUTH AFRICAN ORGANISATIONS' SUPPLY CHAINS

I, the undersigned declare that the work contained in this thesis is my original work, that all the sources used or quoted have been indicated and acknowledged by means of complete references and that this thesis has not previously in its entirety or in part been submitted at another university for a degree.

……..

Jessica Fraser

August, 2007

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SUMMARY

BEYOND SUPPLY CHAIN MANAGEMENT: INVESTIGATING THE EXTENT OF BARRIERS TO INTERNET USAGE WITHIN SOUTH AFRICAN ORGANISATIONS' SUPPLY CHAINS

by Jessica Fraser

Study leader: Prof. G. H. Nieman

Department: Business Management

Degree: Magister Commercii

This research study seeks to identify possible barriers that may exist within supply chain organisations and prevent the full acceptance, integration and utilisation of Internet based information system technologies, as is required by the new information age. The barriers can possibly be behavioural in nature (in measuring the use of information technology applications), psychological (dealing with perceptions) or be based on organisational policies and technical know-how. By conducting an empirical research investigation into the perceptions of users at different levels of supply chain management activity, the intention is to help organisations capitalise on their investment in information technology systems by identifying barriers to its usage after implementation.

The hypothesis is derived from existing literature about business organisations' experiences and best practices, albeit it beyond the borders of South Africa. The respondents' perspective is tested in a questionnaire to determine the level of organisational Internet based SCM integration and information sharing in the current South African market. This survey was conducted over a period of four months and targeted 2568 respondents. Both qualitative and quantitative data analyses were used to improve the value of research findings.

The value of this research investigation is to assist South African supply chain management practitioners and researchers in competing with global players, since competitive advantage depends on competent supply chains in today's digital economy, according to Philip Kotler (2001: 3).

All the research objectives were achieved from the research sample data analysis. From the empirical research, the findings concern their search for lower prices, the payment receipt of money electronically and their order placement amongst others. The two underlying constructs that govern respondents' SC interaction and in particular their information sharing activities are confidence and confidentiality, however the null hypothesis cannot be rejected.

The results of this study and the contribution to the multi-discipline research area could be improved by future studies taking an even larger sample of the sample population to include more heterogeneous technology users in the study. This could facilitate the extrapolation of the results to the South African SCM market with more certainty.

OPSOMMING

VERBY VOORSIENINGSKETTINGBESTUUR: ‘n ONDERSOEK NA DIE OMVANG VAN STRUIKELBLOKKE IN INTERNET GEBRUIK IN SUID-AFRIKAANSE ONDERNEMINGS SE VOORSIENINGSKETTINGS.

deur Jessica Fraser

Studieleier: Prof. G. H. Nieman

Departement: Ondernemingsbestuur

Graad: Magister Commercii

Hierdie navorsingsprojek ondersoek moontlike struikelblokke in die gebruik van Internet gebaseerde inligtingstelsels en die volle aanvaarding, integrasie en gebruik daarvan in die voorsieningsketting organisasies, soos benodig word in die nuwe inligtings-era. Die versperrings kan moontlik toegeskryf word aan gedragsteorie van ondernemings (wanneer die navorser die gebruik van inligtingstelsels meet), dalk aan sielkundige persepsies of moontlik gebaseer wees op organisasiebeleid en tegniese vaardighede. ‘n Empiriese navorsingsondersoek is gedoen om die persepsies van verbruikers te meet op verskillende vlakke van aktiwiteit binne die verkrygingsketting, met die doel om besighede te help om hul beleggings in inligtingstelsels te herwin deur struikelblokke in die gebruik daarvan te identifiseer na inwerkingstelling.

Die hipotese is verkry vanaf bestaande literatuur omtrent ondernemings se ervaring en goeie praktyke, alhoewel dit soms van buite die grense van Suid-Afrika gebeur. Die respondente se perspektief word getoets deur middel van ‘n vraelys om die vlak van integrasie en die verspreiding van inligting te meet in die huidige Suid-Afrikaanse mark. Hierdie opname is gedoen oor ‘n tydperk van vier maande en het ‘n steekproef van 2568 respondente genader. Beide kwalitatiewe en kwantitatiewe data ontleding is gebruik om waarde by te dra met die navorsingsbevindinge.

Die belangrikheid van hierdie navorsingsondersoek is om Suid-Afrikaanse voorsieningsketting bestuurders en navorsers te help om mededingend te wees met oorsese spelers aangesien die voordeel afhanklik is van algehele bevoegdheid van voorsieningskettings in vandag se digitale ekonomie volgens Philip Kotler (2001: 3).

Die navorsingsdoelwitte is in sy geheel bereik vanaf die navorsingsteekproef data-ontleding. Van die empiriese navorsing is bevind dat Suid-Afrikaanse ondernemings hul Internet gebaseerde inligtingstelsels gebruik in die soektog na laer aankoopprys, om geld elektronies te betaal en te ontvang en om bestellings te plaas onder andere. Die twee onderliggende konstrukte wat voorsieningsketting interaksie en die deel van inligting beheer is geïdentifiseer as vertroue en vertroulikheid, maar die nul hipotese kan nie verwerp word nie.

Die bevindinge van die studie en die bydrae tot ‘n multi-dissiplinêre navorsingsveld kan verbeter word deur in die toekoms studies te doen met groter steekproewe om meer heterogene tegnologie verbruikers in te sluit. Dit kan die ekstrapolasie van uitslae tot die algehele mark van voorsieningskettings fasiliteer met groter sekerheid.

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CHAPTER 1

BACKGROUND TO THE STUDY

1.1. INTRODUCTION

"The importance of both information technology and supply chain management to organisational performance and competitiveness is widely recognised. However the small percentage of world class supply chain levels suggests that substantial barriers exist regarding integration of logistics activities and adoption of supply chain technology." *(Patterson, Grimm & Corsi, 2003:96)*

The aim of the research study is to investigate the self-reported extent to which South African firms are utilising their supply chain management (SCM) information technologies with their trading partners and to determine whether barriers exist that prevent them from benefiting from Internet based technologies. The *barriers* can possibly be behavioural in nature (in measuring the use of IT applications), psychological (dealing with perceptions) or be based on organisational policies and technical know-how. Put in simple terms, the question is whether organisations are utilising their supply chain management (SCM) information technologies to share information with internal and external partners and to integrate information technology systems over the medium of the Internet.

1.2. BACKGROUND AND LITERATURE REVIEW

According to Rogers (1995:10) who did extensive work on the diffusion of innovations (DOI), an innovation is any idea, practice or object that is perceived as new by an individual or organisation. The substantial financial investment involved with the implementation of new SCM information technology systems would be justified if the technology is fully accepted and utilised by the organisation. It is therefore in the best interests of organisations to identify variables that positively influence Internet based integration and information sharing amongst supply chain participants as well

as barriers that prevent it. The discussion that follows introduces applicable literature findings in order to derive the research questions and includes the following sub-sections in sequential order:

1.2.1. Supply chain management (SCM)

1.2.2. The digital economy challenges for SCM.

1.2.3. The technology acceptance model (TAM).

1.2.4. Derivation of the proposed research model and research questions

1.2.1. Supply chain management (SCM) arguments

According to Philip Kotler (2001:8), time and technological developments have changed the marketplace in which organisations operate to the extent that the digital economy is impacting on supply chain management practices. In the time span of 4 decades, between 1960 and the year 2000, the marketplace has evolved from focusing on lower price competition, to a focus on quality, business process re-engineering, logistics, information technologies and ultimately the convergence of all these into the current market environment (Kotler, 2001: 8). Since the start of the 21st century, it became necessary to investigate the logistics decision areas after implementation of information technologies, such as SCM systems. The research findings from different authors are briefly discussed in light of information communication technologies (ICT) and its impact on SCM, while also helping to formulate the current research approach.

According to Lancioni, Smith, Schau and Jensen (2003: 211), the extent of user perceptions must be tested at each of the different application areas where users are involved with supply chain management activities. These include activities of purchasing, inventory management, transportation, order processing, customer service, production scheduling and supplier relations management. They caution that a self-selection bias could be inherent in the findings since it was fashionable to claim Internet usage in 1999 when general Internet adoption was prevalent. The division of SCM activity levels was incorporated into the research instrument since it could improve the content validity of the research questionnaire's sub-divisions according to Diamantopoulos and Schlegelmilch (2002: 34).

It was found by Kim and Umanath (2004:814), that the fear of information overload could be a potential barrier to adopting SCM technology, since electronic media may overload decision makers in a supply chain with too much information. Kim and Umanath (2004: 814) derived a measure of electronic information transfer to assess how integrated business processes are between organisations, however the study was limited in that it did not extend to the use of digital technologies on the Internet. This research study is necessary to fill the gap and measure users' perceptions in light of the developments in ICT and digital technologies in South Africa, given that they have to liaise with and make decisions with their relevant supply chain participants on a daily, weekly and monthly basis.

Patterson, Grimm and Corsi (2003: 101) hypothesized that a SCM strategy should be integrated with corporate strategy in order to have significant impact on the pace of technology adoption. They also argue that supply chain partner pressure adds to the impact of technology adoption. The "significant impact" conclusions are not clear from the research findings. The main goal of the Patterson, et al, study was to develop a model of antecedents, but they recommend that further research be conducted to test the nature of the relationships on the decision to adopt or implement the supply chain technology. This research study therefore had to investigate the presence and form of antecedents, with the hope of identifying barriers to SCM technologies' acceptance and use.

It was concluded by Lin and Hsieh (2000: 107) that the fear of complex exchanges of technical and commercial information can lead to "issues" of technical compatibility. The fear of technical compatibility amongst supply chain participants could also be a possible barrier to acceptance of SCM technology and was therefore included in the research instrument.

1.2.2. Challenges of the digital economy for supply chain management (SCM)

The digital economy is defined as including all digital technologies and networks such as the Internet, intranets, extranets and private virtual networks (Turban & King, 2003: 23). The digital economy is also referred to as the Internet economy, the new

economy and the web economy. Business-to-business (B2B) e-commerce refers to transactions between businesses conducted electronically over the Internet and the aforementioned networks. Such transactions may be conducted between an organisation and its supply chain partners while trying to automate the trading process and improve it (Turban & King, 2003: 7). This research study aimed to include organisations that have implemented supply chain information technology management systems in the period between 1990 and 2006, in order to capture the evolution of the last two decades of marketplace development as discussed by Kotler above.

South Africa's introduction to the Internet was initially based on research and information exchanges between academic institutions, which took place about 20 years later than the Internet's inception in 1969. A number of research studies are conducted in business-to-consumer (B2C) contexts with online shopping studies, but this research study adds value by providing insight into South African business-to-business (B2B) SCM practices (Barnard & Wesson, 2003: unpublished).

The traditional practice of SCM has shifted to a more knowledge based discipline and while taking into account the organisational, business process and technical infrastructural aspects (Reddy & Reddy, 2001: 5); more needs to be said about what technology acceptance entails in order for the proposed research to be more meaningful.

1.2.3. The technology acceptance model (TAM)

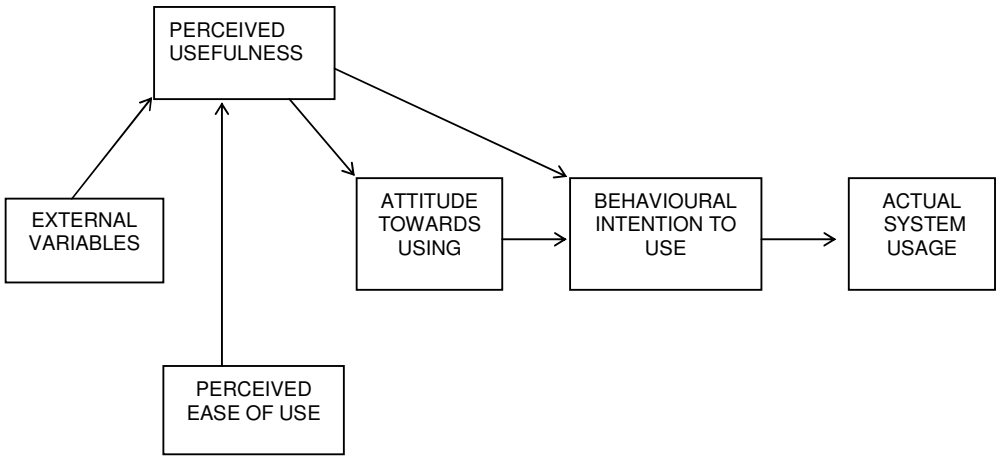
Previously mentioned was the Diffusion of Innovations (DOI) model by Rogers quoted in Brancheau & Wetherbe (2001: 117) as an individual person's adoption process. Innovation diffusion can be defined as the process by which an innovation is communicated through certain channels over time among the members of a social system in the same study. An assumption for this research investigation is that the time period of 17 years, spanning between 1990 and 2006 is sufficient for the diffusion of the Internet as an innovation for the South African society.

From the findings of DOI studies a derivative model called the technology acceptance model (TAM) was first derived by Davis, Bagozzi and Warshaw, (1989: 982) and used to test the acceptance of computer technology. The TAM also draws from the Theory of Reasoned Action (TRA) in their study with the original authors of the TRA being Fishbein & Ajzen in 1975, who in turn had studied the marketing discipline's consumer behaviour findings.

The TAM was intended to serve as a foundation for research on consumer behaviour or technology acceptance regarding mainly computers or the use of information technology and its main constructs are perceived usefulness (PU) and perceived ease of use (PEOU).

Figure 1.1 is an illustration of the TAM used by leading authors in their research (Davis, Bagozzi & Warshaw, 1989: 985; Davis, 1989: 326).

Figure 1.1: The technology acceptance model (TAM)



Source: Davis, *et. al* (1989: 985)

In Figure 1.1 above, the two constructs of perceived usefulness (PU) and perceived ease of use (PEOU) are determinants of the end user's attitude, and thereafter their intention towards using a technology. They (PU and PEOU) are in turn influenced by external variables. Davis *et al.,* (1989:985) concluded that PU has a more direct effect on behavioural intention to use computers than PEOU.

Research studies that followed on the original Davis study from 1989 and the derivation of the TAM, investigated other external variables that impact on technology acceptance. Hausman and Stock (2003:681) noted that adoption and implementation are two critical stages to effective technology adoption. He concluded that a better understanding of potential adopters as active decision makers and not as passive units is required. Active decision-making was taken into account in targeting respondents in the research study and therefore the decision makers at middle management level and above received questionnaires.

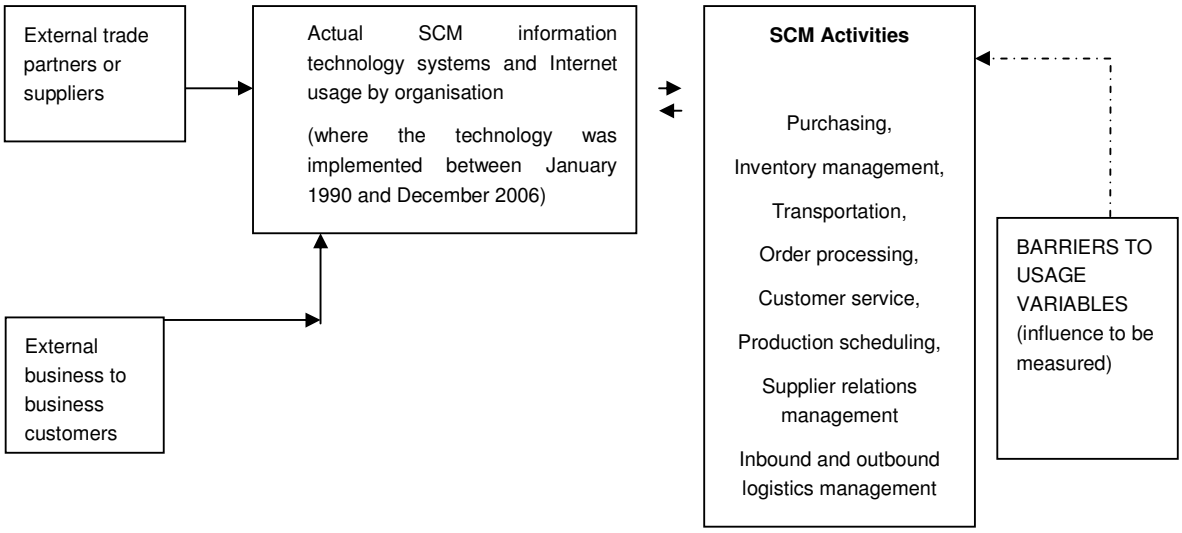
Immediately following the TAM publication in 1989, in a study conducted in 1990, Brancheau & Wetherbe investigated spreadsheet users' attitudes, satisfaction and usage. In the South African context, the use of spreadsheets has commonly been the traditional way of tracking different functions of SCM activities. Brancheau and Wetherbe (1990: 115) argued that user acceptance impedes information systems' success and if avoided, could improve performance on the job; however they found results for the relationship between usage and satisfaction ambiguous. In light of this, the relevance of the current research became more compelling, albeit with the inclusion of spreadsheet software as a usage question for the South African SCM respondents!

Figure 1.2 below incorporates the variables discussed here into the proposed research model in order to address the research gaps identified in the literature review chapters and in an attempt to establish which variables could currently act as barriers to usage after the decision has been made to implement SCM information technology (IT) systems.

1.2.4. Derivation of the research model

Based on the secondary research discussed above, Figure 1.2 below incorporates the supply chain management IT aspects, the challenges of the digital economy for SCM in light of the findings of the technology acceptance model.

Figure 1. 2: Depicting the research model followed in the current study



Note: the dashed arrow line implies the unknown relationship(s)

Source: original compilation.

1.3. THE RESEARCH PROBLEM

From the above introductory literature review, it appears that gaps exist in research that would allow business organisations to effectively adopt and use SCM information technologies (IT), especially those that are Internet based. The aim of the research study is to measure the extent of SCM technologies adoption, by looking at the various activity levels and thereby identifying possible barriers to implementation. The measurement was done by investigating the self-reported perceptions respondents have about the IT being implemented and used within their current SCM structures.

1.4. IMPORTANCE OF THE RESEARCH STUDY

The value of this research is to assist South African businesses in competing with global players, since competitive advantage depends on competent supply chains in today's digital economy according to Philip Kotler (2001: 3).

In the “old economy” (prior to the year 1990), the manufacturing industries focused on standardisation, scale, replication, efficiency and hierarchy, while the new economy is based on information industries which includes differentiation, customisation, personalisation, networks and speed (Kotler, 2001:5). Information based industries take the discussion beyond only the physical realm to the definition of the digital economy. The digital economy includes all digital technologies and networks: the Internet, intranets, extranets and private virtual networks (Turban & King, 2003: 21). In light of this, the research results can provide insight into South African supply chain and information technology practitioners with a basis of comparison with their international counterparts’ SCM practices.

Researchers can examine a number of future research opportunities from this study since it combines the disciplines of supply chain management studies, information technology acceptance studies and the challenges of Internet based electronic business to business interactions and research studies.

The value of the results could also shed some light on users’ normal way of interacting with their supply chain partners given that IT providers spend so much effort in making it possible to integrate the technologies and provide the business organisations with updated products and services within SCM.

1.5. RESEARCH OBJECTIVES

The research investigation attempts to answer questions regarding the use of Internet based information technologies (IBIT) within South African supply chain organisations. The questions are based on the areas of technology types, its uses within organisational functions, the size of the organisation using the IBIT, the level of integration with its partners and the information they share. The ultimate reason for doing this study is to attain the goals set forth by the following primary and secondary research objectives and the questions will be answered by conducting the empirical survey amongst South African business organisations.

1.5.1. Primary objective

The primary research objective is to identify barriers to the use of Internet based information technologies (IBIT) within supply chain management structures amongst South African business organisations' managers who represent the decision makers in this new economy. The barriers can possibly be behavioural in nature (in measuring the use of IT applications), psychological (dealing with perceptions) or be based on organisational policies and technical know-how.

1.5.2. Secondary objectives

The secondary objectives of the study, derived from the literature review are to:

- identify the types of information technologies currently in use amongst users in supply chain management.
- determine how often users from functional departments (finance, IT, purchasing, manufacturing, warehousing) use the Internet in SCM activities.
- investigate the relationship between organisational size and the use of Internet-based SCM technologies.
- investigate the level of integration between external SCM partners and the respondent organisation.
- investigate the amount of information exchange between partners in the supply chain.

In order to attain the primary and secondary objectives delineated above, the research methodology to be applied in order to obtain results is briefly explained next.

1.6. HYPOTHESIS STATEMENT

With the frame of reference provided in the literature review and the gaps regarding the unknown variables and their relationship to the adoption and use of SCM technologies within the digital economy of the Internet, the following research hypothesis is formulated. This allows the researcher to explain how the research objectives will be reached.

The null hypothesis (Ho) is the statement that we are trying to accept or reject by conducting the statistical analyses. If we accept Ho, we are automatically, by default, rejecting the alternate hypothesis. If we do not accept Ho, we automatically are accepting Ha, but the logic and reasoning of the results are more essential since merely proving that organisations are more or less similar proves nothing in the real sense. Therefore formulating the Null hypothesis is considered to be essential to scientific and applied research process.

Null hypothesis: Ho: There are no definite barriers that influence the adoption and use of supply chain management information technologies amongst users in business organisations.

Alternative hypothesis: Ha: There are definite barriers that influence the adoption and use of supply chain management information technologies amongst users in business organisations.

The hypothesis is disproved or not rejected by using a combination of descriptive statistics (frequency distributions and chi-square tests in cross tabulations) and significance tests appropriate for comparison of the variables investigated.

1.7. RESEARCH METHODOLOGY AND DESIGN

The complete discussion is captured in chapter 4 of the document. With reference to the research hypothesis and objectives above, the research study approach will allow the aspects of the problem of identifying the variables that positively influence the decision to accept, adopt or implement supply chain management technology to be studied in depth. The research study approach will allow the identification of each business organisation's common and unique features, which is important for the reliability (Diamantopoulos & Schlegelmilch, 2002: 36) and to show how these features affect the implementation and use of SCM technology systems.

1.7.1. Sample design

The nature of this research study necessitates restricting the number of variables and respondents investigated in order to save costs and restrict the scope of the research to a realistic and practical time frame (Cooper & Schindler, 2003: 149). By applying some judgment sampling criteria to the sampling design, where the respondents are selected based on a particular criterion such as being a manufacturing concern for example, a factor analysis will be done to check the reliability of the data collection (Cooper & Schindler, 2003: 201).

1.7.2. Data collection methods

Approximately 2568 electronic questionnaires were distributed via e-mail to senior level SCM managers over a period of four calendar months. The respondents include SCM and company functional level or activity level managers, in order to gain insight into the experience that the sample ascribes to SCM technology adoption and use.

The value of applying both the qualitative and the quantitative approaches to the proposed research is obtained from the fact that the study will follow a sequential manner of research reasoning according to Cooper & Schindler (2003: 151). Deduction, which deals with quantitative data, will be the process by which the hypothesis will be tested to see how effectively it explains the data obtained under the qualitative approach (Cooper & Schindler, 2003: 151).

The draft questionnaire was pre-tested amongst participants similar to the respondents in SCM practice, in order to make any necessary changes before it was administered to the research sample. The respondents' answers from the actual sample to these questions were used to test the hypothesis listed above (Cooper & Schindler, 2003: 151) and to measure the strength of the relationship between the variables being measured.

Refer to section 2.4 above in order to view the nature of the research model and the variables included in the research study. After conducting a more extensive literature review discussed in chapters 2 and 3, the questionnaire was closely linked to the hypothesis, variables and individual questions.

1.7.3. Data analysis procedure

In the first examination of the data findings descriptive statistics which include frequency distributions and cross-tabulations, was used to summarise both the qualitative and quantitative data and determine measures of location and variability. Data were entered into electronic form and the variables were analysed using statistical analysis software (SAS), under the guidance of statisticians.

A factor analysis was done to verify the validity of the questionnaire items. Factor analysis is done on measures of continuous scales in order to limit error variance and test the portability of the instruments in the South African context. (Cooper & Schindler, 2003: 252) Hypothesis testing about the null hypothesis stated in chapter 5. was done using the classical or sampling-theory approach, since a hypothesis can be rejected or fail to be rejected based on the sample data collected (Cooper & Schindler, 2003: 521).

Two-tailed tests were done at the 5% level of significance which was also dependent on the size of the sample, since *z*-tests apply to larger samples and *t*-tests are used when the sample size is significantly small. The sample obtained was larger than 30 respondents and could not be described as “small” from the t-tests point of view (Cooper & Schindler, 2003: 535).

Since all research investigations need to be formulated as applied research to be conducted in a scientific manner in the academic environment, appropriate controls had to be implemented to ensure reliability and validity of the research study (Diamantopoulos & Schlegelmilch, 2002:233) by using factor analysis to test validity and the Cronbach-alpha as a measure of reliability. The research methodology is discussed in more detail in chapter 4.

1.8. OUTLINE OF CHAPTERS

Chapter 1 is the introduction to the orientation and rationale of the research study. It presents the statement of the problem, research questions and hypothesis. In addition a brief discussion of the research methodology is included.

The literature review is divided into chapters 2 and 3. Chapter 2 explains the history and development of supply chain management and chapter 3 highlights the challenges of the digital economy for SCM.

Chapter 4 deals with the research methodology and describes the sampling design, data collection, the assessment of trustworthiness and the data analysis methods.

Chapter 5 contains the research findings, which present the analysis and findings of the study based on inferential statistics to confirm or reject the hypothesis.

Chapter 6 discusses the conclusions, limitations and recommendations of the study. It summarises the research findings, derives the implications of the findings, identifying limitations and recommendations. It also points out areas of future research.

1.9. CONCLUSION

In conclusion, the aim of the proposed research study is to investigate the extent of barriers to Internet based information technology systems as depicted by the technology acceptance and use of supply chain management (SCM) technology within the last 17 years (1990-2006) in selected South African organisations. The *barriers* can possibly be behavioural in nature (in measuring the use of IT applications), psychological (dealing with perceptions) or be based on organisational policies and technical know-how. By providing an in-depth investigation into the level

of technology acceptance within the current digital economy, it will be possible to help organisations strategise and capitalise on their investment in SCM technology by identifying both influential variables to adopt SCM technology based on the Internet as the transmission medium and possible barriers to the implementation and use thereof.

1.10. ABBREVIATIONS USED

The following abbreviations were used in this document and are listed in alphabetical order and not in the order in which they appeared.

3PL	third party logistics providers
ARPANET	advanced research project agency network
B2B	business to business
B2C	business to consumer
B2E	business to employee
C2B	customer to business
C2C	customer to customer
CERN	European particle science physics library
CRM	customer relationship management
CSM	customer service management
DC	demand chain
DCM	demand chain management
DOI	diffusion of innovations
e-books	electronic books
e-business	electronic business
e-commerce	electronic commerce
ECR	efficient customer response
EDI	electronic data interchange
EFT	electronic funds transfer
ELA	European Logistics Association
EM	electronic marketplace
e-mail	electronic mail
ERP	enterprise resource planning

e-tailers	electronic retailers
FedEx	Federal Express
G2B	government to business
G2C	government to consumer
IBIT	Internet based information technology
IT	information technology
JIT	just in time
LM	logistics management
MILNET	military network
MM	materials management
MPS	master production schedule
MRO	maintenance, repair and operating materials services
MRP II	manufacturing resources planning
MRP	materials requirements planning
NSF	national science foundation
PEOU	perceived ease of use
PU	perceived usefulness
SAS	Statistical Analysis Software
SC	supply chain
SCM	supply chain management
TAM	technology acceptance model
TCO	total cost of ownership
TRA	theory of reasoned action
VAN	value added network
VC	value chain
VMI	vendor managed inventory

CHAPTER 2

SUPPLY CHAIN MANAGEMENT

2.1. INTRODUCTION

The discussion in this chapter will start off with a basic introduction of supply and demand management concepts, followed by a short demonstration of the interrelatedness of the value chain and the supply chain. This is succeeded by a brief history of the development of the supply chain management (SCM) discipline. The discussion highlights some definitions from different authors on SCM and also revisits the Porter model to illustrate the value chain approach.

Business organisations have activities that assist SCM processes and may or may not have specific information technologies to facilitate processes. The chapter concludes with the reasons why the impact of information technologies on supply chain management should be discussed further in chapter three.

2.2. SUPPLY, DEMAND AND THE LINK BETWEEN THE VALUE CHAIN AND THE SUPPLY CHAIN

The historical progression of the supply chain management (SCM) discipline, starts off by discussing the concepts of supply and demand, followed by summaries on purchasing, materials management and logistics management. These disciplines form the components vital to the current practice of SCM. In order to achieve the objectives listed in chapter 1, such as identifying and examining business organisations that have implemented SCM information systems technologies in the 17 year period starting in 1990 until the end of 2006, more background is to be provided in this chapter about the necessity and interrelatedness of these business processes.

2.2.1. Supply and demand

In classic economic theory, scarce resources are transformed by a number of manufacturing business organisations (the supply) competing in a market to supply the unlimited needs (the demand) of buyers for products and services. In a perfectly competitive market, it is commonly accepted that the number of sellers (supply) will be able to produce the exact quantity of products and services that buyers want to buy at a specific price (demand). Grant, Lambert, Stock & Ellram (2006: 5) note that the competition has increased in consumer goods industries to the extent that many suppliers and manufacturers were shaken out and only a few leading suppliers remain.

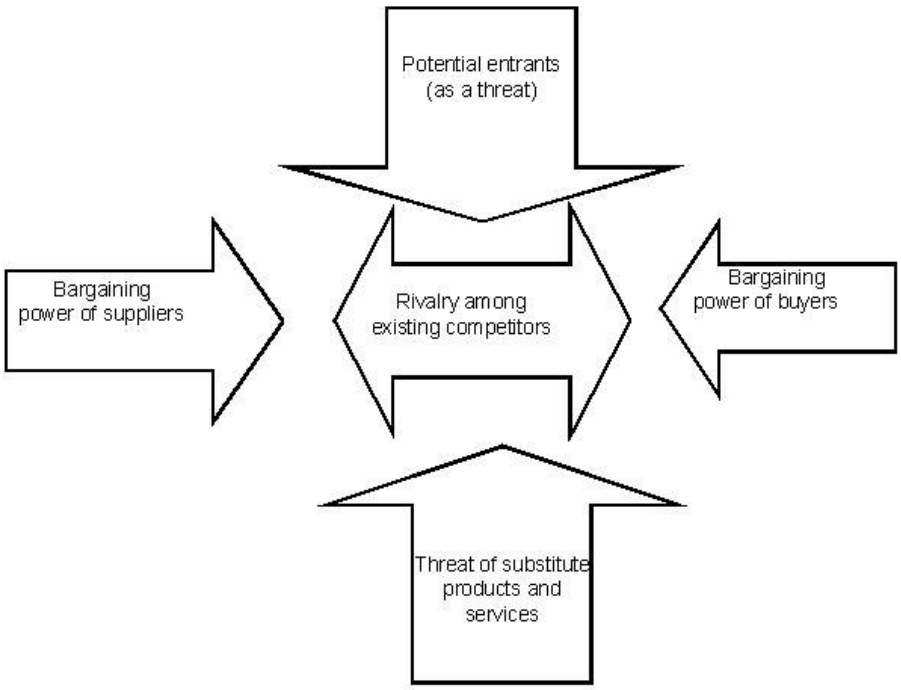
Michael Porter first introduced in 1980, the theory of a model of five competitive forces that influence industrial competition in the quest for market equilibrium (Van Weele, 2000: 11). The Porter model is based on the fact that industry in general consists of a network of organisations (suppliers), where players each perform a part in the process of converting primary raw materials into consumer products, in order to meet market demand. [This is similar to the value chain concept introduced later in Figure 2.2].

The Porter model, shown in Figure 2.1 below, depicts suppliers and buyers at two opposing ends, exercising their respective bargaining powers for competitive gains in a market environment. This model is in a state of dynamic (changing) equilibrium since end users or consumers see all leading brands as substitutes for each other and an unknown brand can decrease a manufacturer's bargaining power. However, this will in turn increase retailers' power since sales are determined by "what is in stock", regardless of what particular brands are offered (Grant, et al, 2006: 5).

The bargaining power of suppliers (on the left side of Figure 2.1), influences the costs of raw materials, hence the purchasing function in a manufacturing organisation is searching constantly for the "right" prices. The bargaining power of buyers can attempt to force prices down, thereby lowering profit margins for manufacturing

concerns since customers are demanding quality products tailored to their individual needs and tastes (Van Weele, 2000: 7).

Figure 2.1: Porter's model of competitive forces



Source: Turban & King (2003: 59)

The link between the forces in a particular industry and the choice of the production system in a particular organisation represents the course of action (its business strategy) that the organisation hopes will accomplish the objective of satisfying the customers (Coyle, Bardi & Langley, 2003: 689). This business strategy can be linked to the organisational strategy of developing superior technology (for example to manage a network of suppliers) with the aim to decrease the cost components and improve the organisation's industry position. This can lead to a better competitive market environment for the particular business organisation.

The Porter Model helps decide which components to include in the research study. If one assumes that both buyers and suppliers operate under economic theory and competitive industry forces, the empirical research study can be restricted to studying

the behavioural attitudes of the two important forces (i.e. buyers and suppliers), without trying to predict the threats of substitutes or new market entrants. Before the South African suppliers and buyers (i.e. business organisations who are customers) can be researched to determine their perceived attitudes towards the Internet and SCM information technology systems influencing their industry; further discussion is required on the value chain, the supply chain and the demand chain concepts.

2.2.2. The interrelatedness of the value chain, supply chain and demand chain.

The value chain (VC), supply chain (SC) and demand chain (DC) will be discussed individually first in order to understand what relation there exists between them later.

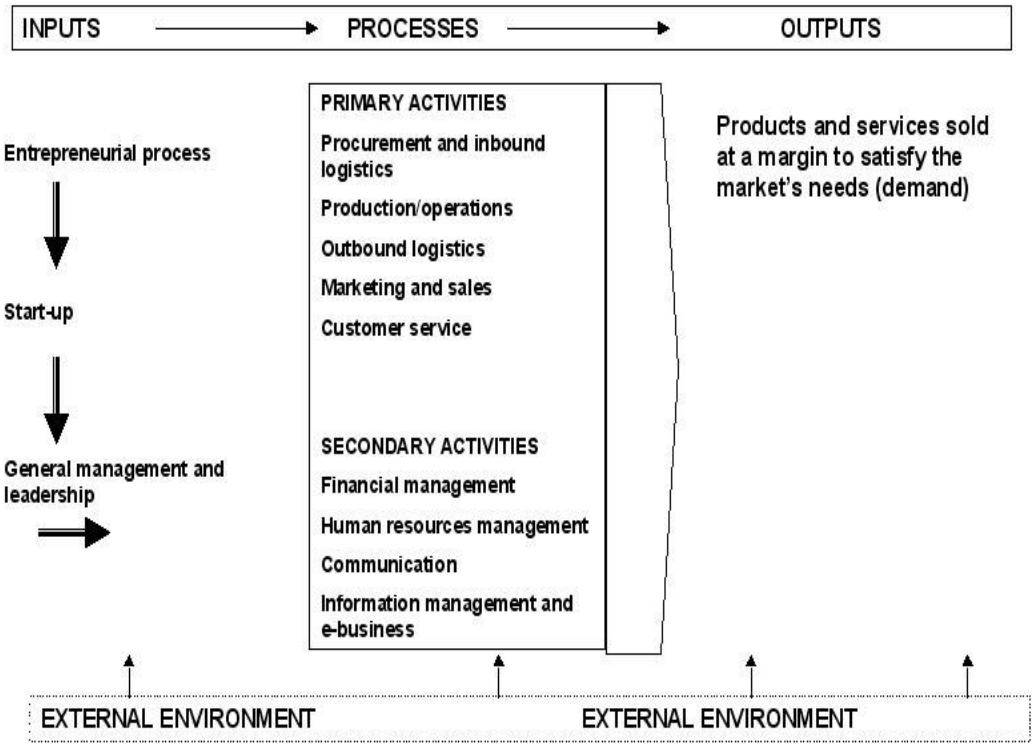
2.2.2.1. The value chain

The value chain is defined as a series of activities that a business organisation performs to achieve its goal(s) at various stages of its production processes. These activities can be divided into primary and support activities, different for each specific type of business but also able to be subdivided into more detailed processes (Van Weele, 2000: 11). A systems approach is followed, similar to the approach in information technology development, where inputs are required to be processed in order to yield outputs.

In the example of a manufacturing concern, Porter again sees inputs (such as raw materials and design specifications) as something to be utilised in a manufacturing process to produce products and their associated maintenance services. From the acquisition of the raw materials, each consecutive activity adds value to the business organisation's product of service thereby contributing to its profit. This sequence of activities seeks to enhance their competitive position in their market environment (Turban, 2003: 52). The typical value chain, where the systems approach is followed to add value in each subsequent activity and process, can be illustrated by Figure 2.2 below.

Figure 2.2 is presented on the following page.

Figure 2.2: The systems approach to add value in the value chain



Source: (Lessing & Jacobs, 2006: 16)

2.2.2.2. The supply chain

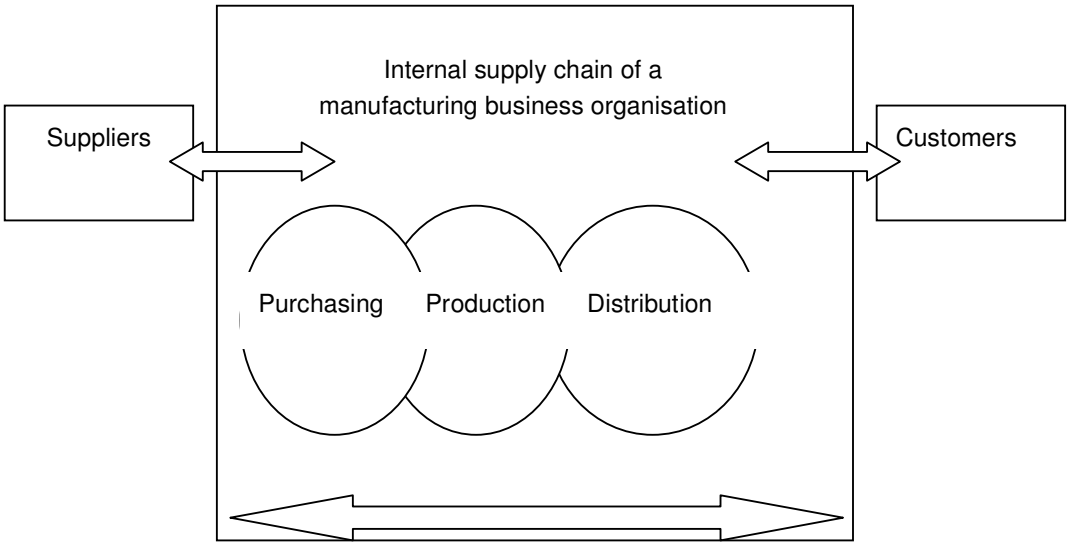
The supply chain in contrast, is seen as a combination of different organisations' entire value chains and will depict the flows of materials, money and information that support the execution of value-adding activities (Turban & King, 2003: 53). This concurs with the view of Chen (2004: 132), that a typical supply chain that has suppliers on the extreme left hand side and customers on the extreme right-hand side, is simply a network of materials, information and services processing links with the characteristics of supply transformation and demand.

The view of a supply chain with three flows consisting of information, money and material is the view of Monczka, Trent and Handfield (2002: 4) who state that the

supply chain encompasses all activities associated with the flows and the transformation of goods from the raw materials stage (extraction) through to end users, as well as the associated information flows. Material and information flows both up and down the supply chain. The supply chain includes systems management, operation and assembly, purchasing, production scheduling, order processing, inventory management, transportation, warehousing and customer service. Supply chains are essentially a series of linked suppliers and customers; every customer is in turn a supplier to the next downstream organisation until a finished product reaches the ultimate end user. Supply chain management (SCM) is the integration of these activities through improved supply chain relationships to achieve a competitive advantage (Monczka, et al., 2002: 4).

The typical supply chain according to Chen (2004: 132) is illustrated in Figure 2.3 below. Note that Chen concurs with Monczka et al, that the directional flow has changed for both suppliers and buyers/customers from the unidirectional flow illustrated in Figure 2.2 above, to become a supply chain with a bidirectional flow as illustrated in Figure 2.3 below.

Figure 2.3: A typical supply chain of a company



Source: Chen (2004: 132)

Figure 2.3 demonstrates that, behind the scenes, suppliers will follow their internal value chains successfully or economically, before being able to slot into the supply chain of other manufacturing business organisations. The outputs of the supplier network will, in turn, become the inputs for the manufacturer to run its internal value chain (with primary and secondary activities combined in a sequential process). Once all its value-adding activities are completed successfully, the business organisation can present its products and services to its market, consisting of customers. These customers are large organisations within a business to business supply chain scenario, and without the necessary information (such as pricing, quantities and quality) being internally administrated and processed for their respective internal value chains, there would be no successful transaction. Information exchange is therefore a vital ingredient to business organisations.

The supply chain concept that utilizes the systems approach to conducting business and combines internal value chains of organisations to convert inputs into manufactured outputs, has been criticised as being too harsh on (unsuspecting) customers. The traditional supply chain is seen as “pushing” products onto the market (like Henry Ford, who allowed customers any car they wanted; as long as it was black), instead of giving the customers more choice in what they demand. If customers play a bigger role in deciding what needs to be produced and how, the supply chain concept is replaced by the notion of a demand chain that is briefly discussed next.

2.2.2.3. The demand chain

The demand chain is communication of the projected market demand as a critical component of the success of the supply chain according to Simchi-Levi, Kaminsky & Simchi-Levi (2003: 200). Erevelles & Stevenson (2006: 481) see one of the central themes of SCM as being the creation of customer value, which means that effective SCM is buyer driven, not supplier driven. It means that organisations should understand the buyers’ needs and work backward along the supply chain from the

end user through channel intermediaries, back towards material suppliers. This customer orientation is characteristic of a marketing focus and the call for integration between marketing and SCM is heard from Juettner, Christopher and Baker (2006: 3), who sees Efficient Customer Response (ECR) as the interface between SCM and marketing, a view supported by Simchi-Levy, *et al* (2003: 239) who says that SCM is the organisation's ability to respond to customer requirements

This concept of demand management (DM) is also seen as a marketing-related business process that SCM must manage across the supply chain and Juettner *et al* quotes Lambert & Cooper (2006: 3) as they integrate SCM and other key business processes by combining DM with customer service management (CSM) and customer relationship management (CRM). Demand management is further extended towards demand chain management (DCM) by Rainbird in Juettner *et al* (2006: 5) who views it as an understanding of current and future customer expectations, market characteristics and of the available response alternatives to meet these through deployment of operational processes. This suggests an overlap between the demand and the supply processes and reinforces that DCM is the true concept that aims to integrate demand and supply oriented processes within a business organisation.

Rainbird in Juettner *et al* (2006: 8) argues that the fusion between demand and supply process integration can be achieved through applying management principles, specific organisation capabilities or technology. The demand chain approach will be revisited in chapter 3 where the discussion on how information technology within SCM can facilitate the organisation's desire to allow customers' demands to be incorporated into business organisations' supply chains. Right now it is necessary to examine more closely the smaller components of the supply chain discipline, by briefly discussing the history and evolution of SCM.

2.3. THE HISTORY OF SUPPLY CHAIN MANAGEMENT (SCM)

Several concepts that were developed in several different disciplines such as marketing, information systems, economics, system dynamics, logistics, operations management and operations research contribute to SCM as it is known today (Fiala, 2005: 419). Some of these are beyond the scope of this research therefore only those concepts relevant to developing the research objectives and the research questionnaire are included. With reference to the marketing focus of demand management above, purchasing will be a great point of reference to delve into the history of supply chain management (SCM).

The development of the SCM discussion starts off with the purchasing function, followed by the progression from materials management (MM) and logistics management (LM) towards SCM. By following the development of SCM through time, it is noted that at each particular stage of business process evolution, the processes used specific technologies that connected them and facilitated the completion of the business function or value-adding activity.

2.3.1 Purchasing

The discussion on purchasing starts with periods of purchasing history, followed by the classification of goods purchased, the purchasing cycle and tactical versus strategic sourcing. It concludes with the integration of relationships, information exchange and the issue of trust.

2.3.1.1. Purchasing history

In early years of purchasing history (around 1850) the purchasing function was such a major contributor to the performance of the organisation that the chief purchasing manager had top managerial status (Monczka *et al.*, 2002: 13). Between 1900-1939 and 1940-1947, purchasing gained importance as being vital to obtaining war materials during World Wars I and II respectively (Monczka, *et al.,* 2002: 13). In the quiet post-war period of 1948-1960s, purchasing was seen as simply an inescapable cost of doing business, which no one could do much about. During this time the Ford Motor company's purchase analysis department started to analyse products and

prices. This purchasing analysis later became the value analysis technique, which could determine which materials or changes in specification could reduce overall product costs (Monczka, *et al.* 2002: 14). During the materials management era of 1960s-late 1970s, firms experienced oil shortages during the Vietnam War and purchasing managers emphasised multiple sourcing through competitive bid pricing. Buyers then still maintained arms length relationships with their suppliers and rarely viewed them as value-added partners (Monczka, *et al.* 2002: 14).

This level of relationships at a distance proved to be inadequate when global competitors emerged amidst the 1980s recession. A global view of purchasing was required to counter the Pacific Rim Tigers (companies) who offered quality at lowered costs in order to capture market share. Technological change and innovation happened to products and purchasing activities until the late 1990s were based on international data networks (Monczka, *et al.,* 2002: 16). In the years from 2000 onward, the call is for purchasing to integrate more with customer requirements as well as with other primary and supporting functions within the business organisations (Juettner, *et al.,* 2006: 3, Monczka, *et al.,* 2002: 16).

2.3.1.2. The purchasing classification of goods

Van Weele (2000: 94) says that there are 4 core responsibilities of the purchasing function that includes in the first instance, to contribute to the continuity of the company's primary activities (or internal customers). Secondly, purchasing should control and reduce all purchasing related costs, which will in turn lead to the lowest total cost of ownership (TCO). Thirdly, purchasing should reduce the company's exposure in terms of becoming too dependent on certain suppliers and technology. As such, the purchasing requirements should be spread among different suppliers. Fourthly, purchasing should contribute towards product and process innovation. However, before purchasing can deliver on the four core responsibilities it is entrusted with, it is necessary to look at exactly what is being purchased by a business organisation.

Purchased materials and services can be grouped into the following 8 categories: raw materials, supplementary materials, semi-manufactured products, components, finished products, investment goods (capital equipment), maintenance repair and operating materials (MRO) and services (Van Weele, 2000: 22). These categories are sometimes aggregated to simpler categories according to Grant, *et al.* (2006: 101), who argues that some purchases are routine, ongoing purchases and others are new or infrequent.

In order to understand the more comprehensive categorisation, the Van Weele categories are explained here. The first category consists of raw materials that are materials in minimally transformed state that serve as the basis for a production process and include examples such as iron ore, copper and grains. The 2nd category of supplementary materials are not physically absorbed into the end product but are consumed during the production process such as lubrication oil and cooling water. The 3rd category of semi-manufactured goods, are goods that have been processed before and since it forms part of the end products, it will be processed again. Examples of these semi-manufactured goods include steel plates and plastic foils. The 4th category consisting of components that are purchased to the exact specification of the customer or buyer, are called specific components and they will be joined with other functional components into the end products. Standard components (such as lamps and batteries) are produced according to the specification of the supplier and will also form part of the end product of the purchasing organisation.

The fifth category of purchased goods are finished products (Van Weele, 2000: 22). These products are goods that the buyer will resell at a mark-up and as an example could be the accessories that accompanies the newly manufactured cars. By far the most expensive items to purchase are those categorised as the 6th category consisting of investment/ capital goods. These products are not consumed immediately, but their purchasing value is depreciated over time. In this category, purchasers buy machines used in the production process, computers and even buildings.

The seventh category, maintenance, repair and operating materials (MRO) are also referred to as indirect/consumable items. These are purchased to keep the organisation operational and include office supplies, cleaning materials and spare parts. The 8th and last category of goods and services being purchased, is the intangible category of services to be executed by third parties. This includes experts such as engineering contractors, the very necessary cleaning services and includes the use of temporary labour (Van Weele, 2000: 22).

Since some of these categories involve the co-operation of other departments such as production planning and quality control, it seems reasonable to expect some relationship to exist and for some interaction to occur between purchasing and other functional departments of the organisation (Van Weele, 2002: 24). Sometimes the decision to make or buy certain goods and services place greater demands on suppliers and therefore the purchasing function has to perform to high standards. It is therefore necessary to look at the difference between industrial and consumer buyers and more closely towards the value of information documented and exchanged during the purchasing cycle.

2.3.1.3. The purchasing cycle and the value of information

The purchasing cycle mostly is applied to buying or purchasing organisations and they are known to purchase from other organisations much more than buying from individuals. When businesses buy from each other the phenomenon is known as organisational buying or industrial buying, whereas individual persons are seen as consumers. Industrial buying or business-to-business (B2B) transactions involve large quantities of goods and services and therefore large amounts of money, necessitating that the purchasing decision will be made by one or more professional buyers (Van Weele, 2000: 30).

Since the demand for goods and services to be purchased by the business organisation is derived from changes that occur in the end user (consumer) markets, there exists a mutual interdependency between the buyers and the sellers and

therefore long term interaction and relationships are formed (Grant, *et al.,*2006: 100). In contrast, end users or consumers are not necessarily interacting with the suppliers in their pursuit of personal, impulsive and more emotional need satisfaction (Van Weele, 2000: 29). The consumers' buying behaviour involves recognising their individual needs and searching for information that can assist them in the purchasing decision. Consumers will evaluate the different alternatives presented to them, make a selection and purchase in a short space of time relative to an organisational buyer (Rayport & Jaworski, 2004: 85). The only post-purchase activity consumers engage in, would be to look for reinforcement of their purchasing decision (cognitive dissonance) even though they spent relatively less money than a business organisation would. In future they may or may not require after-sales service/maintenance to be provided by the supplier for the category of good/services that they purchased.

The B2B objective for purchasing is to enable production, therefore will be more rational and involve discussions and negotiations between industry professionals. Although there are similar steps to the search for information amongst consumers and professional buyers, the amount of information exchanged pre-purchase, during purchase and post-purchase differ considerably. This information is captured in documentation accompanying the different steps included in the purchasing process or the purchasing cycle (Van Weele, 2000: 31, Hugo, 2000: 23).

The B2B purchasing function has a continuous purchasing cycle consisting of a series of consecutive purchasing activities to be performed for each purchasing transaction. This purchasing cycle consists of the consecutive steps illustrated in Table 2.1 below, according to Hugo (2000: 23). Each step is associated with documents that communicate the information required for the organisation to proceed to the next step of the purchasing cycle. According to Van Weele (2000: 31) the industrial buyer would define a specification, select a supplier, agree on a contract, order, expedite and evaluate in its purchasing management function. Hugo breaks the purchasing process up into twelve different steps within the purchasing cycle (Hugo, 2000: 17).

Table 2.1: Flow diagram that depicts the steps in the purchasing cycle and documentation associated with every step.

Consecutive steps in the purchasing cycle	**Documents used at every step of the purchasing cycle**
1. Origin of the need	Materials resource planning (MRP) and KANBAN*
2. Description of the need	Requisition, travelling requisition, materials and specifications list
3. Selection of suppliers	Register of suppliers
4. Determining prices and availability	Price list, catalogues and written quotations
5. Placing the order	Order form, lists of specifications
6. Following up and expediting	Reminder note or letter
7. Receipt and distribution	Order form, delivery note, receipt
8. Inspection	Inspection report
9. Handling of faulty consignments and rejections	Order form, consignment note
10. Analysing the invoice	Order form, delivery note, receipt and invoice
11. Closing the order (payment)	Order form, delivery note, invoice and cheque
12. Maintaining files and records	All the above documents are stored and maintained.

Source: Hugo (2000: 17)

On average, business organisations follow between seven and ten steps for their purchasing cycles, although it is possible to have steps additional to Table 2.1. above. Materials lists, which fall under material resource planning (MRP) in step 1 of the purchasing cycle depicted above, will be explained in the section below (section 2.3.2.). Also mentioned in step 1 above, *KANBANs are information cards forming part of the just-in-time (JIT) system (originally from Japan) that provide suppliers with a clear description of the business organisation's need (Hugo, 2000: 25, Van Weele, 2000: 21). KANBANs form part of the business organisation's internal information technology system, which can possibly be linked to the electronic automated information technology systems of a business' intranet, which is discussed later in chapter 3.

In any purchasing cycle, the various steps involved (describing orders, comparing prices, confirming availability, receipts, handling and payment, amongst others) require a large number of supporting documents and forms (Hugo, 2000: 23). The discussion in chapter 3, will investigate further the introduction of the electronic data interchange and the Internet amongst different trade partners, which eliminated or altered some of the purchasing procedures and thereby minimised the risk of errors in the transfer of purchasing transaction information flows (Grant, *et al.,* 2006: 116). Therefore, for the purposes of this research investigation, it is assumed that the rest of the documentation is important only from the perspective of whether they are handwritten (manual system) or electronic (automated system). It is also only important to make the distinction whether their creation, distribution and storage is manual or automated; therefore the document types will not be explained further here. There is however, more to be said about the information generated by the purchasing cycle.

Any supply chain has flows of goods, money and information based on the derived demand forecasted for the end user market. Purchasing involves information exchange on costs, inventory levels, lead times and delivery times (Simchi-Levi, *et al.,* 2003: 101). In trying to eliminate the bullwhip effect of fluctuating and distorted inventory levels regardless of the fact that customer demand for specific products

does not fluctuate in the same way, suppliers are reliant on quantifiable information to accommodate the variability along the supply chain (Simchi-Levi, *et al.*, 2003: 105). Information sharing can improve co-ordination between other supply chain processes to enable material flow and to reduce inventory costs (Li & Lin, 2006: 2), but this is not as manageable for organisations since information technology can be implemented easier and is more measurable than managing inter-organisational relationships (Li & Lin, 2006: 13).

Before business organisations select the suppliers they want to have a relationship with, they will gather information from internal departments that will assist them in making the right decisions. By taking this information flows into account, the buyer is guaranteeing a more innovative-oriented supplier according to Schiele (2006: 925). This innovative supplier can send market intelligence as a forward information flow to the buying organisation for example on new materials (Grant *et al.*, 2006: 98). The information flows that purchasing takes into account originates from and flows towards the following internal functions, listed in Table 2.2. in no particular order (Grant, *et al.*, 2006: 102).

Table 2.2 is presented on the following page.

Table 2.2: Overview of internal information flows involving purchasing

Function/Department	Information type
Accounting/ finance	▪ Budgets ▪ Commitments ▪ Costs/prices ▪ New product service costs
Quality	▪ Supplier quality history
Engineering/ research & development	▪ Suppliers available ▪ Supplier history ▪ Early supply involvement
Top management	▪ Expenditures ▪ Strategy
Stores	▪ Orders placed ▪ Items being phased out
Operations/ Manufacturing	▪ Availability of materials ▪ Lead times
Logistics	▪ Inbound transportation requirements ▪ Orders requiring warehousing
Public relations	▪ Inform of small, women, minority-owned businesses ▪ Notify of major sourcing changes
Legal	▪ Contractual commitments
Users	▪ Order status ▪ Trade-offs present
Information systems	▪ Information requirements including new technologies ▪ Linkages with suppliers
Marketing/ sales	▪ Costs of special promotions ▪ Market conditions

Source: Grant, *et al*. (2006: 102).

Information exchange would appear to be a motivator towards integration amongst supply chain partners, although Olhager & Selldin (2004: 358) argue that it is easier for organisations to integrate upstream towards their suppliers, rather than downstream towards end users. Monczka, *et al.* (2002: 8) agrees with this view and sees partner integration as the role of a purchasing manager who was initially involved in selecting the upstream supplier base. Purchasing managers therefore can liaise between internal stakeholders and provide relevant information upstream that can assist in supplier performance and relationship maintenance. More about integration and information sharing after looking at the two types of purchasing functions discussed below.

2.3.1.4. Tactical versus strategic sourcing

The entire purchasing cycle process discussed above, with all of its steps to be completed, is referred to in organisations as being the "purchasing function" (Monczka, *et al.*, 2002: 11), but these activities can also be regarded as tactical purchasing or procurement. The purchasing function includes the whole process of deciding and specifying the right goods and services to buy, in the right quantities, at the right time, from the right sources and by what procedures in order to manufacture products and services to meet market demand (Hugo, 2000: 9, Grant, *et al,* 2006: 96). The purchasing function includes the implementation of these decisions and procedures by requisitioning, authorizing, ordering, receiving and paying for these purchases.

Monczka, *et al*. (2002: 11) distinguishes another form of purchasing as being strategic sourcing, which is broader in scope than tactical purchasing. It involves managing, developing and *integrating* with supplier capabilities to achieve a competitive advantage. Advantages may be gained through cost reduction, technology developments, quality improvements, cycle time reduction and improved delivery capabilities to meet customer requirements. Grant, *et al* (2006: 96) agrees that purchasing can become strategic by taking into account what the organisation's

strategic goals and direction are, thereby contributing towards total customer satisfaction. This research study will incorporate what Monzcka, *et al* identified as integration and technology developments as part of the South African research study.

The purchasing function is sometimes referred to as the procurement function, when it is extended towards the more strategic and process-oriented level (Grant, *et al*., 2006: 96). However, in Gattorna (2002: 18) it is argued that the purchasing function is narrower than the procurement concept since it applies only to the transaction functions of buying products and services at the lowest possible price. Procurement is seen as involving also the materials management of goods and is discussed further in section 2.3.2.

The business reasons for the purchasing function would include the increasing need for an assured supply of raw materials and a reduction in the costs of these requirements (Hugo, 2000: 11; Grant, *et al*., 2006: 96). Regardless of the efficiency achieved by decreasing purchase costs and thereby improving business organisations' profit margins, all purchasing transactions are not equally important and therefore the research investigation must be limited to those transactions that form an integral part of the business organisation's value chain. The research investigation is therefore limited to the extent that it will *not* make any distinction between purchase transactions that are new, modified buying-again decisions and/or straight repeat purchasing (Hugo, 2000: 17).

2.3.1.5. New developments to integrate purchasing

In view of the preceding discussion on the principles of economic theory (supply and demand) and assuming there is a value chain in place for business organisations, the purchasing function is discussed as a supporting activity to the business organisation's value chain (Van Weele, 2000: 11). Yet, the call to integrate purchasing with customers and other primary and supporting business activities by Monczka, *et al.* (2002: 16) means investigating all three flows of goods, money and information flows as the areas of possible integration efforts.

The need for clear and professional communication on the company's purchasing policies is increasingly being recognized by the mainly larger companies (Van Weele, 2000: 96). According to Van Weele (2000: 95) the company's image is influenced by what it communicates to its suppliers, which should also be one of a fair and open sense of responsibility that meets the contractual obligations towards the suppliers. The importance of communication from the buyers' side is also reinforced by virtue on its impact on communication and trust amongst supply chain partners. This is in agreement with Schiele (2006: 930) who says that the buyer and supplier can work on joint improvement programs successfully when the buyer (purchaser) sees commitment by the supplier and if inter-firm communications function on a trusted level.

The question of interest regarding B2B buyers in South Africa concerns their respective information flows. This research study wants to determine how accurate, error-free and timely the documentation (and therefore the information) accompanying each step of the purchasing cycle is perceived to be by the managers currently trying to run their business organisations competitively. The research question deals with how they perceive the impact of SCM information technology (such as the Internet) on the purchasing function.

Over time, the purchasing department of business organisations became responsible for long- term supplier relationships, dealing with faulty consignments and quality management. It is therefore important to see whether the purchasing departments of business organisations in South Africa, are also able to significantly influence the decisions on the types of SCM information technologies used in managing the supplier/ purchaser relationships. The question is also whether external vendors can impact the implementation and use of specific SCM information technologies more significantly than the production concerns (buyers) can.

Regardless of the lengthy discussion on purchasing, it is important to note that not only the purchasing activities will be investigated in this research. Recall that the

research focus is not on policies regarding purchasing, but rather on perceptions about SCM information technologies that may possibly influence purchasing decisions made by business organisations' managers.

The questions regarding whether the goods and services purchased deal with new, modified or re-buy decisions is also not relevant to the research study. Documentation and the information that is carried are important only from the perspective or whether it is generated by manual or automated means and whether it is paper-based or in electronic format. The discussion moves on to the next level after purchasing, which is the materials management (MM) aspect of business organisations in order to investigate how it has evolved over a number of years.

2.3.2. Materials management

After the business organisation successfully purchased its raw materials and other input resources, their goal to efficiently manage the supply of these materials to operational activities and processes, is known as materials management (Hugo, 2004: 34). The importance of proper management of materials is highlighted by the fact that they account for substantial portions of project costs and time, regardless of whether it is in the manufacturing or in the construction industry (Ibn-Homaid, 2002: 263).

Materials management (MM) is defined as the utilisation of an integrated management approach to the planning, acquisition, conversion, flow and distribution of *production materials* from the raw material stage until the finished product (Hugo, 2004: 34). This is in agreement with Grant, *et al*. (2006: 174) that says MM consists of four activities that includes, anticipating materials requirements, sourcing and obtaining materials, introducing materials into the organisation and monitoring the status of materials as a current asset. Although MM includes a variety of logistics activities, these will be discussed later in this chapter and sufficient discussion on the topic of purchasing means it does not need to be repeated here. Traditionally one manager's managerial role would have included the responsibility for the planning,

organising and control of all the activities associated with the flow of the materials required for the production process.

This single MM manager referred to above, needed to use materials requirement planning (MRP), which was developed in the 1960s by Orlicky and Wright (Hugo, 2000: 56) because traditional materials management systems and inventory management could not solve the problem of overstocking in manufacturing concerns. MRP is considered to be one of three alternative approaches for managing manufacturing materials, whereas the other two are inventory management and just-in-time (JIT) according to Ibn-Homaid (2002: 264).

The JIT system is suited for where demand is continuous and dependent, while MRP is more appropriate where demand is discontinuous, dependent and non-uniform (Ibn-Homaid, 2002: 264). It is said that inventory management is better than MRP and JIT (where materials and products become available at the very moment they are needed for production); provided that it is managed by a supplier who monitors a buyer's warehouse (the purchasing organisation) and the suppliers assumes responsibility for replenishing that inventory to achieve specific targets. This is called vendor-managed inventory (VMI) and is aimed at achieving less information distortion between buyer-supplier partnerships (Dong & Xu, 2002: 76).

The MRP system consists of logically defined procedures, decision rules and records designed to translate a master production schedule into time-phased net requirements. This implies that materials requirements planning starts with the sales plans that provide estimates of potential sales volume. High level product groups compare sales' plans with finished stock produced and extract more accurate data for volumes to be produced. In the Master Plan, the customer orders, the sales plan, finished stock, and the production and purchasing plans are linked together (Van Weele, 2000: 195). The resources needed to realize the Master Plan are recorded in the Manufacturing Resources Plan, also known as MRP-II, and the required composition of manufacturing resources is derived. Specific, quantified, materials requirements are derived from the Master Production Schedule's (MPS) translation of

the master plan. The MPS will be tested for capacity limitations before the MRP can map out the MPS requirements according to bills of materials, etc. (Van Weele, 2000: 196). Orders are released and managed according to priority levels and work-in-progress managed. Please note that the recipients of the MM efforts are the production or manufacturing group and other internal customers, not the end user customers (Grant, *et al.*, 2006: 174).

Although it is not known at this stage what the business organisations in South Africa currently use in their materials management, it is important to note that the original MRP system from the 1960s has evolved to become the more advanced version called MRP-II. Currently these MRP-II systems have grown beyond the traditional system that was used exclusively for manufacturing purposes.

The evolution meant that in systems where information was based only on physical quantities, it now has to include information based also on financials. This means that an MRP II system today can incorporate not only financial management, but also purchasing management and marketing management (Hugo, 2000: 58, Van Weele, 2000: 198), alongside its traditional manufacturing orientation. It remains to be seen from the findings of the research study how business organisations have integrated their materials requirements planning to include other organisational functions in the new information-based economy, but more importantly whether it is based on Internet accessibility.

The application of MRP systems is however limited to (small and large) series and process production according to Van Weele (2000: 198). This means sales forecasts have to be reasonably accurate for it to be effective and if organisations are receiving customer specific orders, information on quantities and timing varies and they may take on a project approach to production instead of the MRP method (Ibn-Homaid, 2002: 264, Van Weele, 2000: 198).

The discussion and evolution towards the current practice of SCM takes on a new turn, by going another step further towards the topic of logistics management.

2.3.3. Logistics management

Logistics management stems from military organisation used in the time of Louis XIV of France and entailed the rationalised consideration of the transportation and supply of materials, food and ammunition (Van Weele, 2000: 192). In the twenty-first century, logistics is viewed as part of management and has four sub-divisions according to Coyle, *et al.* (2003: 39). The four sub-divisions are business logistics, military logistics, event logistics and service logistics. Business logistics entails that part of the supply chain process that plans, implements and controls efficient, effective flow and storage of goods, services and related information from, point of origin to point of use or consumption in order to meet customer requirements. Military logistics entails the design and integration of all aspects of support for the operational capability of the military forces and their equipment to ensure readiness, reliability and efficiency.

Event logistics is the network of activities, facilities and personnel required to organise, schedule and deploy the resources for the event to take place and to efficiently withdraw after the event. Service logistics is seen as the acquisition, scheduling and management of the facilities/assets, personnel and materials to support and sustain the service operations or business. Therefore the general definition of logistics that appears to incorporate all four sub-divisions is the following:

"Logistics is the process of anticipating customer needs and wants; acquiring the capital, materials, people, technologies and information necessary to meet those needs and wants; optimising the goods- and service producing network to fulfill customer requests; and utilising the network to fulfil customer requests in a timely way." *(Coyle, et al., 2003: 40)*

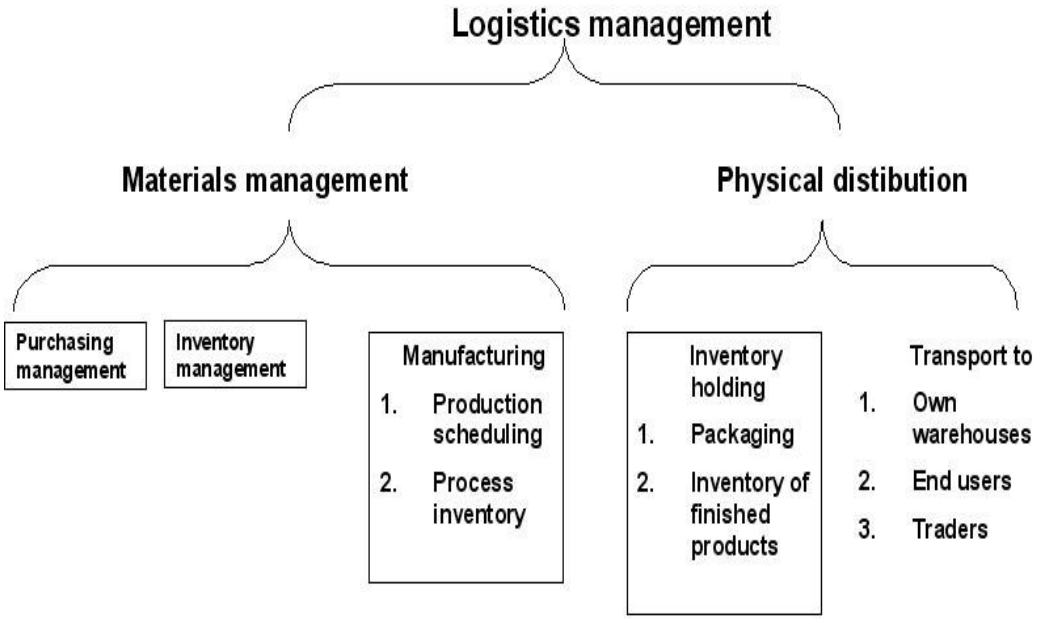
The comprehensive view of logistics is in agreement with the value-added role of logistics, adding time and place utility to a product or service according to Coyle, *et al* (2003: 40) and Grant, *et al.* (2006: 200). Logistics provides place utility by moving goods from production surplus points to points where demand exists. Goods and services should not only be available where the customer needs them, but also at the point in time when customers demand them. The manufacturing process adds form utility by combining raw materials to make a finished product. Logistics can therefore assist the marketing efforts of firms who add possession utility to the product/service by increasing the customer's desire to have it delivered into their possession (Coyle, *et al.*, 2003: 41).

Since the creation of all four value added utility involves the close co-operation between the purchasing and materials related functions introduced earlier, the argument for what should qualify under the heading of logistics management (LM) and its components is better illustrated in Figure 2.4 below.

This view of logistics (Hugo, 2000: 47) illustrated in Figure 2.4 is in accord with the broad definition of Van Weele (2000: 194) who differentiates LM as materials management and physical distribution, giving LM the application to a broad area of activities being integrated throughout the value chain of the business organisation. From Figure 2.4 below, all the different categories of purchased goods and services, will be scheduled for production, managed as inventory (of both semi-completed and finished goods) and sent off for distribution to end users. Logistics is therefore involved with both inbound, upstream activities in the value chain and outbound, downstream activities towards creating customer value.

Figure 2.4 is presented on the following page.

Figure 2.4: Illustrating how logistics management combines purchasing and materials resource planning.

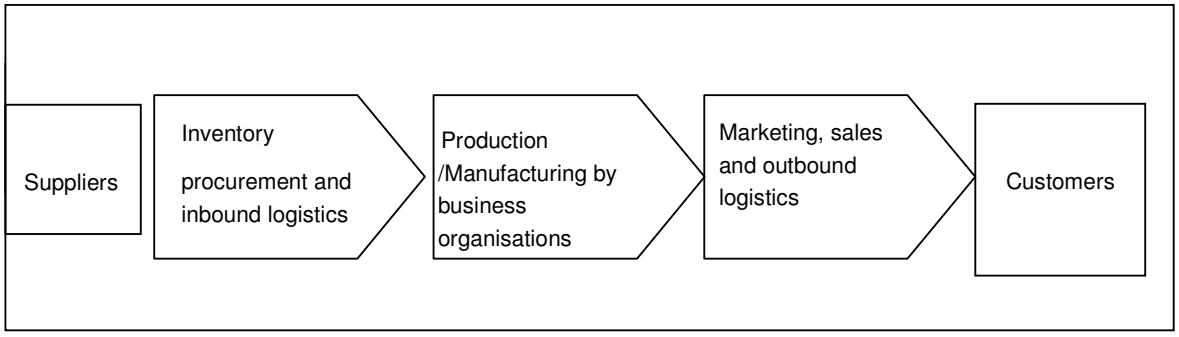


Source: Hugo (2000: 47)

The view of logistics from Bowersox, Closs & Cooper (2002: 4) is that logistics is seen as the work required to position inventory throughout a supply chain. Later, Bowersox, *et al.* (2007: 22) would argue that creating logistics value is costly and it only adds value to the supply chain if inventory is strategically positioned to achieve sales. A quick review of the traditional supply chain diagram, as illustrated below in Figure 2.5 on the following page, shows the division of logistics into the inbound and outbound activities along a business organisation's supply chain.

Figure 2.5 is presented on the following page.

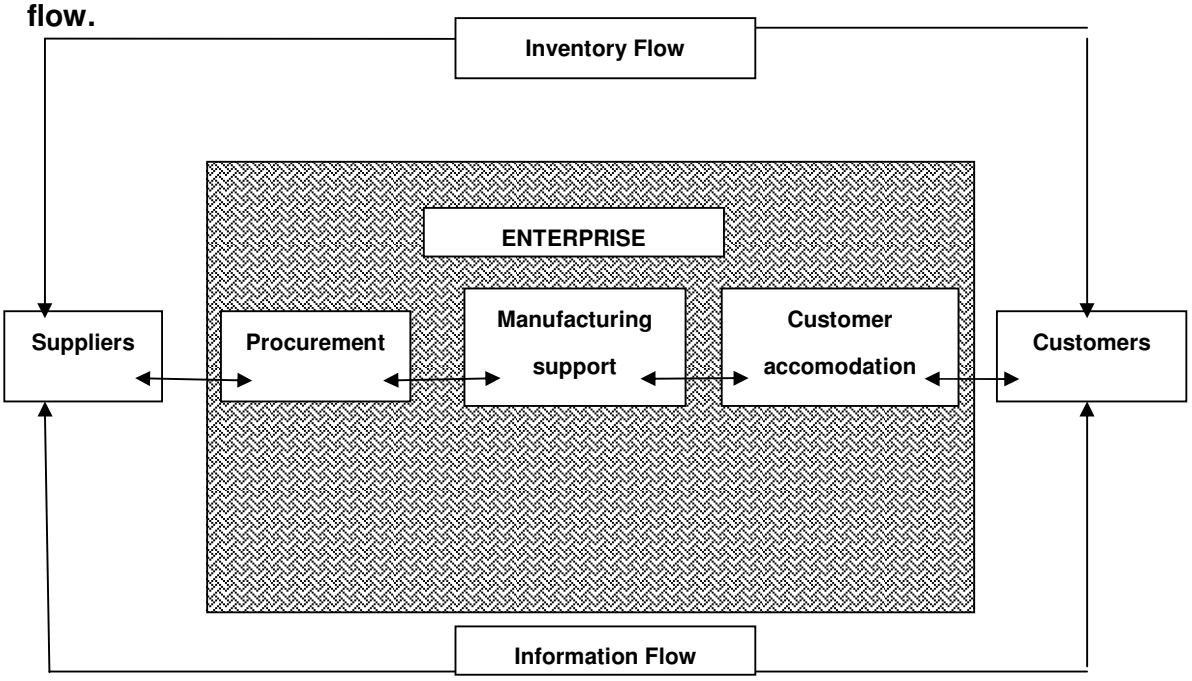
Figure 2.5: The traditional supply chain diagram with logistics illustrated



Source: Greenstein & Vasarhelyi (2002: 12)

Bowersox *et al.* add to their own argument by adding information flow to the flow of inventory (Bowersox, *et al*., 2007: 31) and this means that the traditional supply chain diagram from Figure 2.5. had to be adapted into Figure 2.6, to show how logistical integration is required for any business enterprise to succeed in their strategic business goals.

Figure 2.6: Logistical integration illustrating information flow plus inventory flow.



Source: Bowersox, *et al*., (2007: 31)

In most instances, the business organisation will not try to execute all of the inbound and outbound flows of either goods- nor information flow. The use of third party logistics (3PL) providers to take over some of the responsibilities is becoming more prevalent (Simchi-Levi, *et al*, 2003: 149).

According to Grant *et al*., (2006: 175) there are three major differences that exist between the administration of inbound and outbound logistics transportation. Firstly the market demand that generates the need for outbound logistics is generally uncertain and fluctuating while materials managers experience more predictable and stable demand from the production scheduling activity. Secondly bulk movements of raw materials or large shipments, with different handling-, loss and damage characteristics make cost savings therefore possible. Third, firms look at total delivered price and as such the transportation costs by itself are not identified separately. This is one way of analysing the Bowersox argument that logistics value creation is costly (Bowersox, *et al.,* 2007: 22).

The case of partner integration is strengthened by the use of 3PL, which is simply the use of an outside company to perform all or part of the firm's materials management and product distribution functions. The advantage of using 3PL is that the company can focus on its core competencies (if it does not include LM) and be more technologically flexible in meeting customer needs if the delivery and information technology requirements are more updated than what the firm can provide (Simchi-Levi, *et al*, 2003: 150). Costs need to be compared when deciding to outsource the LM function and partnerships should be accompanied according to the 3PL areas of specialisation and with performance measures agreed upon beforehand (Simchi-Levi, *et al*., 2003: 153). But what is meant by performance in LM?

Basic logistical service is defined as the level of service that a firm should provide to all established customers and the definition of basic logistical performance can be measured according to availability, operational performance and service reliability [according to Bowersox, *et al* (2007: 24)]. Availability involves having inventory to

consistently meet customers' material and product requirements. Operational performance deals with the time required to deliver a customer's order and to do it with speed and consistency. Speed and consistency is in turn affected by flexibility, malfunctions and recovery times.

Service reliability involves the quality of both the availability and operational excellence. Regardless of who is used by the manufacturing firm for logistics management, performance will depend on levels of trust (Li & Lin, 2006: 7, Schiele, 2006: 931), and information sharing amongst partners (Fiala, 2005: 419, Li & Lin, 2006: 2).

The issues of trust and information sharing is not limited to LM partners, but extends towards all trading partners in the supply chain, which is reason enough to continue the discussion on SCM next.

2.4. SUPPLY CHAIN MANAGEMENT (SCM)

Throughout time, as more and more companies embrace the importance of an integrated network of firms that efficiently move materials and components from intermediate processing, to manufacturing and through finished goods intermediaries towards end users; SCM has become a respected management science (Erevelles & Stevenson, 2006: 481). It is necessary to briefly discuss some definitions of SCM and summarise others in Table 2.3. below, since the definition of SCM is relevant to this research study.

Chow, Madu, Kuei, Lu, Lin and Tseng (2006: 2) describe SCM as a holistic and strategic approach to demand, operations, procurement and logistic process management. In this study, Ogulin mentions three distinctive waves of supply chain management in the new economy that includes: operational excellence, supply chain integration and collaboration; and virtual supply chains (Chow, *et al.,* 2006: 2).

More simplified is the view of Lambert also mentioned in Chow, *et al.* (2006: 2) that no matter how complex a supply chain can typically be, it can be implemented through three elements: the supply chain processes, the supply chain network structure and the management components. The variety of supply chain processes, are customer relationship management (CRM), customer service management, demand management (DM), order fulfilment, manufacturing flow management, supplier relationship management (SRM), product development and commercialisation; and returns management (Chow, *et al.,* 2006: 2).

The definitions of SCM as in Table 2.3 all seem to emphasise different components of all that had been discussed previously in this chapter. The similarity is shown with the repeated mention of materials, money, information, product and services that needs to be purchased, stored, processed and eventually transported for consumption by end users. This chain of events by a business organisation was already illustrated by the concept of a traditional supply chain process, historically presented in the form of a left-to-right flow sequence such as the one illustrated in Figure 2.3.

Previously this chapter looked at purchasing as being at the beginning of such a chain of events, which is initiated by the order and receipt of raw materials that represent the inputs to the manufacturing process. The manufacturing takes place in order to meet the forecasted demand of the customer, based on historical sales. In this traditional supply chain process the customer receives the end product (goods or services), which was produced through various value-adding processes of the organisations involved in the supply chain. Table 2.3 summarises a few definitions of SCM below.

Table 2.3 is presented on the following page.

Table 2.3: Definitions of supply chain management (SCM)

Sources	Proposed definition of supply chain management
Turban & King (2003: 48)	A supply chain is the flow of materials, information, money and services from raw material suppliers through factories and warehouses to the end customers. A supply chain also includes the organisation and processes that create and deliver these products, information and services to the end customers.
Patterson, Grimm, & Corsi, (2003: 96)	The integration of key business processes from end user through original suppliers that provides products, services and information that add value for customers and other stakeholders.
Bowersox, *et al.* (2002: 4)	Supply chain management consists of firms collaborating to leverage strategic positioning and to improve operating efficiency.
Stock & Lambert (2001: 709)	SCM involves three closely related elements namely the SCM infrastructure, the supply chain business processes and the management components.

In the end, it is Lefebvre, Cassivi & Lefebvre (2001: 23) that inspires our adoption of a SCM definition that the supply chain exists to meet the needs of the customer at the end of the chain as quoted:

Lefebvre *et al.* (2001: 23) states that: *"SCM integrates planning and balances supply and demand across the entire supply chain – it ties suppliers and customers together in one concurrent business process that focuses on the ultimate customer. This has been illustrated by the discussion and illustration of the traditional supply chain".*

However the Lefebvre', *et al.* definition that adopts the traditional supply chain in the definition of SCM may be outdated for the current modus operandi from the year

2000 onwards. The diagram above (Figure 2.5) has been labelled the "supply-side" way of doing business where the business organisations could manufacture, ship and deliver products that they wanted to supply for the particular market that they are serving. Predictably, the traditional supply chain was accompanied by the use of information systems technology (i.e. use of the Internet) in limited situations, but still in a consequential manner. In other words, the use of information systems technology (and therefore the Internet) was predominantly applied in the same (traditional!) direction of flow from left to right to move from raw material stage to end product stage.

2.4.1. Supply chain integration and knowledge sharing

The activities or functions involved in the supply chain according to Lancioni, Smith, Schau & Jensen (2003: 213) include in non-consequential order: purchasing/ procurement; inventory management, transportation, order processing, customer service, production scheduling and vendor relations management. The main objective of this research is to investigate how business organisations can streamline and integrate all these activities, given the technologies that exist in the current knowledge-based economy. The motivations for the current research study include identifying barriers to seamless SCM integration using Internet-based SCM technologies, which in turn can be traced back to some agreed-upon SCM strategies for the respondent business organisations.

Eng (2006: 682) sees SCM as involving the co-ordination and integration of activities and processes among different business functions for the benefit of the entire supply chain. Eng (2006: 682) identifies three critical areas of SCM that includes firstly competitive advantage based on the notion of value chain analysis in SCM. Secondly Eng notes the use of relationship management for successful collaboration along the overall supply chain and strategic partnerships. Thirdly, the co-ordination and integration of disparate functions and activities are necessary to enhance overall supply chain performance.

Eng (2006: 682) seems to lean his critical areas of SCM definition more towards strategic thought while the other SCM definitions mentioned above could have been attempts by traditional business organisations (i.e. before the Internet revolution) to remain competitive.

Remaining competitive according to a study by Accenture in April 2000, (Bowersox, 2002: 7) could be determined by the implementation of any one of six different, but equally successful supply chain strategies, which the traditional supply chain organisations would have been implementing. These six supply chain strategies identified by the Accenture study are as follows:

2.4.1.1. Market saturation driven

The focus is on generating high profit margins through strong brands and ubiquitous marketing and distribution.

2.4.1.2. Operationally agile

Assets and operations can react easily to emerging consumer trends along product category or geographic region.

2.4.1.3. Freshness oriented

In this strategy attempts are made to earn a premium by offering fresher offerings than competitors.

2.4.1.4. Consumer customiser

This strategy involves the use of mass customisation to build and maintain close relationships with end-consumers through direct sales.

2.4.1.5. Logistics optimiser

The emphasis of this strategy is a balance of supply chain efficiency and effectiveness.

2.4.1.6. Trade focused

This strategy has low price and best value for the trade consumer as priority.

This research study does not aim to prescribe a "best practice" from one of the six strategies mentioned above, however in order for any organisation to implement their agreed- upon strategic plans and work together with extended supply chain relationships, they will depend to some extent on useful, efficient and effective SCM integration technologies to help them reach their SCM goals (Bowersox, *et al.,* 2007:364). Since it is not research prerogative to generalise in terms of where the respondent businesses find themselves in the SCM spectrum, these supply chain strategies will serve only as a back-drop of possible South African business organisations' SCM strategies. It is beyond the scope of the research investigation to determine whether the use of the Internet is making South African business organisations predominantly business process oriented, customer oriented or logistics oriented.

According to Ke and Wei (2006: 4) the means of integrating trading partners to achieve optimal SCM is to engage in knowledge sharing. In order to remain competitive and assist in knowledge transfer between supply chain partners, the literature reveals that firms are implementing supplier development programs to maintain a capable and high performance supply based standard (Modi & Mabert, 2006: 1). According to Meixell and Gargeya (2005: 534), the Supply Chain Operations Reference (SCOR) says that performance includes reliability, responsiveness, flexibility, cost and assets.

Little is known about superior supply chain performance since there appears to be some intangible aspects of why some chains excel while others struggle. There is a definite fit between strategy-knowledge and chain performance, however the lack of attention to the link between knowledge as an intangible resource and supply chains is unfortunate because firm and chain outcomes are increasingly intertwined.

Hult Ketchen, Cavusgil and Clantone (2006: 13) say that SCM Performance includes speed, quality, cost and flexibility and that there are 8 measures of knowledge viz. memory, tacitness of knowledge, accessibility of knowledge, quality of knowledge, knowledge use, knowledge intensity and responsiveness. The existing ack of studies

of the interrelationship between these 8 elements is strongly suggested as a reason for further knowledge research (Hult, *et al.*, 2006: 13), however only the accessibility of information and the responsiveness of business firms will be included in the research questionnaire to see how they are influenced by the Internet today.

In agreement with the Accenture study, the integration of business processes is a best practice in supply chain management that involves co-ordinating decisions across multiple facilities and tiers. In practice, firms engaged in vendor managed inventory (VMI) and collaborative planning, forecasting and replenishment (CPFR) effectively integrate replenishment planning between enterprises by sharing sales and promotion information (Meixell & Gargeya, 2005: 534).

Based on the literature reviewed, the inclusion of information sharing and partner integration in SCM practices in South African can be seen as relevant and forming a small section in a global SCM practice investigation. The benefits of sourcing globally means that business organisations can improve quality, meet scheduling requirements, reduce costs, access new technologies and broaden their own supply base in the SCM function (Meixell & Gargeya, 2005: 534).

Any study of SCM as a discipline definitely has many variables that can be investigated, however in light of the research time and cost constraints, this research study will be limited to investigating the levels of SC partner integration and information exchange amongst South African based business organisations.

2.5. CONCLUSION

In summary, this chapter gave a short overview of the history of development of the supply chain management (SCM) discipline by the progression from purchasing, materials management and logistics management towards SCM. The link between the value chain (VC) and the traditional supply chain (SC) was highlighted and is

based on the premise that internally a firm will optimise their VC before participating in the SC being formed with external trade partner organisations.

Since the discussion followed a timeline of events, it is to be anticipated that the markets in which the research from the literature reviewed originates, have experienced a shift in the traditional understanding and operational business practice of SCM. This enlightened understanding is due to the influence of the new demand side approach of SCM and the growth of the Internet and SCM information technologies.

It is necessary to note that the research study will question respondents only on the current practices involving SCM information technologies when executing activities such as ordering, inventory management, warehousing, transport management and billing. This will help identify what barriers exist to prevent the business organisations from embracing the use of Internet-based systems in their SCM practices. On that note, a closer look at the challenges facing SCM in the digital economy is presented in chapter 3.

CHAPTER 3

CHALLENGES FOR SUPPLY CHAIN MANAGEMENT IN THE DIGITAL ECONOMY

3.1. INTRODUCTION

This chapter highlights the history of the Internet, explains the categories of electronic commerce and the levels of integration amongst different trading partners. It explains the transition from manual systems of purchasing, to electronic data interchange and legacy systems before the Internet phenomenon. The focus is on how SCM processes have been influenced by the new electronized, digitalised and automated information technology practices over time.

"E-business is the exchange of information (value) across electronic networks, at any stage of the supply chain , whether paid or unpaid. It can take place within an organisation or between businesses, between businesses and consumers or between public and private sectors." *Searle (in Samson, 2003: 5)*

Various viewpoints from different research authors will be incorporated in each specific section in order to derive the constructs that indicate gaps in the research literature and therefore has motivated this South African based research investigation.

3.2. INTERNET HISTORY AND E-COMMERCE CATEGORIES

The literature reviewed will look at Internet history and developments with the aim to linking it to the supply chain management environment of business organisations.

3.2.1. Internet history

The Internet is a large system of interconnected computers that spans the globe (Schneider, 2003: 39, Chaudbury & Kuilboer, 2002: 89) and was formalised in the

late 1960s when the US Department of Defence developed a network of military computers called the ARPANET (Advanced Research Project Agency Network). Their main objective was to decrease the dependence on one centralised computer for its military operations, in the event of a nuclear attack on the "controlling computer's" facilities. ARPANET also sponsored research students and at a conference at the University of Illinois, laid out plans to network the systems of ARPANET-funded universities to allow specific academics previously involved in research on the development of the Internet, to simultaneously meet the identified need to share data between academic institutions (Deitel, Deitel & Steinbuhler, 2001: 5). The early form of the Internet branched off into a military network called MILNET and the non-military portion of the Internet, was administered by the National Science Foundation (NSF). In time other networks, such as those from other government departments, academia and businesses started to connect to the Internet (Deitel, *et al.* 2001: 6, Laudon & Traver, 2002: 111).

In order to access the Internet, their users connected to a computer on the Internet known as the host. This still applies today, with an Internet service provider creating access to a host computer (Tong, 2006: 290, Deitel, *et al.* 2001: 6). The Internet is seen as an interconnected network of thousands of networks and millions of host computers linking businesses, educational institutions, government agencies and individuals together (Laudon & Traver, 2001: 109). The Internet provides about 400 million people across the world, of which 170 million are estimated to live in the USA, with services such as electronic mail, newsgroups, shopping, research, instant messaging, music, videos and news (Laudon & Traver, 2001: 109).

The Internet is in itself an overwhelming system, grandiose in scale and therefore able to be the basis of the commonly known and globally utilised services of the world-wide web (www), or web for short, to help users deal with the information overload by storing information with random links. This web was first thought of and written in a software program form called "Enquire" by Tim Berners-Lee in 1980. At the time he was working for CERN, the European Particle Physics Library in Geneva, Switzerland. Internet users started using the web and provided feedback to Berners-

Lee, who redesigned the web between 1991 and 1993, after having a successful proposal to CERN in 1989 to continue with the project development (Deitel, *et al.* 2001: 6).

The initial web idea had been expanded to allow users to work together and share information in a web of documents that use hypertext to link pages together. The web incorporates the use of hypertext links, software portability and network and socket programming (Greenstein & Vasarhelyi, 2002: 7). The web is also described as the standard set for naming and linking conventions that uses the Internet to locate and transport hypertext documents and other files stored on computers all over the world (Davis & Benamati, 2003: 12).

In 1994 the first Internet and web browser (a software interface that lets users read or browse the hypertext documents) for Microsoft Windows was released, followed by Microsoft's competition, Netscape, releasing their web browser edition the year thereafter (Tong, 2006: 290). Initially no buying or selling on the Internet was allowed but by using the Web and the Internet for commercial uses as opposed to using it for academic or pure research purposes; the birth of electronic commerce was established (Greenstein & Vasarhelyi, 2002: 7l). Currently in the new millennium, users of the Internet and its services are benefiting from developments over 40 years, which started with the original concept of the Internet being conceived, institutionalised and commercialised (Laudon & Traver, 2002: 109).

The digital economy is also known as the Internet economy, new economy or web economy and refers to the economy that is based on the digital technologies (computer hardware and software) and other related information technologies.

Turban et al. (2002: 45).

When business activities start using the Internet platform, the web and hypertext protocols for the exchange of information, products and services for cash or reward, the phenomenon of electronic commerce (e-commerce) is being conducted in an

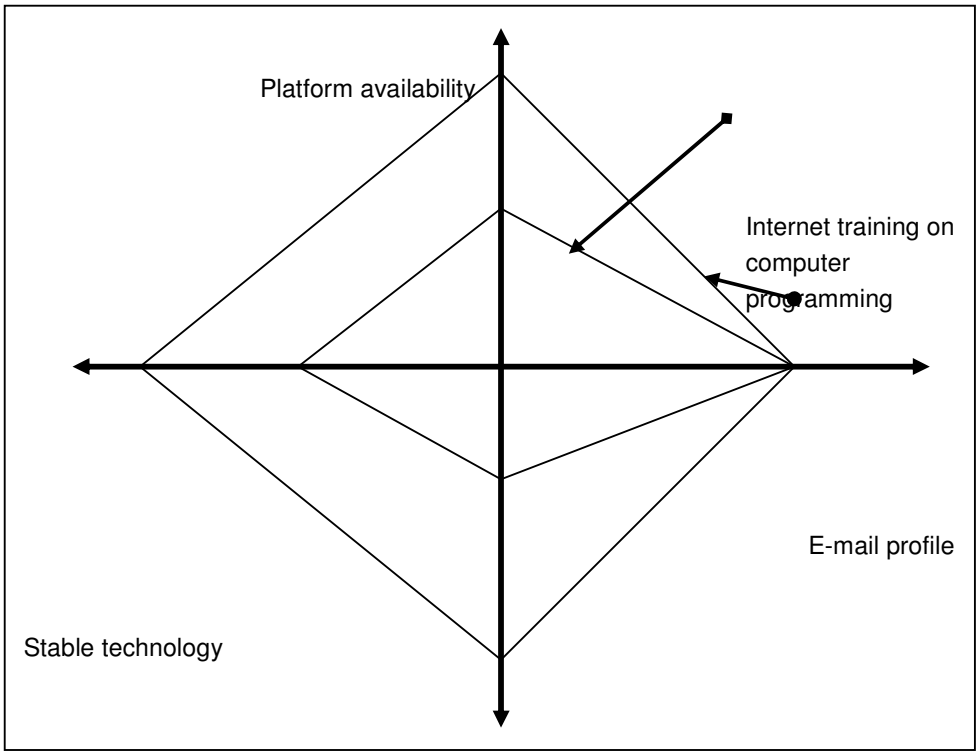
online business environment (Turban & King, 2003: 3, Chaudbury & Kuilboer, 2002: 6). E-commerce is different to the concept of electronic business (e-business), which is more comprehensive since it includes servicing customers, collaborating with business and transactions/operations within the business itself (Turban & King, 2003: 3, Deitel, *et al.* 2001: 8). Much debate continues about whether the term e-commerce or e-business should be used, but for the sake of simplicity, this research investigation will adopt e-business to be the all-inclusive reference for business organisations' transactions and information exchange.

Before the adoption of the Internet as a platform for e-commerce, other electronic initiatives were in existence. For example, Chase Manhattan Bank introduced a keyboard equipped with a card reader in 1984 together with the telecommunications company, AT&T, for their banking clients. Clients could connect this to their television to display their accounts data, while the keyboard would telephonically connect to the bank and execute transactions. The idea was not as popular with clients because of cumbersome cable connections.

The theory of other acceptances/rejections of a new technological platform can be described as depending on four elements. These include affordability, convenience, technology stability and technology availability (Chaudbury & Kuilboer, 2002: 9). These four elements can be graphically demonstrated in Figure 3.1. below. The diagram illustrates the two technologies of electronic mail (e-mail) and Internet-based computer programming training plotted against these four elements.

Figure 3.1 is presented on the following page.

Figure 3.1: The acceptability profile of various technologies



Source: Chaudbury & Kuilboer (2002: 9)

In Figure 3.1 above the principle is shown that by being further on the perimeter of the diamond, more of the four elements' characteristics are attained. The diagram shows that although both technologies are affordable, the profiles show that e-mail is more convenient to learn and use, that it is a mature, stable technology and is easily accessed. These elements' profile makes e-mail more accepted by users than the online computer training offering in this example.

The logical explanation for Figure 3.1, is that a technology is scored between zero and four, where the intersection of the axes represents zero. The e-mail introduced in the 1990s was accepted more readily because its scores were more towards the outer limits of the diamond (Chaudbury & Kuilboer, 2002: 9).

According to Lancioni (2003: 212) it was “fashionable” to claim Internet usage amongst users in the 1990s since general Internet adoption was prevalent, however it is still necessary to test the extent of user perceptions at each of the different business application areas today. The research is to target specifically the users who are involved with supply chain management activities. The perceived usefulness and perceived ease-of-use from the previously discussed technology acceptance model, are also constructs that add to the above technology acceptance argument. As a reminder, the technology acceptance model (TAM) was derived during late 1989 and used to test the behavioural intention to use versus the actual use of new technology systems (Hausman & Stock, 2003: 681).

3.2.2. Categories of e-commerce

There are different types or categories of e-commerce, acknowledged in the growing discipline of e-commerce, which includes businesses interacting with other businesses, individuals, governmental- and other organisations. The two categories most commonly known are business-to-consumer (B2C) and business-to-business (B2B), which were also researched most often by academics prior to the year 2000. The other e-commerce categories include business-to-employee (B2E), consumer-to-consumer (C2C), consumer-to-business (C2B) and government to business or consumer (G2B or G2C). The above classification is inconclusive since academic institutions and social organisations can engage in non-business commerce while individuals and businesses may be engaged in collaborative commerce (Turban & King, 2003: 8).

These categories of e-commerce are dynamic and converging according to Rayport & Jaworski (2003: 6). If consumers band together in a buyer group, they become demand aggregators and can bargain with a business (C2B) for what they require, for example a large supply of books. After consuming or reading the book, the consumers may auction it online to other consumers in a C2C scenario. The behind the scenes activity means that the big order of books had to be placed B2B from the publisher to its printers (Rayport & Jaworski, 2003: 6). Only the two most utilised and profitable categories of e-commerce (B2C and B2B) are discussed in 3.2.2.1. and

3.2.2.2. to highlight why the research investigation is focussing on B2B activities within business organisations' respective supply chains.

It is important to note that all the categories of e-commerce form part of the same puzzle (Davis & Benamati, 2003: 141): meaning that any organisation will have components that generate money directly from consumers (B2C), or from government departments (G2B) and/or from other components of the supply chain (B2B); in the process of concluding various transactions. Another example of this e-commerce category convergence would be where an airline sells flights online (B2C) but provides for its passengers' requirements by co-ordinating food and beverages quantities online with their catering suppliers (B2B).

3.2.2.1. Business-to-consumer (B2C) e-commerce

This is the best-known form of e-commerce because it involves the animated and colourful promotion and marketing of goods and services directly to the retail customer or end user in an online market environment (Davis & Benamati, 2003: 371). The primary focus of any business organisation however continues to be the profitable generation of revenue and the most common way for most traditional retailers to use the Internet is to become e-tailers, whereby they offer their existing products and services for sale on the Internet to customers or consumers. Retailers used the Internet and the Web to be online and became electronic retailers (otherwise known as e-tailers), while bricks-and-mortar businesses changed into clicks-and-mortar businesses (Turban & King, 2002: 86) where they have both physical stores and virtual interfaces.

The benefits associated with B2C e-commerce for e-tailers and clicks-and-mortar businesses include allowing businesses to reach more geographically dispersed customers, help lower the costs of procurement, reduce the holding of Inventories, reduce the cycle times and lower sales and marketing costs (Greenstein & Vasarhelyi, 2003: 3). The B2C e-commerce category links businesses directly to the customers and represents the downstream (or front end) of the business

organisation's value and supply chains (Davis & Benamati, 2003: 143). Examples of e-tailers in the South African market would be where traditional retailers like Pick 'n Pay and Woolworths created websites with e-commerce capabilities to enable online shopping of groceries and household items, to be delivered to the customers' homes at a minimal fee. Another specific new trend of B2C commerce is mobile commerce (or m-commerce) where the consumers shop via their wireless cellular telephones, however any discussion on m-commerce extends beyond the scope of this research.

Consumer value is created in a Web shopping experience by buying at lower prices, having choice unrestricted by floor space, convenience in not leaving home to shop and products customised to suit individual tastes and preferences (Chaudbury & Kuilboer, 2002: 19, Greenstein & Vasarhelyi, 2002: 4). The extent of B2C interaction is limited to 4 easy steps of promotion, ordering, delivery and after-sales service (Chaudbury & Kuilboer, 2002: 12) since consumers continue to respond to branding attached to companies and their products and decision-making happens in the same way as before in bricks-and-mortar environments (Greenstein & Vasarhelyi, 2002: 3). This can be contrasted to B2B interaction below in section 3.2.1.2., where businesses do not pay online via credit or debit cards as consumers would.

A constant critique of the Internet and e-commerce in general is that the Internet enables both digital distribution and digital piracy (Davis & Benamati, 2003: 144) since most digital products (such as electronic or e-books, online music, movies and software) cannot be protected on the Internet. Cases of intellectual property violations are however part of many reasons why the dot-com bullish scenario turned into a dot-bomb scenario. Companies failed for lack of differentiation in a highly competitive online market environment, where products and services that seemed to be unique propositions were reduced to commodity status (Turban, *et al.* 2002: 53). Regardless of the competitive forces online, in the 21st century consumers are demanding more convenience, more efficient use of technologies and more leisure time. Therefore it is to be expected that B2C will continue to operate 7 days per week, 24 hours per day, relentlessly. Next, we look at business-to-business (B2B) e-commerce.

3.2.2.2. Business-to-business (B2B) e-commerce

This is perceived as being the most significant part of e-commerce (due to the larger volume of transactions than is the case for B2C) and involves the electronic exchange of information, digital goods and services. It was predicted that by 2006, the trade between business firms would exceed $16 trillion (Laudon & Traver, 2002: 653), which is about 4 times the size of the B2C market.

B2B is defined as electronic commerce where all the participants are businesses or other organisations (Turban & King, 2003: 7). Schneider (2003: 565) describes B2B as transactions conducted between businesses on the Web. Deitel, *et al.* (2001: 750) defines B2B as the relationship between two or more companies. B2B is seen as the channels that permit close co-operation between businesses, assisting with outsourcing, facilitating ordering from suppliers and aiding in keeping track of shipments (Deitel, *et al*. 2001: 10). Laudon & Traver (2002: 654) defined B2B as all types of computer-enabled inter-firm trade, such as the use of the Internet and other working technologies to exchange value across organisational boundaries.

All of these B2B definitions confirm that this research investigation, where SCM and information technology are being combined, should be placed into the context of the 21st century, where technology links the businesses of the world by the click of a button. While still maintaining the principles of the traditional value-adding chain of business activities (Gunasekaran, Marri, McGaughey & Nebhwani, 2002: 195) the investigation takes place in the information technology dominated new/digital economy where Schneider (2003: 15) highlights many e-commerce benefits for businesses. These include reduced costs of handling enquiries in a pre-purchase scenario, lower input prices, less inventory and reduced transaction costs through more efficient payment mechanisms such as the electronic transfer of funds (EFT). E-commerce is also seen to contribute to economic efficiency in five important ways by shrinking distances and timescale, by lowering the distribution and transaction costs; by speeding up product development; providing more information to and

sellers and by enlarging customer choice and supplier reach (Gunasekaran, *et al.*, 2002: 186).

Regardless of the many benefits that accrue to both the consuming organisation and the manufacturing organisation, there are four basic types of B2B transactions (Turban & King, 2003: 205). These are:

- Sell-side: where one seller sells to many buyers.
- Buy-side: where one buyer buys from many sellers.
- Exchanges: where many sellers sell to many buyers.
- Collaborative commerce: where there is communication and sharing of information, design and planning among business/ trading partners.

The type of B2B transactions that are most common amongst the respondents of the research study is dependent on where they are positioned as they fit into their respective supply chain structures. Suffice to say, that any business organisation can fluctuate between sell-side and buy-side, dependent on whether they are doing for example their own procurement of unprocessed inputs or engaging in the distribution of their completed outputs (Turban & King, 2003: 206). Where there are many buyers and sellers supporting the exchange of goods and services of different kinds, Grieger (2003: 280) sees point (c) as an Internet-based electronic marketplace (EM), which is growing in popularity due to its revenue generating abilities. The most common example of such an e-marketplace will be the B2B online auctions.

Regardless of how sophisticated the market environment has become, a more in-depth discussion is required to appreciate the full value of the evolution of business practices in response to the stages of technological development that a business was conducting business in. It is important to go back in time and revisit the perspective of traditional business-to-business transactions and follow traditional information flows in the following discussion.

3.3.1. The Intranet and the traditional value chain concept

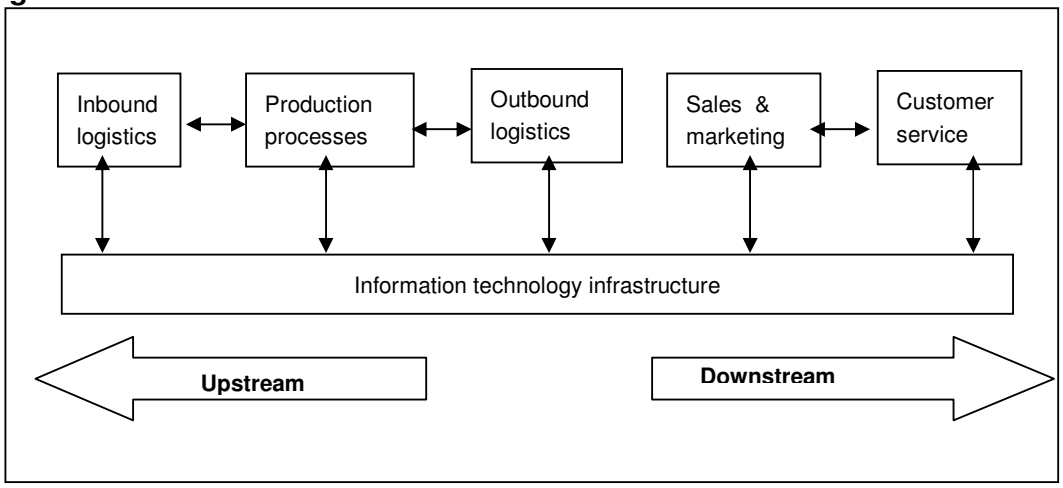
In chapter 2, the business organisation's functional areas were discussed such as human resources, marketing, purchasing, logistics and finance, amongst others. Together they form the business value chain. Since these value chain functional areas can sometimes be run as independent, non-integrated islands of automation, a business organisation's intranet is seen as a scaled-down, single-organisation version of the Internet and the web, that can help integrate islands of automation from different functional areas within the organisation.

Any intranet can be defined as a private (internal) corporate network that uses Internet protocols and interfaces (Davis & Benamati, 2003: 185). Since the intranet is smaller and its employee-based users are less, the organisation can make information and applications available to its employees that it would not consider releasing to the rest of the world. Intranets are considered an excellent low-cost way to distribute internal corporate information efficiently, since producing and distributing paper-based information is usually slower and more costly than using web-based communications (Schneider, 2003: 68, Turban, 2003: 296).

Currently a number of functionalities are inclusive to the intranet such as document flow and distribution, groupware, interactive communication tools such as chatting, audio support and video conferencing; search engines, indexing engines and directories that assist in keyword-based searches. In the late 1990s, a survey of a thousand managers, concluded that the information most included in intranets was in the form of product catalogues (49%), corporate policies and procedures (35%), purchase ordering (42%), corporate phone directories (40%), document sharing (39%) and human resource forms (35%), according to Lancioni (2003: 211). The objectives of this current research study would include an investigation into the different uses of the intranet within South African organisations to see how it helps information sharing internally before looking at its role in facilitating its supply chain management functions externally.

With reference to the internal value chain of the business organisation, where business activities are in sequence and interdependent, the use of computer technology helped to speed up the flow of information, by transferring data inputs and outputs to the next level of activity in the normal production or value-creating process. By linking the different departments, activities such as the buying, warehousing and manufacturing, were able to access more accurate data, in less time and with less errors from manual duplication. This value chain focus where information technology infrastructure is integrating the functional areas into an internal, organisational intranet facility, is illustrated in Figure 3.2. below.

Figure 3.2: The value chain and the intranet



Source: Davis & Benamati (2003: 166)

The next step in utilising the intranet as efficiently as possible, is to examine how it evolved into an extranet application within and between organisations. When companies have opened their intranets to selected trading partners and customers, the extension becomes an extranet that may even link two or more intranets. An example of an intranet being accessible to customers is FedEx, the package distribution company, who moved away from toll-free telephonic enquiries from customers, to allow them package-tracking software for their computers. No customer service operators were required from FedEx and customers had access to information that was entered into FedEx information technology systems to inform them about the location of their parcels/packages. By allowing their customers

access to their intranet value chain, the FedEx business organisation officially put into place an extranet facility (Schneider, 2003: 68).

3.3.2. The Extranet and B2B e-commerce

The extranet is considered to be a mini-Internet (Davis & Benamati, 2003: 213) since it shares information over public bandwidth and forces business organisations to secure their transmissions of potentially sensitive business information. When using the extranet over the full scale of the network of networks known as the Internet, it means that information flows from the intranet or internal corporate databases, to employees in other locations, dispersed trading partners and customers in the marketplace over an electronic transmission medium. Extranets is the linking of businesses' intranets with each other via a costly dedicated leased line or by creating a cheaper tunnel through the Internet to create a virtual private network with full or limited access (Bandyo-Padhyay, 2002: 154). An extranet can form the route for business transactions/e-commerce amongst participants and is able to easily and securely facilitate communication between organisations (Bandyo-Padhyay, 2002: 155).

A research study conducted for the European Logistics Association (ELA) amongst 157 companies during 2000-2001, showed that the Internet is mostly used for procurement/purchasing followed by distribution/sales and logistics. The finding also showed that the technology applications already in use include marketing homepages, tracking and tracing tools, information gathering tools, procurement, tenders and Internet–sales tools, order entry applications, production visualisation tools and credit management tools (TradenetOne.Com: 2001). More noteworthy though, it was found that in most companies a variety of technology applications are in use, but they all seem to lack an integrated strategy to include Internet technologies in business processes. In other words, they have isolated applications only.

This scenario of isolated business applications within organisations is possibly not limited to the European Union companies alone and only a research study conducted in South Africa can identify possible barriers to technology integration within existing supply chain functions. The study was also conducted telephonically, which may limit the number of respondents that can be reached in the South African context; therefore a more feasible method will be employed.

3.4. PURCHASING: THE B2B EVOLUTION

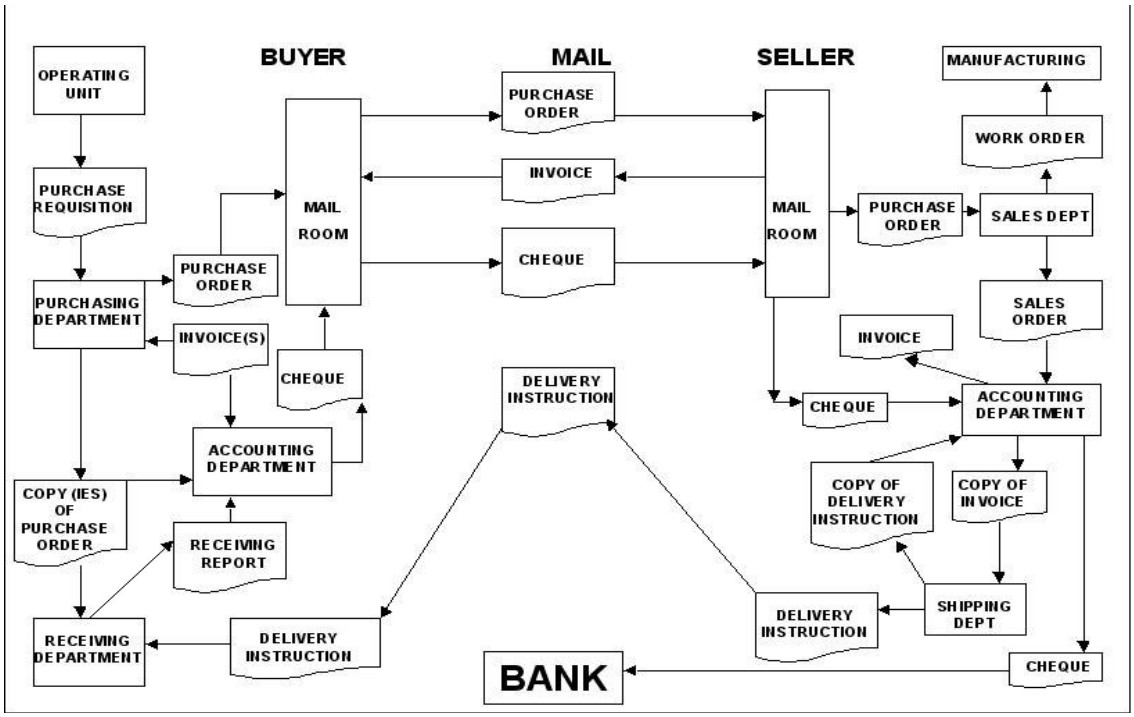
The process of one business entity purchasing goods and services from a myriad of suppliers has undergone major changes with the evolution of technologies and processes. This evolution is discussed from a business to business point of view.

3.4.1. From manual, paper-based purchasing to EDI business-to-business procurement

Within the normal value chain of any business organisation, there is a movement of materials, goods and finances from each value-adding step in the process until the end where manufactured goods are consumed by the end user. This movement of materials and money is accompanied by a constant flow of information and documentation, related to all the business organisation's activities along the chain to illustrate that many transactions have taken place (and probably will take place in the future) between buyers and sellers. The two figures below, (Figure 3. 3 and Figure 3. 4) illustrate the number of steps that are involved in a paper-based transaction. The distinction is made between how the traditional way to conclude transactions would normally be by telephone, fax or courier services and it is shown how manual systems were changed by the introduction of electronic data interchange (EDI) processes (Schneider, 2003: 210).

Figure 3.3 is illustrated on the following page.

Figure 3.3: Information flows in a paper-based process (before EDI)



Source: Adapted from Schneider (2003:210)

In Figure 3.3, (follow the steps from the top left corner, downwards and to the right) a company is in the process of ordering a new machine for its production facility and after completing a purchase requisition form, will send it to the purchasing department. When they have gone through the steps necessary to select the right vendor to buy from, it will negotiate price and terms of delivery before completing the purchase order to be sent to the mailing room. This document is usually filled out in triplicate to allow the delivery area and the accounting department to be notified immediately of the need for space and money when the new machine's order is completed. The mail department will use ordinary, traditional (snail!) mail or a courier service to get the purchase order to the selected vendor/seller as soon as possible. Once the mail department of the seller receives the purchase order, their sales department will prepare a sales order for its accounting department and a works order for their manufacturing division to start putting the ordered machine together. Once the manufacturing division completes their tasks, they will notify the accounting

department, who sends the original invoice to their mailing room and a copy of the invoice (together with the completed machine) to the shipping department. At the shipping department, the information on the invoice copy will serve as inputs into the delivery instruction document, which is then sent to accompany the machine to the buyer. The department receives the machine at about the same time as what it took to get the original invoice there and payment procedures will be put into effect once the buyer is satisfied with the quality of the product and the accounting department is has checked it against the original purchase order. When the seller finally records payment received, this whole process could have taken about 16 steps (Schneider, 2003: 210). Imagine what a tedious, time-consuming process it is for any business organisation to repeat the process daily for various types of business transactions, where different parts and components would have to be sized, priced, packaged and shipped in order for both buyers and sellers to be satisfied and paid on time.

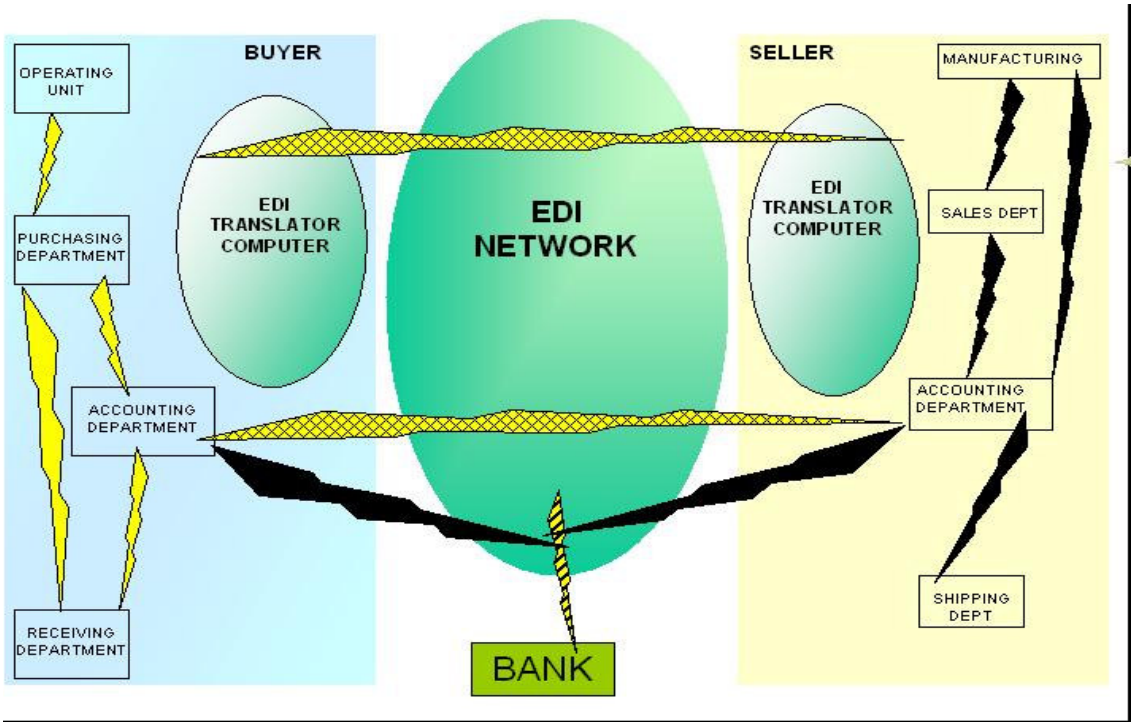
Fortunately, progress has been made since the use of a wholly manual process of information flow in business transactions. The next level immediately following the traditional way of non-automated systems, was introduced merely a few decades ago and is called electronic data interchange (or EDI).

Before the Internet business revolution, there were a number of companies striving for more error-free exchanges of transaction data. The introduction of electronic data interchange (EDI) refers to the exchange of electronic business documents such as purchase orders, invoices and more, in a specified, pre-arranged standard format, without the physical exchange of paper documents (Greenstein & Vasarhelyi, 2002: 181). The EDI electronic standard was a step-up from the manual way of providing quotes, placing orders and submitting invoices and because it required no human intervention, it took place in a matter of seconds.

Figure 3.4. illustrates how the same business organisations from Figure 3.3. would change if the buyer and the seller agreed to be “better” trading partners and to invest in computer equipment and the compatible software required to conduct EDI with each other. Note that the lightning bolts symbolise how much faster and more

efficiently information is flowing between buyer and seller, by virtue of turning the purchase orders, invoices, delivery instructions and so forth into electronic format and interchanging them without the delays of manual and physical systems.

Figure 3.4: Information flows in the EDI purchasing process



Source: Adapted from Schneider (2003: 212)

However, the mere introduction of computers to translate these documents into a similar agreed-upon format, does not automatically mean the implementation of EDI will be plain sailing. If the trading partners were using a direct EDI link to each other with each one maintaining their own computer systems, serious translation problems can arise. Problems are experienced when businesses are connected directly, by using a dedicated leased line of communications, to a myriad of trading partners but each business uses different protocols or standards for their communications (Schneider, 2003:214, Greenstein & Vasarhelyi, 2002: 184). Traditionally the EDI transactions used dedicated leased lines between specific trading partners and this

by itself could prove to be a very costly implementation investment for potentially new trading partners. Dedicated leased lines become expensive when taking into account the issues of geographic locations and distance, different time zones and regulations associated with trade across the globe. These represent barriers to business organisations' trade.

If the trading partners had difficulty in making their respective organisations and computer infrastructures match, they would consider the solution of a third party to provide translation services between the various trading partners' information and communications infrastructures. Buyers and sellers can use the services of a value-added network (VAN) to be their intermediary, so that they are faced with only supporting the standards and protocols of the VAN instead of many possible protocols used by their trading partners (Schneider, 2003: 215). However, the use of a VAN and its associated services of translating valuable transaction related information into the required format for a particular trading partner, also come at a price. Most VANs require enrolment fees, an investment in EDI software, hardware and monthly connection fees from the business organisation wanting to enlist them. Add to this a transaction fee based on the volume of transactions, the duration of the transaction, or both and the cost of ongoing transactions can start draining the business' financial resources (Schneider, 2003: 215).

In order to overcome the challenge of costly EDI implementations, or the costs associated with using a VAN, trading partners have started switching to Internet-based EDI implementations in the 1990s. As the Internet and web-based electronic commerce became more accessible and more affordable than the traditional EDI for all the trade partners involved (Greenstein & Vasarhelyi, 2002: 3), trade partners have adopted it. E-commerce had an effect not only on operations management but also on the purchasing process (Gunasekaran & Ngai, 2002: 280). This is discussed below.

3.4.2. Transition from traditional EDI to Internet-based EDI

From chapter 2 and the preceding discussion it is known that a business organisation can have many trading partners (suppliers and customers) that they transact with. From the discussion above, it appeared to be expensive for business organisations to switch from paper based systems to the EDI standard. Unless the trading partners are large enough and can justify the costs associated with dedicated leased lines, the automated, electronic EDI system is not accessible, nor to be advised for smaller trading partners. With the Internet and the Web providing an open, common platform means of transmission, smaller business organisations can actively participate in the online sharing of information and more importantly, transact with each other. By installing Internet browser software in their existing computer systems, businesses are able to access a global, Internet or web-based community of trading partners.

By using IT applications supported by Internet-based computing and communication means, trading partners can share their knowledge about the market and products, synthesize this knowledge and use the integrated knowledge to orchestrate the supply chain (Bandyo-Padhyay, 2002: 155). The firms can share two types of knowledge with each other: know-what (contextual information) and know-how (Ke & We, 2006: 4). Know-what is declarative knowledge that "can be transmitted without loss of integrity, once syntactical rules required for deciphering it are known". Know-how examples include forecasting techniques and development of pricing strategies (Ke & Wei, 2006: 4) that could be exchanged and would cement the relationship between trading partners.

The internal integration of company processes is one of the stages towards integrated enterprises and can be facilitated by the lower cost of the Internet compared to EDI and VANs, according to Mufatto and Payaro (2004: 295). The quality of information sharing can be used as an evaluative criterion by channel members to evaluate manufacturers according to Forman, Lippert and Kothandaraman (2006: 3). The electronic sharing of information is also present when business processes from the value chain (demand planning, scheduling, order management, product development and sales support) are using Internet

applications (Li, Du & Wong, 2005: 7). Inter-organisational information systems can facilitate the creation, storage, transformation and transmission of information across organisational boundaries (McIvor, Humphreys & McCurry, 2003: 150). The contrasting view of information technology (IT) as being a vulture, comes from Tiernan and Peppard (2004: 609), who argue that companies can also spend massive quantities on IT without determining how they are benefiting from the spend. They argue that the value of IT emerges when it is used by the organisation both operationally and strategically, including also interactions with customers, suppliers and even regulatory authorities (Tiernan & Peppard, 2004: 610). In the year 2000, a study by Walczuch, Van Braven and Lundgren (2000: 561), pointed out that start-up costs, unfamiliarity with the Web and a lack of guidance to start the process of using Internet-based technologies served as barriers for small businesses to obtain value from the Internet.

Small businesses may also be relieved to know that the ease of Internet accessibility and connectivity acts as a double-edged sword. The competitive nature of business in the 21st century, means that information about trade is always under threat of being stolen or accessed without the necessary authorisation. Information regarding sales forecasts, development of new products, marketing initiatives for instance, is not to be shared as common knowledge in any marketplace. The Internet was not originally designed for sending sensitive information on transactions around and by being a very public network of networks by nature, the fear of information leaks can influence the willingness of trade partners to do electronic data interchange via the Internet. It is possible for information to be viewed, copied and altered while *en route* to its final (trade partner) destination (Greenstein & Vasarhelyi, 2002: 197). In order to overcome this fear of being online, trade partners are developing and implementing some security and reliability measures in order to ensure the Internet is still a safe transmission medium, but it is acknowledged that fear of data leakage may be a possible barrier to Internet use.

One possible measure of improving the safety of information transfer is by implementing security measures. This is done by firstly using designated user

names and passwords for employees working on transactions as part of daily operations. However the issue of user access is also considered a contentious issue according to Li *et al.* (2005:8) who suggest that channel members may have conflicting policies used both within and between organisations. Conflicts can be resolved by implementing a conflict resolution scheme where an access control list can determine priorities and privileges of access to information (Li, *et al.* 2005: 8). It is also necessary in business transactions to use encryption and authentication techniques in order to encode and decode information over the transmission networks and make it a safer mode to transact with partners across the world.

Beside the security of transactions, there are also the concerns that in a web-based EDI environment, an untrustworthy trade partner could deny having concluded transactions since the Internet does not provide an audit log of transactions concluded. From a legal perspective, non-repudiation means that no one can deny or repudiate the transaction's existence by providing proof of the origin, receipt and contents of an electronic message (Schneider, 2003: 216, Greenstein & Vasarhelyi, 2002:239). The possibility of a non-repudiation problem occurring must be addressed specifically by the sender of information and can be done by setting return receipts and time stamps, which are some of the techniques available to ensure the information is received by the intended trade partner recipients (Greenstein & Vasarhelyi, 2002:240). These aspects of secure and valid transactions can be potential barriers preventing Internet usage in the activities and transactions between business organisations.

In the year 2000, the promise of cutting supplier costs by as much as 15% has made e-commerce and purchasing on the Internet (online) one of the hottest topics of the century (Lin & Hsieh, 2000: 105). The most significant savings came from the reduction in processing paper requisitions, purchase orders and invoices, while accelerating the flow of important information between the buyer and the supplier (Lin & Hsieh, 2000: 106). In the 1990s, software development companies such as SAP, Oracle and Baan, released electronic procurement products that could be integrated

into their enterprise resource planning (ERP) systems of IT, emphasizing the value of the Internet and Web browsers for online procurement.

3.4.3. The move from ERP legacy systems to SCM

Since the medium of the Internet was suddenly cheaper for businesses to exchange information amongst trading partners than using EDI systems, the next stage in the evolution of technologies was for businesses to implement enterprise resource planning (ERP) systems. ERP systems are meant to form the basis of organisations' infrastructure to share ideas, information and knowledge for improved decision-making (Bandyo-Padhyay, 2002: 71). The original intent of the ERP was to integrate and automate existing processes and systems, according to traditional performance metrics. Put another way, ERP benefits included the replacement of complex and sometimes manual interfaces between different systems with standardized, cross-functional transaction automation (Hendricks, Singhal & Stratman, 2006: 4). All enterprise data are collected once during the initial transaction, stored centrally and updated in real time (Hendricks, *et al.* 2006: 4). ERP uses database technologies that link functional areas' different technology applications together and can update all systems automatically when changes are introduced to data (Bandyo-Padhyay, 2002: 142). From this, ERP reports provide managers with a clear view of the relative performance of the various parts of the enterprise, which should stand it in good stead when trying to share information with external partners (Hendricks, *et al.* 2006: 4).

However ERP is criticised since no one asked *how* business processes had to be designed in order to take advantage of the new systems. Therefore the true capability of the ERP systems did not reflect in business organisations' results (Srinivasan, 2004: 319). The old and traditionally inefficient processes merely became automated with the implementation of ERP systems. Organisational restructuring may be required if a company decides to implement an ERP system and even the workforce characteristics has implications according to Gunasekaran & Ngai (2004: 274). In practice, the implementation of an ERP system can take between 6 months and three years, compared to a SCM system, which is between 6 months and a year (Hendricks, *et al*: 2006: 6). The timeframe required for the ERP

implementation also led to strategic ambiguity that stemmed from the lack of understanding of the business processes and the role of a suitable IT system for SCM (Gunasekaran & Ngai, 2004: 276). This made supply chain management (SCM) which followed ERP, look better since it included planning and execution systems (Srinivasan, 2004: 319) and could help eliminate supply non-value-adding activities (Gunasekaran & Ngai, 2004: 276). For example SAP/R3 has been widely implemented to create value-oriented supply chains that enable a high level of integration, improve communication within internal and external business networks and enhance the decision making process (Gunasekaran & Ngai, 2004: 283). Supply Chain Management software and its associated IT infrastructure arose as a direct result of some of the shortcomings of ERP systems, which mainly supported logistics operations.

3.4.4. SCM and the demand side approach

The SCM process has evolved over the years starting from its activities or functions such as materials resource planning (MRP), handling customer orders and payment being done manually, to the point where fully automated and integrated ERP systems were in use. The 2001 study done by TradeNetOne for the European Logistics Association (ELA) was intended to show how to adapt companies' processes for future necessities. The view by TradeNetOne (2001: 7) was that in future, fast delivery and higher flexibility will be important and companies will require more hardware and software. However the findings were that logistics service providers would have to adapt their information systems to the demands of their customers (i.e. the demand side).

This requirement for demand side SCM is reinforced by the criticism of the information technology (IT) focus for businesses, where the focus had shifted from customers towards IT systems, although it is also necessary for companies to develop their e-commerce websites for creating a good image (IT focus) with their customers on technology competencies (Gunasekaran & Ngai, 2004: 287). The response of businesses was to attempt to change its focus from supplying customers

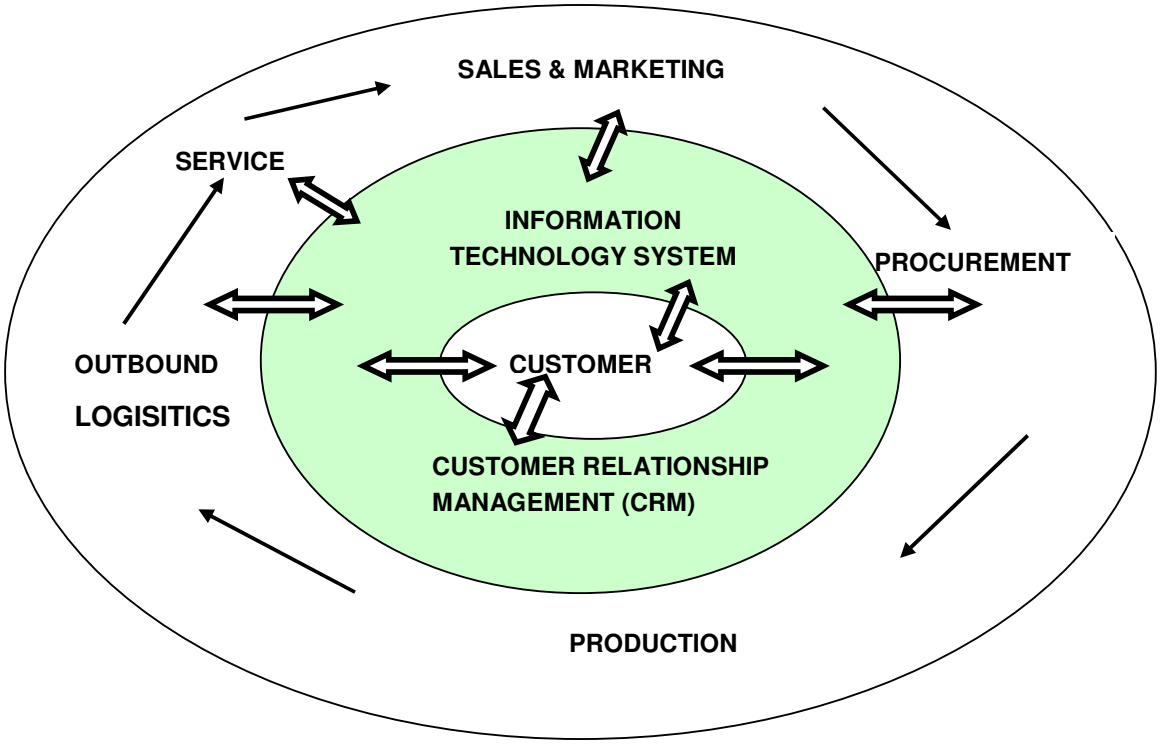
with end products or services, to the extent where the demand of customers influenced the business organisations' supply chain. Customer relationship management (CRM) modules of software were latched onto existing ERP systems to enable data mining, in order to improve the customer focus. However the entire supply chain still resembled a "push technology" phenomenon, where customers were at the end of the value chain, instead of allowing e-commerce and to support the seamless integration of partnering firms (Gunasekaran & Ngai, 2004: 288).

This push technology represented SCM as a supply side process where business organisations attempted to forecast market consumption (the demand of the market) in order for them to be the business that supplied the consumables in time and profitably. Competition from other players in supplying the forecasted demand, called for a change by business organisations operations and activities to swing from the supply side approach to a demand side approach towards doing business, where the value chain is more customer-oriented (Greenstein & Vasarhelyi, 2002: 13).

The effect of customer orientation means that customers can influence the supply chain of organisations more by having access to all functions of the supply chain, as opposed to the traditional receipt of finished goods at the end of the supply chain. The demand side approach is depicted in Figure 3.5 below. The demand side approach should *not* be seen in the same way as a "buyers market", as is the case where there are more suppliers than buyers. The demand side approach means that the customer can be included in decision-making by the business organisation by for example, being given access to the business organisation's intranet to access product catalogues, make price comparisons and even look at stock availability.

Figure 3.5 is presented on the following page.

Figure 3.5: The new demand side approach of supply chain management



Source: Adapted from Greenstein & Vasarhelyi (2002: 12)

In Figure 3.5 above, the customer has moved from being the recipient of finished goods and services at the end of a supply chain (as depicted in Figure 3.2 above) under the traditional supply chain, to being in the centre and the focus area of the approach.

The demand side approach illustrated in Figure 3.5 will save time for a business organisation, whose resources do not have to be unduly occupied by obtaining/chasing down information requested by various customers on a daily basis. The entire demand side approach is facilitated through the use of middleware, where the customer is "glued" to each function (such as logistics, marketing or billing) of the

supply chain through information systems technology and a customer relationship management (CRM) database as illustrated in Figure 3.5. It means that customers are able to share the information stored in the supplier's information systems by being able to check for example, the status of the order or service placed.

Surely the demand side approach is easier said than done? A study by Patterson (2003: 96) found that IT adoption have the capacity to impact a business' organisational structure, the firm strategy, the level of communication exchange, operational procedures, buyer-supplier relationships and bargaining power. This is in correspondence with the illustration of Figure 3.5 where the past relationships of a business organisation with its customers have evolved to be more collaborative and interactive in the new SCM. However there is a trade-off between the quality and quantity of information being made available to customers online and the IT skills of employees that should also be invested in for this to work (Gunasekaran & Ngai, 2004: 289). Juettner, Godsell and Christopher (2006: 989) call for the alignment between demand creation (a marketing perspective) and demand fulfilment (the SCM perspective) but what are the issues surrounding the integration of the supply chain?

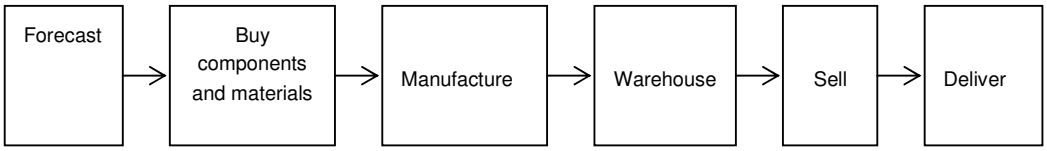
3.5. THE CHALLENGES OF SEAMLESS INTEGRATION

By looking at a demand side approach to supply chain management in the preceding section, it must be noted that information connectivity created the *potential* for developing response-based business models (as illustrated by Figure 3.5 above). However, in reality, there are few business organisations that utilise the demand side approach to SCM in full although many businesses cement their relationship with their partners through the use of digital technologies under the heading of *collaborative* commerce (Li, *et al.* 2005: 7*).* In collaborative commerce, business processes such as demand planning, planning and scheduling, order management, product development, vendor management, sales support and knowledge sharing are integrated between partners (Li, *et al.* 2005: 7) and leads to better business operations and information exchange. Wu, Yeniyurt, Kim and Cavusgil (2006: 493) see IT enabled supply chain capabilities as firm specific and hard to copy across

organisations, which agrees with the view by Patterson (2003: 96) that successful strategic IT systems are not easy to implement since they require major changes in how businesses operate internally and with external suppliers and customers (Gunasekaran & Ngai, 2004: 291). Wu, *et al.* (2006: 495) agree with the reality that information exchange allows businesses to share knowledge with its supply partners, but argue that information must be exchanged when it is needed, originate from a credible source and be in an adequate format.

To overcome the lack of ability to use the demand side approach to SCM fully, a compromise must be reached by contrasting the traditional anticipatory business practice (illustrated by the traditional supply chain in Figure 2.1), with the emerging time-based responsiveness model (Bowersox, 2002: 14). The traditional anticipatory business model entails the business organisation forecasting what customers require, based on insufficient useful information on customer behaviour. Throughout the chain, the high risk of misgauging the requirements were duplicated from left to right as the organisation moved along the supply chain, as illustrated in Figure 3.6 below. The business organisation may be using a combination of manual and electronic IT systems, however they still operate in anticipation of a forecasted demand realising a profitable venture for their market environments. This is the traditional value chain and supply chain approach illustrated by Figure 3.6 below.

Figure 3.6: The anticipatory business model

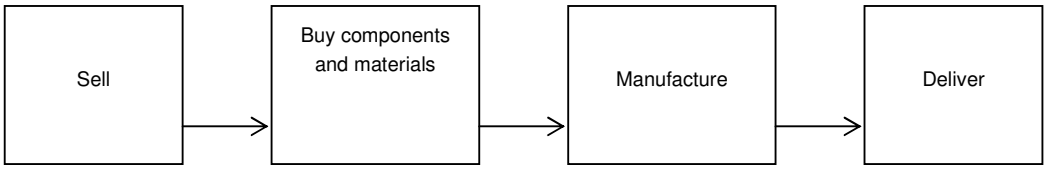


Source: Bowersox, (2002: 15)

The fundamental difference between the anticipatory business model and the response-based model of supply chain arrangements, necessary for the demand side SCM, is that of timing in the rapid exchange of information between supply chain participants (Bowersox, 2002: 15). The aim of the response-based model (illustrated

in Figure 3.7. below) is that all members of the supply chain synchronize their operations, to allow opportunities for reducing overall inventory and eliminate costly duplication practices.

Figure 3.7: The response-based business model



Source: Bowersox, (2002: 16)

The response-based model is similar to the demand side approach illustrated in Figure 3.5. above where interactivity between customers and business organisations' functions of the supply chain is intended to accelerate the flow of information via technology. Much friction, and a waste of valuable resources, results when supply chains are not integrated, appropriately streamlined and managed (Stock, 2001: 709).

In addressing the criticism by Gunasekaran earlier on the lack of IT skills amongst employees, Forman, Lippert and Kothandaraman (2006: 2) see appropriate integration as taking into account that today's society has knowledge workers as users of IT along the supply chain and that their work might be radically transformed by technology. These knowledge workers are similar in profile to users in buying centres and key influencers of purchase decisions and therefore are able to evaluate the effect of IT on their supply chain performance. However it is necessary to appeal to both the cognitive and the affective/emotive side of employees in implementing integrative IT systems along the logistics and supply chain functions, in order for the knowledge workers to see it as successful (Forman, *et al.* 2006: 9). It is therefore also necessary not only to test non-emotive attitudes in the South African research environment.

Wu, *et al.* (2006: 495) views the inter-firm integration as a two dimensional process: inter-firm technology integration as well as the better known functional activity integration. The aims of continuous access to information and direct connectivity with end customers (mostly other business organisations), necessitate that technologies be continually more Internet/ web-based to simplify seamless integration between existing information technology systems. Seamless integration is a noble objective, when no barriers exist to Internet usage, which motivates the need for functional SCM departments' and technical departments' respondents to be included in the study amongst South African based organisations.

Sahin and Robinson (2005:579) conducted a study where they used a simulation based scheduling process to analyse a manufacturer's ordering policies, transportation and order fulfilment activities under five alternative integration strategies. Their aim was to identify whether integration benefits derived from information sharing or co-ordination, while their experiment showed a 47.58% cost reduction for the organisation when it moved from their traditional supply chain towards an integrated system. The Sahin and Robinson findings were that co-ordinated decision making yielded more benefits than information sharing, however the simplicity of their integration strategy classification is worthy of being reproduced. The integration levels were simply subdivided according to "no information sharing, partial information sharing and full information sharing" (Sahin & Robinson, 2005: 585) which would be useful if accompanied by some IT integration options to determine the strategic variations in the South African context. The classification of IT system types put forward in a framework by Themistocleous, Irani and Love (2004: 398) showed that brand names of legacy systems were replaced by IT system characteristics in order to demonstrate the business integration activities. The IT system integration was classified according to: custom-to-custom, custom-to-packaged, custom-to-e-business, packaged-to-packaged, packaged-to-e-business, e-business-to-e-business and finally custom-to-packaged-to-e-business; to again emphasize the development of technologies within SCM over the years. Although this research covers a fifteen year period of South African IT systems and SCM developments, it is not guaranteed that respondents would know the difference

between their types of integration and therefore only their attitudes toward integration may be investigated rather than their knowledge of technical systems.

Strategic thought also comes into play when deciding which e-commerce software to use to integrate inter-organisational IT solutions. Conflicts that arise when organisations have more than one supply chain that they are part of, can be resolved by giving no organisation any veto-power on decision making for supply chain software, and to stay in line with the individual company's strategic goals and directions (Sarkis & Talluri, 2004: 318). This is in agreement with Rosenbloom (2006: 1) who argues that seamless integration is still more the exception than the rule since channel strategy issues (and therefore B2B power struggles) are still in play, even though technological barriers seem to be falling rapidly. He argues that strategic alliances require channel members to share similar long term goals but that the real core of trade partner relationships is still based on trust (Rosenbloom, 2006: 3). This argument was supported by McIvor, *et al.*(2003: 147) who said that a strategic partnership between buyers and suppliers where information can be exchanged on a regular basis, will require a culture change to create an environment of trust. This implies that despite the enabling role of technologies and the Internet within SCM information exchange, it would be also relevant to study the organisations' people and their attitudes (which points towards B2B culture) in the implementation of strategic goals and objectives amongst trade partners, than merely investigating IT system compatibility and integration (McIvor, *et al.*, 2003: 151). Lancastre and Lages concur (2006: 786) on the non-technical influences of the determinants of customer co-operation. They argue that it relies mainly on trust and commitment even in an electronic and real-time environment, which will in turn lead to meaningful information exchange and a long term relationship between buyers and suppliers.

3.6. THE VALUE OF THE INTERNET TO SCM

Most business organisations are not experiencing limited bandwidth, slow speed and lack of privacy that affect the access quality for B2C users and is termed the Digital Divide (Skinner, Biscope & Poland, 2003: 875). The reasons why the Internet can

possibly provide a seamless integration medium for business organisations that would help them achieve their objectives of timeous and accurate information flow between supply chain partners are manifold. According to Kobayashi, Tamaki & Komoda (2003: 769) the impact of the Internet is such that it allows the replacement of legacy systems (ERP, SCM or self-developed systems) with less manpower in less time through the ability to share business process integration templates online. The Internet also allows real-time information sharing and the ability to integrate several systems with enterprise application integration.

One particular Internet-SCM integration success story is that of Sun Microsystems, one of the leading computer manufacturing business organisations. Sun spent a lot of time during the mid-1990s by starting to outsource its manufacturing operations to electronics manufacturing service providers in the US and abroad. In order to outsource, they had to improve the ability to communicate with the more complex tiers of suppliers, who ranged between being EDI-proficient and moving on to XML, while others were not so advanced and they needed a SCM tool that worked with merely an Internet browser (Van Weele, 2005: 169).

Sun Microsystems created an Internet based portal framework, to make it easier for all suppliers and buyers to access the tools and information that they required (Van Weele, 2005: 169). The information available on the portal included publicly available information for prospective suppliers and confidential information for existing contracted suppliers who required purchase orders and forecasts. In this way, sensitive and public knowledge was made clear to the people who needed the information in time to participate in transactions.

The benefits to customers of having more comprehensive search capabilities, better price information and access to the best deals can only be realised by utilising the full extent of the Internet (Bowersox, 2002: 16). The Internet makes it possible to access a broad range of trading partners and exchange detailed information quickly and inexpensively. This means managers (who are the respondents on the survey questionnaire) have to redefine their business strategies with the available

information and communication technologies in existence currently, in order to facilitate their relationships with supplier and customers (Stock, 2001: 711). This strengthens the argument for conducting the current research study, limiting it for the sake of time and feasibility to selected business organisations within the South African business context.

3.7. CONCLUSION

This chapter gave a brief overview of the history of the Internet (1969), the web (1989) and the development of electronic commerce. A short discussion is given from the evolution of the purchasing process as it changed from paper-based, manual processes to incorporate automated electronic data interchange (EDI) and Internet based technologies. The integration of the supply chain management functional activities and its accompanying technologies is discussed from the perspective of the value chain that extends towards the supply chain, which consists of all business organisations' value chains together. A similarity is drawn between how the intranet capability of an organisation is like the value chain while the extranet capability represents the supply chain system.

The literature reviewed describes how in the time period 2000-2006, business organisations were coming to terms with the new information technology systems and the impact of the Internet and e-commerce on supply chain management. Especially noticeable was that the practice of information sharing or exchange was as important as partner technology integration. Instead of merely integrating processes, businesses had to strategise for whole networks of trading partners to be involved in alliances and partnerships, with the resultant access control and privacy of information becoming a relevant issue. Since ERP and SCM were traditionally considered to be "push" technologies, the call is made for the customers to be more involved in manufacturers' planning processes and therefore customer relationship concerns were highlighted as being more complex than merely attaching a CRM module to existing legacy systems. The issue of trust was only considered to be an ingredient for long term trading relationships to be developed, together with the

acknowledgement of a new breed of employees who are knowledge workers and can determine the success of partner relationships.

To conclude this chapter, it would make sense to collect the few consistent arguments to be taken into account before attempting to determine barriers to Internet use amongst South African organisations in their SCM. These are to be formulated into a research instrument in the next chapter and include determining attitudes amongst respondents about information sharing, partner integration in pursuing business strategies, goals and objectives and whether issues such as technical skills/knowledge affect the levels of trust. It is hoped that some insight might be gleaned about the influence of supply chain partners on businesses' use of the Internet for SC activities from both the suppliers upstream and the customers downstream.

CHAPTER 4

RESEARCH METHODOLOGY

4.1. INTRODUCTION

The task of research is firstly to determine the nature of the evidence needed to confirm or reject the stated hypothesis and secondly to design methods to discover and measure the evidence (Cooper & Schindler, 2003: 38). In order to understand the research methodology being applied, this chapter discusses in sequential order the research problem and objectives, the sampling process, the data collection method, the research instrument or questionnaire, the assessment of trustworthiness and the data analysis objectives and methods.

The value of the research study lies in the multi-disciplinary approach taken to combine SCM, consumer/user behaviour, information technologies and e-commerce into one research investigation in South Africa.

4.2. RESEARCH PROBLEM

The research problem is to investigate the current business practices of South African business organisations, to determine how they are utilising the technology of the Internet within their SCM structures. The *aim* of the research is to test the hypothesis that proposes that there are no barriers to Internet-based information technology systems' usage amongst supply chain participants. The *purpose* of the research study is to investigate the extent of usage barriers that exist amongst managers (those in charge of procurement, production, warehousing, finance and information technology) that prevent the use of Internet-based information technology (IBIT) usage within their SCM activities and functions.

The term Internet usage is focusing specifically on the amount of information sharing and the level of technology integration amongst supply chain participants. By identifying barriers that prevent South African business organisations from utilising IBIT for their SCM, a strategic training intervention can be designed in the future, that

will contribute to more focused learning in business organisations within the new technological economy in which they operate currently.

4.3. RESEARCH OBJECTIVES

The research objectives are divided into one primary and five secondary objectives.

4.3.1. The primary research objective

The primary research objective introduced in chapter one, is to identify barriers to the use of IBIT within SCM amongst South African business organisations' respondents.

4.3.2. Secondary research objectives

The secondary objectives of the research study are to:

- identify the types of information technologies currently in use amongst users in supply chain management.
- determine how often users from functional departments (finance, IT, purchasing, manufacturing, warehousing) use the Internet in SCM activities.
- investigate the relationship between organisational size and the use of Internet-based SCM technologies.
- investigate the level of integration between external SCM partners and the respondent organisation.
- investigate the amount of information exchange between partners in the supply chain.

These primary and secondary objectives together form the basis for designing the research questionnaire and the selection of specific methods of data analyses.

4.4. RESEARCH DESIGN

The research design constitutes the blueprint for the collection, measurement and analysis of data and expresses both the structure of the research problem and plan

of investigation to obtain empirical evidence on relations of the problem (Cooper & Schindler, 2003: 146).

The research study is considered a formal study since the preceding literature review of secondary data discussed in chapters 2 and 3 earlier, highlighted unanswered questions in the South African supply chain management context and served as the exploratory part of the research.

In this chapter, the research purpose and methodology is explained that will form the basis of the formal, cross-sectional (since it is carried out once only and at a particular point in time), primary research study (Cooper & Schindler, 2003: 149) conducted amongst South African supply chain managers. This study is done with an *ex post facto* (after the event) design, which implies that the variables under investigation cannot be controlled or manipulated and therefore an effort is made to limit the introduction of bias by the researcher (Cooper & Schindler, 2003: 149).

Before the research study was formulated and put into the field, there were three informal interviews (see reference list for contact details) conducted on the same day in June 2006, with manufacturers of SCM information technology systems and databases that are representative of the types of systems that respondents targeted within the research population have installed in the last 17 years (1990-2006). These preliminary interviews enabled a glimpse into the types of IBIT systems being used and the value of the research study was reinforced when unanswered questions surfaced within the South African SCM context. It also served to update the researcher's knowledge of what the operational realities were for the South African market environment before designing the research instrument.

4.5. THE SAMPLING PROCESS

The sampling process can be broken down into five different and sequential stages, according to Diamantopoulos and Schlegelmilch (2002:18). These are in order of

sequence: defining the sample population, specifying the sampling frame, selection of the sampling method, determining the sample size and drawing the sample (sample selection) in order to collect the data. What was done in the research investigation is briefly discussed under each stage of the sampling process.

4.5.1. Sample population definition

The research universe for any research investigation consists of population units, analysis units and population boundaries (Cooper & Schindler, 2003: 186). The applicable population units for this SCM research investigation consists of individuals, specifically managers in charge of SCM functions such as procurement/purchasing, production/manufacturing, warehousing, information technology and finance/administration.

The units of analysis are South African business organisations that fall within different industrial categories, while the population boundaries are limited to those organisations that are involved with purchasing and manufacturing activities and are most likely to have implemented SCM information technologies in the period 1990-2006 in South Africa.

The questionnaires were electronically distributed via the databases of the Institute of Purchasing Southern Africa (IPSA), the Council of Supply Chain Management Professionals (CSCMP), the training company Intenda, the software development company, SAP and a randomly selected list of manufacturing entities listed on the Johannesburg Securities Exchange (JSE), obtained from the BFA Mc-Gregor database.

In total 2568 questionnaires were e-mailed and with 113 respondents the response rate is 4.4%. The researcher did not have direct access to these databases therefore cannot verify the exact number of questionnaires distributed as communicated by the respective councils however, the time constraint necessitated finding only a

statistically sound sample instead of attempting a record-breaking response rate. Also, the need for informed and willing respondent organisations meant that existing contact details had to be accessible for the effective implementation of the research investigation.

4.5.2. Sampling frame

The sampling frame is closely related to the population/universe being studied since it lists the elements from which the sample is actually drawn (Cooper & Schindler, 2003: 188). However sampling in itself, means that certain population elements will be excluded from the sample, which leads to sampling error (Diamantopoulos & Schlegelmilch, 2002: 12). Since the entire sample frame may be inaccurate or include elements beyond the parameters of interest, the sample has to be drawn according to predefined units, analysis units and population boundaries (Cooper & Schindler, 2003: 188).

The sample selected out of the population universe allows the collection of data within the parameters of interest and these sample statistics are used as estimators of the population parameters of business organisations in South Africa (Cooper & Schindler, 2003: 186). The parameters of interest are discussed further in the section dealing with the research instrument (questionnaire) being applied and the methods of analysis, where the data collected are classified according to their meaning, their source and their time dimension based on their measurement properties (Diamantopoulos & Schlegelmilch, 2002: 4).

4.5.3. Sampling method selection

A distinction is made in the literature between probability and non-probability sampling methods that a researcher may select dependent on the requirements of the research investigation. A brief description of the various types of methods is listed in Table 4.1 showing the advantages and disadvantages of each.

Table 4.1: Comparison of probability and non-probability sampling designs.

Probability sampling designs			
Sampling Type	**Description**	**Advantages**	**Disadvantages**
Simple random	Each population element has an equal chance of being selected.	Easy to implement with random digit dialling.	Uses larger sample sizes. Is expensive. Requires a listing of population elements.
Systematic	Selects an element at the start randomly and thereafter selects every k^{th} element.	Simple to design. Easy to determine sampling distribution of means or proportion. Less expensive than simple random sampling type.	Periodicity within the population may skew the sample and results.
Stratified	Divides the population into subpopulations or strata and uses simple random on each.	Researcher controls sample size in strata. Increases statistical efficiency. Provides data to represent and analyse subgroups.	Increased error results if subgroups are selected at different rates. Is expensive.
Cluster	Population is divided into internally heterogeneous subgroups.	Provides an unbiased estimate of population parameters if properly done. Easy to do without a population list.	Often lower statistical efficiency due to subgroups being more homogeneous than heterogeneous.
Double sampling	Process includes collecting data from a sample using a previously defined technique, then selecting a subsample based on information found.	May reduce costs if first stage results in enough data to stratify or cluster the population.	Increased costs if indiscriminately used.

Table 4.1 continues on the following page.

Table 4.1: Comparison of probability and non-probability sampling designs (continued)

Non-probability sampling designs			
Sampling Type	**Description**	**Advantages**	**Disadvantages**
Convenience	Researchers or field workers choose whoever they find.	Normally the cheapest and easiest to conduct. Useful in the early stages of exploratory research.	Considered the least reliable design. Researcher has no controls to ensure precision.
Purposive has 2 types: • Judgment sampling	Sample conforms to certain criteria. Researcher selects respondents on a particular criterion.	This method can save costs and is useful at the exploratory levels.	
• Quota sampling	Certain relevant characteristics describe the dimension of the sample.	Can be used to improve representativeness and precision control.	Cannot give the assurance of representativeness of the specific variables being studied. Has some danger of systematic bias.

Sources: Adapted from Cooper & Schindler (2003: 199) and Diamantopoulos & Schlegelmilch (2002:14).

The sampling designs that were not selected for use in this study, are not discussed further but rather only the one that expands the research methodology for the current study. The sampling method selected for the research investigation consists of a purposive, non-probability judgment sampling (Zikmund, 2003: 392). By using the databases over which the researcher had no control, the number of population units had a non-zero chance of being randomly selected as respondents (which is characteristic of a probability sampling), while still looking for the SCM characteristic and being of moderate cost as compared to other sampling methods.

4.5.4. Sample size

The nature of this research study necessitates restricting the number of variables and respondents investigated in order to save costs and restrict the scope of the research to a realistic and practical time frame (Cooper & Schindler, 2003: 191). Some key statistical considerations in determining the sample size include: the degree of variability in the population, the desired degree of precision required and the desired degree of confidence associated with any estimates made (Diamantopoulos & Schlegelmilch, 2002:16). As the sample size increases, the sampling error decreases (Diamantopoulos & Schlegelmilch, 2002:13), which means that the results based on the sample would be not as different as that obtained when the whole population would have been studied.

According to Statsoft (2006a) the rule of thumb is for a sample size to be more than 50 in order to rule out serious biases and that for sample sizes greater than 100, the researcher should not be too concerned about normality assumptions. For a frequency distribution of data to be considered normal, it must have a mean of zero and a standard deviation of one.

For a sample size of less than 30 respondents, the researcher is limited to use only non-parametric statistics, which are less powerful statistical analysis techniques. However, the nonparametric test with a sample of 100 will provide the same statistical power as the parametric test with a sample of 95 (Cooper & Schindler, 2003: 532, Diamantopoulos, 2002: 67). It is necessary for the researcher however not to make assumptions about the (probability) distribution from which the observations are drawn (Gujarati, 2003: 465). The aim of collecting questionnaires is to make the sample size significantly large in order to have sub-samples (or groups) of respondents to compare to each other when in the statistical analysis phase..

If the population is more heterogeneous, a larger sample size would be required to capture the diversity of the population (Diamantopoulos & Schlegelmilch, 2002: 16). In this research study 2568 questionnaires were distributed to potential respondents via electronic mail (e-mail) and 111 usable questionnaires were returned. Two

returned questionnaires were not included in the data analysis due to one being faxed back with page numbers missing and the other being incompletely answered.

4.5.5. Sample selection

According to Cooper & Schindler (2003: 184) and Diamantopoulos & Schlegelmilch (2002: 15) the unrestricted simple random sample is the simplest form of probability sampling, which allows each population element a known and equal chance of being selected. By selecting a random sample, it allows the use of known probability values to be utilised for point estimates or confidence intervals in the statistical analysis of variables (Gujarati, 2003:121) that follows the empirical collection of data.

However since the sample selected for the SCM study was not random, other characteristics of a good sample were aimed for. A good sample, according to Diamantopoulos & Schlegelmilch (2002: 16) would have the following characteristics:

- It must strive to be accurate: which means there should be an absence of bias.
- It must provide a precise estimate: therefore the sampling error must be known or measurable.

Even though Diamantopoulos & Schlegelmilch (2002: 66) agree with Gujarati (2003: 121) that the sample should preferably be a probability sample it is important to note, however that probability sampling procedures does not mean that the sample will be representative of the population nor that the results will be accurate, but only that is allows the assessment of sampling error (Diamantopoulos & Schlegelmilch, 2002: 14).

The sample size is one determinant of the methods of statistical analyses to be done on the data collected, but to find a sample larger than 2568 would become too costly and time consuming in managing responses. It is also necessary to examine the measurement characteristics of the sample discussed later, since this also influences

the statistical analyses conducted. (Diamantopoulos & Schlegelmilch, 2002: 67). Before that, comment about the data collection methods is next.

4.6. DATA COLLECTION METHODS

Data collection within the applied sciences differs from the natural sciences where experiments are conducted under controlled circumstances. In applied sciences the communication approach involves surveying people and recording their responses (Cooper & Schindler, 2003: 319). The data collecting was done by the survey method, which was implemented by the e-mailing of a structured questionnaire to obtain self-reported data from managers in different functional areas of SCM (purchasing, production, warehousing, information technology and finance).

Qualitative studies may employ indirect methods such as experience surveys, focus groups or in-depth interviews (where the third person is used) to measure the respondents' attitudes and motivations towards certain things or activities (Zikmund, 2003: 130). Due to time and budgetary constraints no personal interviews were conducted with the respondents by either the researcher nor by field workers, but the electronic medium of distribution was meant to increase the geographic reach of the investigation according to the benefits derived in e-commerce research studies (Cooper & Schindler, 2003: 326; Rayport & Jaworski, 2003: 79).

The computer-delivered questionnaire is also an attempt to appear more "business-like" to the respondents and provided access to the computer-literate respondents, since computer literacy must be assumed applicable for the respondents in the year 2007 (Cooper & Schindler, 2003: 326). The value of the electronic distribution of the questionnaire is to be consistent with the premise that most South Africans are familiar with e-mail as the modern, everyday form of business communication (World Wide Worx, 2006), however the e-mail survey method was chosen after due consideration of the following:

- Computer delivered e-mail questionnaires meant that it could be forwarded easily to a relevant respondent in the case of it reaching the unintended person.
- No interviewer assistance was required in order to complete the e-questionnaire.
- The interviewer presence was not required as would have been the case for personal or telephonic data collection methods.
- The risk was eliminated of respondents being "unwilling to talk" to people such a filed worker, as would have applied to personal and telephonic interviews.
- There was no need for repeated call-backs when the respondents were not reached.
- The e-mail is the lowest cost option as compared to the other two (all from Cooper & Schindler, 2003: 324).

The following section explains how the data collection was completed.

4.6.1. Data collection steps

The first step towards the primary research collection was to electronically mail (e-mail) the questionnaire and introductory letter to the contact person at the company targeted. The introductory letter served as informed consent to the respondent since e-mail is subject to "spamming", a 21st century phenomenon (social evil!) of consistent and relentless, unsolicited e-mail.

Two weeks thereafter a follow up e-mail message was sent out. If the response rate was too low, it may have been necessary to do telephonic follow-up after the second reminder and work towards the completed questionnaire being returned before the due date. However respondents returned their answers before the due date provided in the introductory letter. The deadline for completing the questionnaires needed to fit into the time constraints of the research project and therefore could not be completed by the respondent later than four months after receipt.

It is not known whether the respondents were encouraged to return their questionnaires electronically since the return address was non-personalized to the researcher and therefore created an impression of being confidential and non-threatening to the respondent.

After manual data coding of the completed questionnaires by the researcher, the statistical department of the University of Pretoria (Statomet) was involved in capturing the encoded data and processing it with the Statistical Analysis Software package (SAS).

The nature of the data collected is both qualitative and quantitative in nature to extend the results beyond the mere description of current SCM technology practices and towards the measurement of the extent of potential barriers to Internet-based SCM technologies. The value of applying both the qualitative and the quantitative approaches meant that the study will go beyond exposition, to develop an argument to explain the findings as recommended by Cooper & Schindler (2003: 36).

4.6.1. Questionnaire design

The questionnaire or research instrument was compiled by adapting selected questions from previously validated instruments used in the research study conducted by Patterson (2003: 106-116), in combination with audited questionnaires published in Stock & Lambert (2001: 715-719) in order to obtain a South African perspective. The limitation of the Patterson questionnaire was that it was used to collect data telephonically only and in the South African context, this may *not* be economically feasible over the geographic reach as mentioned before in the section on data collection methods.

The questionnaire has three sub-sections that firstly pertain to information about the respondents and their business organisations, secondly investigates their current use of technologies and thirdly deals with the level of integration with supply chain partners. The structure is briefly outlined below:

- **Section 1: background information**

This section collected information on the respondent's main area of responsibility, their gender, the type of business organisation participating in the research study and the number of permanent employees the organisation employs currently.

- **Section 2: technology usage**

This section interrogates the age of the technology systems in years and measures the frequency of the respondent's use of different types of software.

- **Section 3: supply chain partner interaction**

This includes a breakdown of the type of goods ordered from suppliers, a checklist to determine whether information files are manual or computerised, the method of monthly ordering of goods used by respondents, a measure of the administrative tasks involved, the benefits of Internet based technologies being experienced, the frequency of the Internet use and the respondent's relationship with their supply chain partners.

The subsections of the research questionnaire can be translated into the research objectives of the study, which in turn can be matched to the research constructs as listed in Table 4.2 below.

Table 4.2 is presented on the following page.

Table 4.2: Research objectives and constructs for the study.

Research objectives	Research construct
1. To identify the types of information technologies currently in use amongst users in supply chain management.	Technology types (TT)
2. To identify how often users from functional departments (finance, IT, purchasing, manufacturing, warehousing) use the Internet in SCM activities.	Departmental Internet use (DIU)
3. To investigate the relationship between organisational size and the use of Internet-based SCM technologies.	Organisational size Internet use (OSIU)
4. To investigate the integration of external SCM partners and the organisation.	Partner Integration (PI)
5. To investigate the level of information exchange between specific partners.	Information exchange (IE)

Source: original compilation.

More in-depth discussion follows on the questionnaire methods of response.

4.6.1.1. Questionnaire response methods

In order to move beyond qualitative data gathering to meet the objectives set out in Table 4.2. the nature of the data can determine whether it can be quantitatively as well. The are four different data levels or measurement scale types which in ascending form (from the lowest to the highest level) are called nominal, ordinal, interval or ratio type data. These influence the methods of response for questionnaire items.

Nominal data serves only to identify (e.g. male or female) and can therefore only be counted (Diamantopoulos & Schlegelmilch, 2002:24). Ordinal data can provide an ordered relationship (e.g. from bad to worse) but is limited in being unable to explain

how much better or worse the respondent feels about technologies. Interval data such as temperature readings are characterised by the equality of the intervals and permit inference being made as to the extent of differences between “bad” and “worse”. However interval data lack a true zero point, which is characteristic of ratio data according to Diamantopoulos & Schlegelmilch (2002:26) and Cooper & Schindler (2003:223). An example of ratio data would be age in years, which requires a true zero since no person or computer system can have negative numbers of years in existence (Cooper & Schindler, 2003:223).

Besides the reality that the data being collected by the research instrument can have different measuring levels as explained by Cooper & Schindler (2003: 223); Zikmund (2003: 324) concurs that the individual questions on the research instrument can also be formatted according to different scaling formats. Scale formats are useful when trying to measure more abstract constructs (such as customer attitudes) for which no standardized scale exists (Cooper & Schindler, 2003: 250). The custom designed questionnaire used in this study therefore had to provide the respondents with different response types for example to choose out of a checklist; choose between a dichotomy (yes or no responses only); or to rank options directly by selecting a specific point on the scale (Cooper & Schindler, 2003: 252, Diamantopoulos & Schlegelmilch, 2002: 31).

The choice of selecting different scaling formats depends on the type of research problem, the respondent groups and the construct characteristics to be measured. The questionnaire was used to link the hypothesis, variables and individual questions in a structure according to the aims determined by the five research objectives discussed above. Table 4.2 can now be expanded to include the level of data measured and illustrate how questions have been linked to different objectives as illustrated in Table 4.3 on the following page.

Table 4.3: Link of objectives, constructs, questions, data levels and variables

Reference to research objective:	MAIN CONSTRUCT	Q - Ref	Question(Q) number reference and data level type.	Description of variables (V) at every question number.
1. To identify the types of information technologies currently in use amongst users in supply chain management.	TECHNOLOGY TYPES (TT)	Q4, Q5, Q6	Q4= ratio, metric Q5=ordinal Q6= ratio	Q4= nr. of employees [V5] Q5 = age of technologies [V6] Q6 = software types in use & frequency of use (direct rating) [V7-V14]
2. To identify how often users from jobs in different functional departments) use the Internet in *SCM activities* (mktg, routing, tracking, paying).	DEPARTMENTAL INTERNET-SCM USE (DISCMU)	Q1, Q3, Q8, Q10, Q12	Q1, Q3 = nominal (non-metric) Q12= ordinal (non-metric)	Q1=Functional role in dept.[V2} Q3 = Main bus. type in SC [V4] Q10 = frequency of doing admin task [V39-V50] Q12=use of the Internet (Rank order 1 Never, 2 Seldom, 3 Often) in SCM activities [V57-V68]
3. To investigate the relationship between organisational size & type and the amount of benefits from Internet-use	ORGANISATIONAL SIZE/TYPE INTERNET BENEFITS (OIB)	Q2, Q3, Q4, Q11	Q2 = nominal Q3 = nominal Q4=ratio Q11 = ordinal	Q2= dichotomous nominal, male/female [V3] Q3 = Determinant choice of business area as mfer, supplier. [V4] Q4= nr. of employees [V5] Q11 =benefits received from Internet (none, little, much) [V51-56].
4. To investigate the level of integration between SCM partners and the respondent organisation.	PARTNER INTEGRATION	Q1, Q3, Q7, Q9	Q1 = nominal Q3 = nominal Q7 = ratio constant sum Q9 = ordinal	Q1 = main job description of respondent [V2] Q3 = main area of business [V4] Q7 = percentage of goods ordered [V15-V19] Q9 = methods of order entry [V29-V38]
5. To investigate the amount of information exchange between partners in the supply chain.	INFORMATION EXCHANGE	Q13, Q14	Q8 = nominal category Q13 =nominal, dichotomous agree/disagree Q14 =Likert scale, ordinal treat as ratio	Q8=Information file type Direct Quantification of either (manual/computerised) [V20-V28] Q13 = statements about suppliers [V69-V75] Q14 = Reasons for disagreement /reasons not to share information [V76-V83]

Source: original compilation

4.6.2. Pre-testing of the questionnaire

The draft questionnaire was pre-tested by administering it for completion by respondents similar to those included in the research study. The data collection process (i.e. survey via e-mail) was piloted in order to prevent any loss of questions over the electronic telecommunications medium and in order to make any changes necessary before it was administered to the research sample (Cooper & Schindler, 2003: 86, Frazer & Lawley, 2000: 33). Pre-testing was needed since the respondents' answers from the effective sample will be used to test the hypothesis listed above (Cooper & Schindler, 2003: 86) and to measure the strength of the relationship between the variables being measured.

However, no amount of pre-testing of a questionnaire can eliminate the measurement error that will creep in whenever any measurement instrument is being applied. Measurement error is the difference between the observed score, which the respondents complete on the questionnaire and the true score (i.e. the accurate reflection of the characteristics being measured) and this indicates measurement quality (Diamantopoulos & Schlegelmilch, 2002: 33). Measurement quality means that the researcher used a valid questionnaire on which to base the statistical analysis' findings and conclusions, which brings the discussion to the topic of sensitivity, validity and reliability, in an attempt by the researcher to minimise measurement error.

4.6.3. Reliability and validity

There are generally three major criteria for evaluating measurements viz. sensitivity, validity and reliability according to Zikmund (2003: 300). A sensitive measure (such as the Likert scale) has numerous items on the scale instead of having dichotomous options only (for example yes/no, male/female). Sensitivity can also be accomplished by allowing for subtle attitude changes on the scale (for e.g. having a scale that ranges in 5 steps from strongly agree, mildly agree, neither, mildly disagree or strongly disagree) as put forward by Zikmund (2003: 305). This section will further explain how to assess the reliability and validity of the questionnaire, given

that being reliable does not automatically presuppose that the questionnaire will be valid (Diamantopoulos & Schlegelmilch, 2002: 34).

4.6.3.1. Reliability

Reliability relates to the truthful replicable consistency of the measure(s) while validity is concerned with how well the concept is defined by the measure(s) (Statsoft, 2003). Reliability pertains to the representivity of the results of the specific sample for the entire population from which it is drawn. In other words, reliability indicates how probable it is that similar relations between variables would be found if other samples were drawn from the population.

Zikmund (2003: 300) sees reliability as applying to a measure that yields similar results over time and situations, which underpins the concepts of repeatability and internal consistency. This is in agreement with other definitions of reliability as the extent to which a variable or set of variables is consistent in what it is intended to measure (Statsoft, 2003) or is free from random error (Diamantopoulos & Schlegelmilch, 2002: 33).

Random error is one part of the measurement error and can also be defined as inaccuracies of measuring the “true” variable values due to the fallibility of the measurement instrument (Statsoft, 2003). Random error will creep in whenever one is administering a measurement instrument, since it is difficult for the observed score or value of a characteristic being measured, to be exactly equal to its true score or value (Statsoft, 2003, Diamantopoulos & Schlegelmilch, 2002: 32).

The other part of the measurement error is called systematic error and is basically a bias that inflates or underestimates the true score of a measurement (Diamantopoulos & Schlegelmilch, 2002: 33). If a particular measurement can be free from *both* systematic and random error, it indicates the reliability of the measure (Diamantopoulos & Schlegelmilch, 2002: 32). Refer to section 4.6.2.3. for specific statistical tests of reliability. A brief look at validity follows.

4.6.3.2. Validity

Validity forms can be external or internal according to Cooper & Schindler (2003: 231). The external validity of research findings refers to the data's ability to generalise across persons, settings and times. Internal validity is limited in this study to the ability of the research instrument to measure what it thinks it is measuring.

In order to improve the likelihood that the research study is actually measuring what it thinks it is measuring (i.e. that the questionnaire is valid) it is important to distinguish between the various validity assessment approaches as summarised in Table 4.4. The validity approaches deal with content validity, criterion validity and construct validity of which the latter is the one proven later in chapter 5.

Table 4.4 is presented on the following page.

Table 4.4: Different approaches to validity assessment

Approach	Description (s)
1.Content validity	The extent to which a measure *appears* to measure the characteristic it is supposed to measure. This approach can be sub-divided into two sub-categories: face validity and sampling validity.
1.1. Face validity	The extent to which the measure (*prima facie*) seems to capture the characteristic of interest.
1.2. Sampling validity	The extent to which a content population of situations relating to the characteristic of interest is adequately represented by the measure concerned.
2. Criterion validity (also known as pragmatic or empirical validity)	The extent to which a measure can be used to predict an individual's score on some other characteristic (the criterion). It has two sub-divisions: concurrent and predictive validity.
2.1. Concurrent validity	The extent to which a measure is related to another measure (the criterion), when both are measured at the *same* point in time.
2.2. Predictive validity	The extent to which *current* scores can be used to *predict* future scores of another measure (the criterion).
3. Construct validity	The extent to which a measure behaves in a theoretically sound manner. It has three subdivisions: convergent, discriminant and nomological validity.
3.1. Convergent validity	The extent to which a measure is *positively* related to other measures of the same concept obtained by independent methods.
3.2. Discriminant validity	The extent to which the measure is *not* related to measures of different concepts with which no theoretical relationships are expected.
3.3. Nomological validity	The extent to which a measure is related to measures of other concepts in a manner consistent with expectations.

Source: Diamantopoulos & Schlegelmilch (2002: 35)

It is important to note that it is the *overall*, collective picture painted by all the different kinds of validity that determines the overall validity of a measure (Diamantopoulos & Schlegelmilch, 2002: 35). The data analysis process discussed below is dependent on whether the research instrument (questionnaire) can pass the tests of validity and reliability and therefore specific tests of validity and reliability will be discussed in the following section.

4.7. DATA ANALYSIS PROCEDURE

The data analysis objectives must be in line with the reason why the research is being done (i.e. the research objectives) and therefore the process of setting the current data analysis objectives can be described in terms of the research investigation's content and focus (Diamantopoulos & Schlegelmilch, 2002: 64).

4.7.1. Data analysis content

The content refers to the variable(s) that were selected for inclusion into the research study. Broadly speaking, the variables relate to the sections of enquiry as discussed before under the questionnaire design section of this chapter, however the research instrument can be viewed in the annexure of this document to see all 83 variables used in the investigation.

4.7.2. Data analysis focus

Focus refers to whether the research aim is:

- to describe (i.e. to paint a summary picture)
- to estimate (which is to use the information obtained on the sample to make an informed guess based on incomplete information)
- to make inferences, i.e. decide whether to hypothesize, that is to test propositions regarding the variable(s) of interest, according to Diamantopoulos and Schlegelmilch (2002: 65).

The data analysis focus will be explained in more detail below to demonstrate that the researcher firstly used a descriptive focus, followed by an estimation focus and ending with a hypothesis-testing focus in explaining the data patterns.

4.7.2.1. A descriptive focus

It is advisable to use descriptive statistics as the initial step of data analysis in order to examine the data and develop sufficient knowledge to describe the phenomena according to the data analysis objectives set beforehand. It is still possible also to introduce errors even at the data input stage, therefore this step is essential for scientific procedures to follow.

Before any descriptive statistics can be generated using the SAS program and examined, the completed questionnaires had to be edited to determine completeness, detect missing values and code the data for input into electronic form, processing and reporting. Choosing the methods of analysis is dependent on all the previously mentioned aspects such as sample size (111 for this study), levels of measurement (metric or non-metric) and the number of variables (83 under investigation), amongst others (Diamantopoulos & Schlegelmilch, 2002: 66).

Metric data (interval or ratio data) calls for parametric statistics for analysis and non-metric data which includes nominal or ordinal data uses non-parametric statistical techniques (discussed later under the chi-square discussion), according to Diamantopoulos and Schlegelmilch (2002: 27). When the variables of interest are measured on an interval or ratio scale and therefore have many potential values as for example in using a Likert scale, then frequency tables may not be sufficiently informative and further statistical techniques have to be applied (Cooper & Schindler, 2003: 488).

Regardless of the ultimate goals being inference and/or hypothesis testing, a descriptive statistical analysis is useful in order to present the data in an easily understood manner, by drawing up frequency distribution tables and displaying data in histograms and frequency polygons, even if it serves the sole purpose of adding

up the number of observations correctly or examining percentiles (Diamantopoulos & Schlegelmilch, 2002: 73, 83).

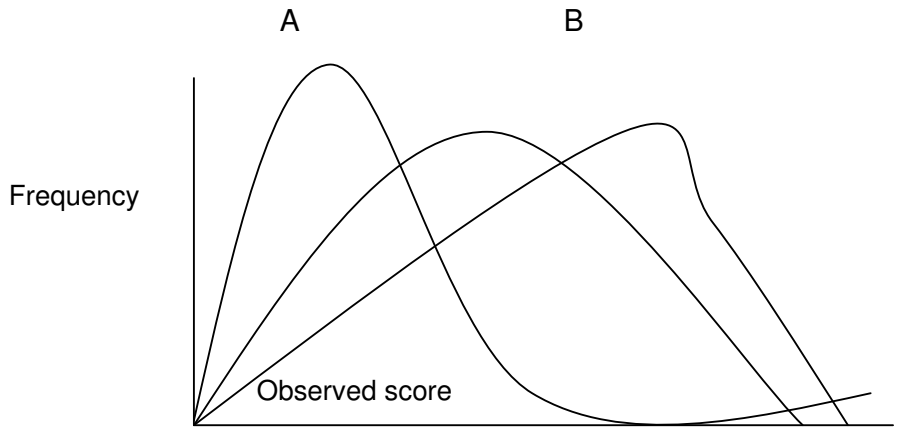
Descriptive statistics was used to examine each variable's frequency distributions and cross-tabulations were used to summarise data from more than one group of respondents in comparison to specific variables. Both the qualitative and quantitative data were used to determine measures of location and variability (Statsoft, 2003). Cross tabulations is explained more in the section dealing with hypothesis testing.

Measures of location include calculating the means, modes or medians, depending on whether the data levels are interval/ ratio data, nominal or ordinal data respectively (Diamantopoulos & Schlegelmilch, 2002: 95). Measures of variability refer to how many standard deviations an observed score is situated relative to the measure of location when the data frequency distribution is examined.

The shape of a frequency distribution (i.e. its flatness/peakedness and skewness) can be compared to known frequency distributions of which the normal distribution is well known. In Figure 4.1 below, the normal distribution is presented by the B-curve.

Figure 4.1 is presented on the following page.

Figure 4.1: Three frequency distributions differing in skewness



Source: Diamantopoulos & Schlegelmilch (2002: 91).

From Figure 4.1. it is seen that the B-distribution average or mean is in the middle when there is no skewness, is skewed to the right when higher frequencies tend to appear towards the end of the distribution as in C or is skewed negatively when the opposite to C applies as depicted in A. Flatness is referred to as kurtosis to describe the peak of the curve (Diamantopoulos & Schlegelmilch, 2002: 92).

In the descriptive focus thus far, the data had applied to the population sample, which is a subset of the total population. The next level of the data analysis procedure introduces the estimation focus briefly to allow for the estimation about the population measures of location or variability.

4.7.2.2. An estimation focus

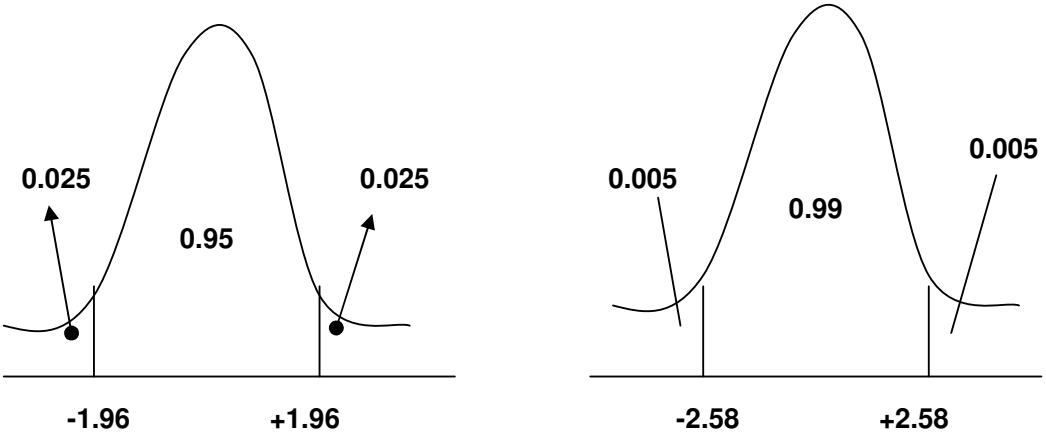
Since the data (mean and standard deviation) obtained from the empirical data collection applies to the sample, the estimation focus allows for the estimation about the population measures of location or variability.

Estimation is the process of using the sample statistic for example the sample mean (depicted as x bar) or the standard deviation (*s)* to estimate the population mean (μ) or the variance (σ) as the corresponding population parameters (Diamantopoulos &

Schlegelmilch, 2002: 116). Due to the fact that sampling error will distort the estimation process, a range of the estimate would make any researcher more confident that the population parameter is somewhere in the *interval* on either side of the sample point estimate that is known.

In order to set confidence intervals for example to be 95% or 99% sure that the confidence interval will contain the parameter being estimated, the diagram below (Figure 4.2) explains the concept a little easier.

Figure 4.2: 95% and 99% confidence intervals for the normal distribution.



Source: Diamantopoulos & Schlegelmilch (2002:122)

In Figure 4.2 above the graph with 0.95 in the main area depicts the chances that the estimated value will fall within the range between it plus or minus (+/-) the values of +1.96 and –1.96. These values represent the *z-scores* obtained from known statistical tables, so that all calculations can be standardized in case of uneven numbers in the groups between compared for example. In our research study where the proposition is that no difference exist from one business to the next, it means the likelihood of value to estimate the correct population parameter can go in either direction, therefore the residual 5% chance of being wrong is split into two and equals 0.025 respectively.

For being 99% confident the diagram on the right hand side will split the residual 1% chance into 0.005 each. In the discussion on hypothesis testing, more light will be shed on what *values* are *critical* from the calculations made form the sample population. Suffice to say at this point that when more confidence is required under the 99% graph, the standard deviation values of either –2.58 or +2.58 obviously require a bigger area under the graph or a bigger probability to be attained that the population parameter being sought will fall into the set confidence interval.

After determining summary statistics, without estimating the population parameters, the averages (means) of distributions and variances can be interpreted by applying the techniques of hypothesis testing or inferential statistics, which is discussed next.

4.7.2.3. A hypothesis-testing focus

In the previous discussion on estimation, as applicable to any research instrument sent into the field, there is an element of sampling error. If the estimation sample was chosen probabilistically, we can assess the likely sampling error and incorporate it into the population estimates, ending up with confidence intervals about the estimation. When testing hypotheses, the sampling error can be addressed by using significance tests, which are statistical techniques that help the researcher to decide if sample results are likely to hold in the population as well (Diamantopoulos & Schlegelmilch, 2002: 139).

From Figure 4.2. above, the 5% or 1% decision is known as the significance level and is an association of the probability or chance of the researcher being wrong. We can denote this *significance level* as Alpha or α. If we run any statistical test on the data and obtain a value that has a probability (or p-value as the SAS program will automatically calculate!) of occurrence of *less than or equal to* the Alpha (α), then we can reject our original premise as encapsulated in a Null hypothesis statement in favour of the alternate hypothesis (Diamantopoulos & Schlegelmilch, 2002: 139).

If on the other hand, the probability or p-value obtained with the test result is more than the α value, the results of the tests are seen as *non-significant* and we cannot reject the Ho, null hypothesis. Hypothesis testing discussed in chapter 5 was done using this classical or sampling-theory approach, since a hypothesis can be rejected or fail to be rejected based on the sample data collected (Cooper & Schindler, 2003:521). But first, the steps of hypothesis testing are set out below, with explanations related to chapter 5, in Table 4.5.

Table 4.5 is presented on the following page.

Table 4.5: The sequential steps in conducting a hypothesis test

Steps to be taken.	Reasons why and explanations for what is applied in chapter 5 .
A. State the null hypothesis, Ho and the alternative Ha.	Ho and Ha are non-directional, which means that no significant differences are anticipated.
B. Choose the statistical test to be done.	Descriptions of univariates are based on frequencies, means and standard deviations. For bivariate or multivariate analyses, comparisons are made in contingency tables. Read about the chi-square test below. Tests of association is done by the factor analysis discussed later.
C. Select the level of significance ($\propto$ = the Greek letter alpha). (dependent on how much risk of being wrong is willing to be accepted by the researcher).	Two-tailed tests are done at the 5% level of significance in this study.
D. Compute the calculated difference value.	After data collection, coding and input, the SAS program can calculate test values.
E. Obtain the critical test value.	For example the chi-square* ($\lambda 2$) value may be more or less than the significance value.
F. Interpret the test.	What are the implications of the results: significant or non-significant?

Source: adapted from Diamantopoulos & Schlegelmilch (2002:136)

**Section E is completed every time an analysis is completed for the results of the chapter 5 tests, even if all the steps are not explained in such detail in the next chapter.*

* Chi-square (λ^2) tests are the most widely used non-parametric test of significance (Cooper & Schindler, 2003: 536). If the qualitative parts of the research analysis focused on variables by themselves in order to answer some of the research objectives, then the bivariate and multivariate tests will be compared as to their expected and observed values, in order to answer all the research questions. The greater the difference between the categories of business organisations or the difference between functional areas of the respondent organisations, the less is the probability that these differences can be attributed to chance and therefore the larger the chi-square value. If we do not reject the null hypothesis when the calculated evidence suggests that we should, we are committing a Type I error (Cooper & Schindler, 2003: 525) and when we do reject the Ho when we should not have, it will be a Type II error.

Perhaps it would be most useful not to accept or reject hypotheses without ensuring that the research instrument is valid and reliable in the first instance. The test of validity and reliability applicable to this research study is briefly explained next (Cooper & Schindler, 2003: 235).

4.8. TEST OF VALIDITY

A factor analysis is a statistical test done after obtaining the descriptive statistics to verify the validity of the questionnaire items. The validity test (factor analysis) discussed here deals specifically with the construct validity, to determine what accounts for variance in the underlying construct being measured and determining how well the test represents it (Cooper & Schindler, 2003: 232). Factor analysis is done on measures of continuous scales in order to limit error variance and test the portability of the instruments in the South African context (Cooper & Schindler, 2003: 234).

Since a large part of this research project deals with respondents' attitudes towards the Internet in their SCM functions, the variables being investigated yielded a large number of varied responses. This is also a direct result of the questionnaire/measurement scale being designed to be sensitive to attitudinal changes (Zikmund, 2003: 300). The main applications of factor analysis techniques, which is a concept first introduced by the attitudinal studies pioneer Louis Thurstone in 1931, are to reduce the number of variables and to detect structure in the relationships between variables by classifying variables (Statsoft, 2003). By being applied as a data reduction or structure detection method, factor analysis helped to determine the construct adequacy or construct validity of the questionnaire (Cooper & Schindler, 2003: 234).

If the validity test entails looking for patterns among the variables to discover if an underlying combination of the original variables (a factor) can summarize the original set, it means that the variables are found to be highly correlated with each other (Cooper & Schindler, 2003: 613). They can therefore be combined into one factor, which is the same principle that is applied to principal components analysis (PCA), which explains why factor analysis is sometimes referred to as PCA (Statsoft, 2003).

4.9. TEST OF RELIABILITY

Reliability and item analysis may be used threefold; to either construct reliable measurement scales (questionnaires), alternatively to improve existing scales or to evaluate the scales already in use (Statsoft, 2003).

Each measurement (response to an item) reflects the true score for the intended variable and some random error. Reliability can therefore be seen as an index of the proportion of true score variability that is captured amongst respondents relative to the total observed variability (Statsoft, 2003).

The reliability index can be expressed as: $R = \sigma^2_{\text{(true score)}} / \sigma^2_{\text{(total observed)}}$

The more items (or variables) were included in the research study design to measure a particular concept, the more reliable will the measurement (sum scale) be according to Statsoft (2003).

The most common index of reliability is the Cronbach' coefficient Alpha or Cronbach's alpha (∝). This value is calculated by the SAS program and is not to be confused with the Alpha value discussed under significance testing above, which is set by the researcher.

According to Diamantopoulos & Schlegelmilch (2002: 36) researchers can also approach the reliability assessment procedure by splitting different samples to check the consistency of results over sub-samples of respondents. This entails checking consistency of results over individual *items* comprising a composite measuring scale. Zikmund (2003: 301) calls the technique of splitting halves of the data the split-half method and uses it to check internal consistency by dividing and comparing even numbered items with odd numbered items.

4.10. RELIABILITY AND SIGNIFICANCE TESTS

In order to emphasise the discussion about estimating what the population parameters or even respondent behaviour is like, more is referred to here in terms of reliability and p-values. The reliability of the questionnaire can be quantitatively estimated and represented using a standard measure such as a p-value or statistical significance level (Statsoft, 2003). The statistical significance (p-value) of a result is the likelihood that the observed relationship (between variables) or a difference (between means) in the drawn sample is by pure chance and not really in existence in the population. *This means that the higher the p-value, the less believable and reliable will be the results of observed relationships from the sample as being the relationship of the respective variables in the population.* Therefore it is again required that the sample size is large enough (i.e at least more than 30 respondents) to decrease the errors of reliable measuring (Statsoft, 2003).

4.11. CONCLUSION

In order to conclude the discussion on the research methodology, a summary of the approach to the research study is provided here.

The research study involves investigating the extent of possible barriers to the use of IBIT within South African based SCM organisations. Respondents were targeted by the distribution of e-mail questionnaires in a survey method of data collection.

With a response rate of 4.4%, it means that 111 usable questionnaires were collected from respondents out of 2568 questionnaires distributed over a four calendar month period in 2007. The data collected were coded and entered into the SAS program and processed to obtain descriptive data with univariate frequency distributions and where applicable the summary statistics of the mean and standard deviations.

A descriptive focus allows the five research objectives discussed in this chapter to be attained without the need for estimation of population parameters. In order to test the statistical significance of the data obtained, variables are compared within categories and factor analysis used to ascertain the validity of the research instrument used.

This chapter briefly introduced the reader to only the relevant statistical concepts i.e. in particular the ones that were applied to the research data obtained from the investigation. If it is necessary to be enlightened on the reasons why a particular stage or technique is applied in the research study analysis, then it is discussed under the applicable section in the penultimate chapter 5. The impact of the data patterns and interpretation of the findings follow in a more holistic discussion in the final chapter.

CHAPTER 5

RESEARCH FINDINGS

5.1. INTRODUCTION

This chapter is divided into three main areas of discussion according to how the research instrument (questionnaire) was divided. The three main sections in sequential order are: background information (results follow in section 5.2.), technology usage (results follow in section 5.3.), and supply chain partner integration (results follow in section 5.4.).

The background information section focuses on both the individual respondent's main job description and the organisation's main area of business. The section on technology usage gives some descriptive insight into the organisation's information technology age and types being used currently in the respondent's part of the supply chain. The section on supply chain partner integration is subdivided into firstly, information about the level of integration between supply chain partner organisations and secondly, the amount of information that is exchanged amongst these partner organisations.

The variables included in the research questionnaire are presented here as in their *univariate descriptive* measures of location and variability. Measures of location include calculating the means, modes or medians, depending on whether the data levels are interval/ ratio data, nominal or ordinal data respectively (Diamantopoulos & Schlegelmilch, 2002: 95). Measures of variability refer to how many standard deviations an observed score is situated relative to the measure of location when the data frequency distribution is examined. For *bivariate or multivariate* analyses, comparisons are made in *contingency* tables (also known as cross tabulations).

Finding the descriptors and doing the comparison of variables in cross tabulation tables are based on the steps of the hypothesis testing (refer to Table 4.5). The steps are reiterated here in order to show the modus operandi followed in conducting

the statistical analysis and to know the basis of interpreting the findings presented in this chapter. **The steps involved in hypothesis testing for this chapter are:**

- *State the null hypothesis, Ho and the alternative Ha.* Note that Ho and Ha are *non-directional*, which means that no significant differences are anticipated between groups of respondents or organisational types. The two hypotheses are stated for every section below as the variables under scrutiny may differ.
- *Choose the statistical test to be done.* Descriptions of univariates are based on frequencies, means and standard deviations. For bivariate or multivariate analyses, comparisons are made in contingency tables. *Read about the chi-square test below.* The test of association is done by the factor analysis discussed in chapter 4 under tests of validity and reliability.
- *Select the level of significance* ($\propto$ = the Greek letter alpha). Two-tailed tests are done at the 5% level of significance in this study.
- *Compute the calculated difference value.* After data collection, coding and input, the SAS program electronically calculated test values.
- *Obtain the critical test value.* For example the chi-square* ($\lambda 2$) value may be more or less than the significance value. The p-value at alpha (α) level of 0.05, where the researcher needs to be 95% sure of the significance of the results obtained, the probability (p-value) of accepting the null hypothesis is $p < 0.05$.
- *Interpret the test.* The implications of the results are discussed in each section to determine whether it is significant or non-significant. Any results obtained will only be considered significant if the chi-square tests yield a *p*-value of less than 0.05.

Chi-square (λ^2) tests are the most widely used non-parametric test of significance (Cooper & Schindler, 2003: 536). The greater the difference between the categories of business organisations or the difference between functional areas of the respondent organisations, the less is the probability that these differences can be attributed to chance and therefore the larger the chi-square value. If we do not reject the null hypothesis when the calculated evidence suggests that we should, we

are committing a Type I error (Cooper & Schindler, 2003: 525) and when we do reject the Ho when we should not have, it will be a Type II error.

Note: If the qualitative parts of the research analysis focused on variables by themselves in order to answer some of the research objectives, then the bivariate and multivariate tests were done by the comparison of the relevant variables by means of contingency tables **(cross tabulations). This is done in order to compare variables' expected and observed values, and in most instances were sufficient to answer the research questions.**

The research objectives from chapter 4 are the main drivers in searching for relationships between the variables and measures of association in the form of factor analysis. These are listed again for the sake of completeness:

5.2. BACKGROUND INFORMATION: DEMOGRAPHICS OF RESPONDENTS AND ORGANISATIONS

The background information section of the questionnaire focused on both the individual respondent's main job description and the organisation's main area of business. There are 111 respondents who fully completed questionnaires of which 94 of the respondents are male and 17 are female. This unequal split between the gender indicators is a reflection of the phenomenon of women being underrepresented in the South African supply chain environment at managerial level. Thirty seven percent (37.84%) of the respondents chose purchasing or procurement as their main job description in their respective firms, while 9% of respondents chose financial manager/administrators as their main job function.

The Table below (Table 5.1) summarizes all the categories for selecting the main job description while the 12th category was open-ended and allowed respondents to fill in the details in the "other" category if their main job description was not previously mentioned in the selection list.

Table 5.1: Main job descriptions and accompanying frequencies

Main job description of respondent	Number of respondents (n)	Percentage (%)
Purchasing/procurement manager	42	37.84
Inventory management	3	2.70
Forecast manager	0	0.00
Operations manager	1	0.90
Logistics manager	6	5.41
Manufacturing /Production manager	1	0.90
Warehouse manager	0	0.00
Quality control manager	3	2.70
Information technology manager	8	7.21
Financial manager/administrator	10	9.01
General manager	5	4.50
Other (*explained below*)	32	28.83
Total `	**111**	**100.00**

The open-ended category (”other”) mentioned above, included the following main job descriptions, listed here in alphabetical order:

- Assistant supply chain manager
- Business analyst and operations
- Business analyst supporting the procurement process
- Business process specialist for production planning and execution systems
- Business systems manager
- Continuous improvement director

- Contractor
- Customer relations and services
- Director
- Materials manager
- Procurement consultant
- Program manager
- Software support manager
- Sourcing manager
- Supplier planner
- Supply chain analyst
- Supply chain director
- Supply chain manager
- Supply chain planning & primary distribution
- Toll systems manager

The overall picture of these main job descriptions indicates that the categories in question one were in itself non-exhaustive and that some descriptions such as forecast and warehouse manager, (both at 0% frequency) could possibly be sub-categories contained within the job descriptions listed under the open-ended section. Other descriptions (for example purchasing, manufacturing and financial management) could also be included in the collective noun description of *supply chain manager*, therefore the open ended category was a necessary inclusion in the demographics question.

On first examination of the data if was found that each individual main job description category did not display a high enough frequency except for the open category. Therefore it was decided to group the main job descriptions into two major categories which include the listing of 1 to 8 firstly and secondly numbers 9 to 12 of the main job

descriptions *(note that 12 includes "other").* This will simplify the comparison of main job descriptions with other variables later.

These two categories can be named **Logistics/Operational Staff** (for the first eight job descriptions) and the other **Administrative/Executive Staff** (for descriptions nine to twelve) since the latter includes IT and financial administrators, amongst others. The two main job description categories will remain constant and is used in all bivariate analyses consistently from this point forward. In an attempt to summarise the changes to Table 5.1, the data can be adapted to reflect the two new major groups of job description. The changes are reflected in Table 5.2 below.

Table 5.2: Two new main job groups of job descriptions.

New main job description	Number of respondents (n)	Percentage (%)
Logistics/operational staff (LOS)	56	50.45
Administrative/Executive staff (AES)	55	49.55
Total	**111**	**100.00**

The respondents have participated in the research project as representatives of their firms and its internal business practices, but these firms in turn form links with other business organisations to constitute entire supply chains within their respective industries. In response to the question to identify their organisation's main area of business (designating the links in the supply chain structure), the resultant frequencies are summarised in Table 5.3 which is presented on the following page.

Table 5.3: Frequencies of main business areas for the respondents' organisations.

Main area of business	Number of respondents(n)	Percentage (%)
Main supplier to a manufacturer	9	8.49
Manufacturing producer	51	48.11
Transport operator	18	16.98
Warehouse facility	4	3.77
Distribution –only center	11	10.38
Wholesaler	4	3.77
Retailer	9	8.49
Did not indicate	5	0.00
Total	**111**	**100.00**

The summary data displayed in Table 5.3 indicate that the sampling population was defined accurately in terms of population units (individual managers) since the research design encompassed managers in charge of supply chain management (SCM) functions. The research design also correctly targeted and defined the units of analysis i.e. the business organisations. The full spectrum of SCM is therefore present in the respondents' main business areas.

Initial investigation shows that the majority (48.11%) of respondents selected manufacturing producer as their main areas of business and it became imperative to classify the main business areas as either "in manufacturing" or "in another part of the supply chain". This new classification will again enable a more straightforward way to explain the comparison of main business areas and the responses recorded on the types of administrative tasks completed by respondents regularly. Administrative tasks such as inventory management, analysing buyer requirements,

using different methods of order entry, amongst others, is discussed in the section on supply chain integration later in the chapter. The revised Table 5.3. is therefore adjusted to become Table 5.4 below.

Table 5.4: The main areas of business adjusted into two groups.

Main area of business (MAB)	**Number of respondents (n)**	**Percentage (%)**
Suppliers & Manufacturing producers (MAB1)	60	48.11
Another part of the supply chain (MAB2)	46	51.89
Did not indicate	5	00.00
Total	**111**	**100.00**

Further analysis of the respondent organisations will follow the two-category classification as stated in Table 5.4. The decision to re-classify the seven main areas of business into two major sections namely “suppliers and manufacturing producers” (MAB1) or “in another part of the supply chain” (MAB2) is derived from preliminary inspection of the data. This categorisation will be discussed again in the section that deals with supply chain partner integration (Section 5.4).

The fact that almost half of the respondents are in manufacturing concerns, which were traditionally more labour intensive, brings the discussion to the number of human resources the respondent organisations employ.

The number of permanent employees yielded a minimum of 3 and a maximum of 65000 employees in the respondent organisations, with a mean of 6 136 and standard deviation of 12 185. The large range of number of employees prompted a look into the South African National Small Business Amendment Bill (Government

Gazette, 2003) for the definition of small, micro and medium enterprises (SMME) in order to develop a framework for the categorisation of the sample population studied. Due to the vast range between 3 and 65000 employees, with very low frequencies in each category, the data is not displayed in tabular form.

When business enterprises have between 5 and 50 employees they are qualified as "micro to small", between 51 and 200 is medium and beyond 200 employees designate the large business organisations. This applies to all sectors of the market in accordance with the Standard Industrial Classification (SIC), which is an internationally utilised classification system of industry categories.

From the descriptive summary data, two of the respondent organisations fall into the micro/small category, 15 organisations are medium and the remainder are large. For easier analysis, the two 'micro/small' organisations were re-categorised as medium for the purposes of comparison and the designation is therefore either medium or large when referring to the size classification of respondent organisations according to their number of full-time employees.

Seventy six percent of the respondents are employed by or representatives of organisations that have permanent employees of 3500 or less. This could be indicative of operational efficiencies within the respondent organisations or suggest that the automation of work has taken place where previously it was perhaps more labour intensive. This leads the discussion towards the findings on technology usage amongst the supply chain organisations.

5.3. TECHNOLOGY USAGE

The section on technology usage investigated the age of the technology systems being used by the organisations and the types of software applications that the respondents were utilising in executing their duties on a weekly basis.

5.3.1. The age of the SCM technologies

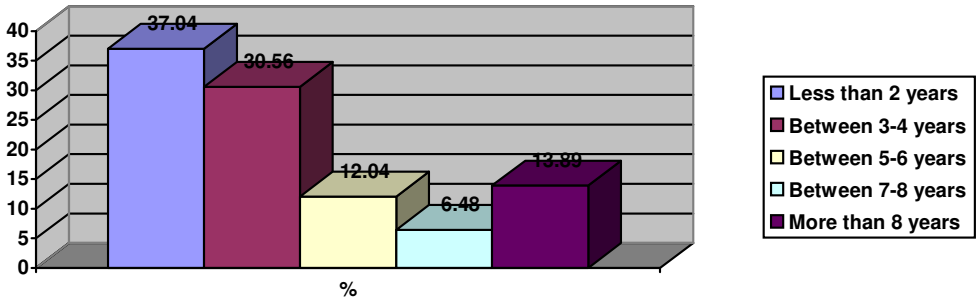
The question on the age of technologies was divided into two yearly intervals where less than 2 is the lowest interval and more than 8 years is the upper interval. The reason for using two-yearly categories is that any successful software development project would allow software upgrades or version improvements to be released on a business market on average every two years. The results from the study are noted in Table 5.5. below.

Table 5.5: Age of technologies (in years) and frequency of responses.

Age of technology systems (in years)	**Number of respondents (n)**	**Percentage %**
Less than 2 years (a)	40	37.04
Between 3-4 years (b)	33	30.56
Between 5-6 years (c)	13	12.04
Between 7-8 years (d)	7	6.48
More than 8 years (e)	**15**	**13.89**
Did not indicate	**3**	**00.00**
Total	111	100.00%

The results show there is a concentration of systems that are less than *four* years old amongst the respondent organizations, which accounts for more than two thirds (67%) of the sample. This implies that the age of technology systems can be eliminated as a possible barrier to supply chain integration or information sharing amongst the respondents. The findings from Table 5.4. are graphically displayed as in Figure 5.1. below.

Figure 5.1: Graphical display of technology age categories from Table 5.5 summarised above.



Source: original Excel compilation

5.3.2. The types of software used by respondents

The types of software being used by the individual respondents include the three main database owners of SAP, Baan/Oracle (a merged concern) and *i*2 (pronounced "eye-two"). The category for "off the shelf software" includes brands such as "Crystal, Access or Pastel", which are accounting and reporting types of software whose implementation into an organisation occurs much faster than the aforementioned three modular systems. The "in-house, custom designed software" usually consists of spreadsheet-type applications and systems that are unbranded and unique to organisations for their SCM functions. The category for "outsourced /leased" software may have been once-off agreements or project-specific type applications of software where the user is not likely to have had any input to its design processes and may therefore also have less chance of ownership.

The latter category of outsourced software is contrasted by the category of "outsourced/value-added network or Internet service provider" where a long-term partnership or strategic alliance between the business organisations and a software service provider, actively assists the respondent organisation to streamline their supply chain transactions and activities. The respondent organisations pay subscription fees and sometimes fees-per-transaction, for the software housed at the value-added network (VAN) or Internet service provider (ISP) premises. The transactions for the partners of the VAN or ISP affiliates may/may not be taking place over dedicated telecommunications transmission mediums.

The category of ”other” included software such as Ellipse, Business Portal, Great Plains, Lotus Notes, Microsoft Outlook, Syspro, Adonix, Fuel system and client dependent software. Although these are also branded software solutions, it makes more impact that the information was volunteered by the respondent rather than solicited by the researcher. Two respondents listed the Internet and the Intranet as software types, since they are constantly using it in their work environments, although strictly speaking they were not listed as software types.

The measure for the frequency of use for each of the different software categories on question 6, is a five-point Likert scale where 1=never, 2= once a week, 3 = twice a week, 4 = three times a week and 5= all the time. It is worth noting that respondents are at two extremes of either “never” using the software type or “using it all the time”. From the initial examining of the results obtained, it *was decided to reduce the Likert scale used in the questionnaire to three instead of five rating scale options,* which means that the response for the frequency of specific software types used is now classified as 1 equals “never”; the values 2,3 and 4 mean “between one and three times per week” and 5 indicates “all the time”.

Table 5.6. is presented on the following page.

Table 5.6: Software types and the reduced three point Likert scale with their respective use of software types per week.

Software types	Never 1	Between 1 and 3 times per week. 2,3,4	All the time 5	Number (n) of respondents who answered this question
SAP	37	19	41	97
Baan /Oracle	57	06	06	69
i2 software	47	04	08	59
Of the shelf-branded software (Crystal, Access or Pastel)	30	14	36	80
In-house custom designed software (more than a spreadsheet).	27	22	34	83
Outsourced/ leased (pre-designed software)	44	12	17	73
Outsourced/ value-added network (VAN) or Internet Service Provider (ISP) software.	37	11	16	64

In order to summarise the frequent non-response items on the question pertaining to software usage, it was assumed that they adhere to the category of 1 on the Likert scale, which indicates that the respondent “never” uses the specific software type in their business organisations. The results of category 5 (use of software = “all the time”) is summarised in Table 5.7, which is presented below.

Table 5.7: The percentage of the *most frequently used* software types (i.e. Likert score of 5) in descending order of average use.

Software types	Percentage (%)
SAP	36.94
Of the shelf-branded software (Crystal, Access or Pastel)	32.43
In-house custom designed software (more than a spreadsheet).	30.63
Outsourced/ leased (pre-designed software)	15.32
Outsourced/ value-added network (VAN) or Internet Service Provider (ISP) software.	14.41
Baan /Oracle	7.21
i2 software	5.41
Total	**100.00**

From Table 5.7 it can be seen that SAP software is used all the time by most of the respondents at 36.94%, followed by off-the-shelf branded software (Crystal, Access and Pastel) at 32.43%. In-house custom designed software is the third most prominent at 30.63%, which shows that regardless of what type of software is available on the market, any business organisation needs to and has apparently implemented a system of technologies that takes their operational requirements into account. It must be added that some respondents have indicated that they are in the process of implementing a new information technology but no details were given as to the software types.

Future research can be conducted to ascertain whether respondents are more brand conscious or brand loyal about certain information technology applications, which could explain why *i*2 scored so low. Respondents' knowledge of the software types could possibly also be influenced by whether its IT adoption was a much publicised and/or noticeably disruptive implementation project or one to the contrary, one with

minimum disruptions to their work environments. From the results of this study, it would also be presumptuous to generalise that any IT application is more popular or useful in SCM than another as the limitations and constraints of the research investigation discussed later would indicate.

5.4. SUPPLY CHAIN PARTNER INTERACTION

Supply chain partners can be interacting based on the supply chain partner integration in the buying and selling of goods and services or the practice of information exchange between respondents and their trade partners.

5.4.1. The level of supply chain partner integration

This section is divided into the two sub-categories of investigating the types of goods ordered and the methods of order entry used by respondents in their interactions with their supply chain partners.

5.4.1.1. Types of goods ordered

The re-classification of the main areas of business into either “in manufacturing” (MAB1) or “in another part of the supply chain” (MAB2) is reinforced by the evidence that the first group of businesses require more raw materials and the latter parts of the supply chain organisations will order more finished products from their suppliers.

Table 5.8. is presented on the following page.

Table 5.8: The average percentage of the type of goods ordered

Type of goods ordered	Number of respondents (n)	Mean	Standard deviation	Minimum % of goods ordered	Maximum % of goods ordered
Raw materials	64	48.60	32.82	2	100
Components	69	25.65	22.42	2	100
Semi-finished goods	36	14.47	11.29	1	40
Assembled goods	40	17.97	17.29	3	90
Completed products.	82	53.40	37.03	2	100

Table 5.8. reinforces the re-classification into two groups by demonstrating that two high means resulted for the types of goods ordered by the respondent businesses. The first high incidence of a mean applies to the raw materials ordered from suppliers (mean = 48.6) and the second refers to completed products ordered (mean= 53.4).

5.4.1.2. Methods of order entry

It was discussed previously in this chapter that the respondents' ordered either a majority of raw materials or a majority of completed products from their suppliers, which led to the split of the main areas of business as being either in manufacturing or in supply chain areas that succeed the production process (refer to Table 5.4). Supply chains are characterised by the operational necessity of ordering goods from one's suppliers on a daily, weekly or monthly basis.

In the evaluation of how often respondents use different methods of order entry to place orders on their suppliers (given that they can order raw materials, components, semi-finished goods, assembled goods and finished products), the following findings were made:

- Eighty percent of respondents use postal mail less than once per month to order anything from their suppliers, while 89% send direct e-mail messages to suppliers to place orders, more than 3 times per month.
- Free telephone (0800-numbers) and shared call (0860-numbers) are not utilised upstream to place orders and are used about once a month respectively by 78% of respondents.
- It is possibly a good indication for business-to-business website usability that 84% of respondents visit the suppliers' websites online and place orders about twice a month.
- The frequency tends towards three times a month for 83% of respondents, when applied to the placing of orders via electronic data exchange (EDI), which is a sure sign that the legacy systems are still being used in the South African context amongst supply chain partners.
- An unexpected phenomenon is that 95% of respondents fax directly to their suppliers' offices more than three times per month to place orders.
- The methods of order entry via online auctions are used "almost never" by 67% and hand-deliveries to their suppliers' offices is used "almost never" by 79% of respondents, respectively.

In essence, the most frequently used methods of placing orders on suppliers in the research sample takes place firstly via e-mail and secondly per fax, both of which are traditional direct methods however, it is not known from this study whether faxes are sent via the Internet or not.

The need for supply chain partners to be integrated is undeniable considering that the respondents place orders of all types of goods consistently regardless of the methods used for order entry. However besides the seemingly harmonious and resource dependency level of integration enjoyed upwards in the supply chain, other areas are discussed below.

5.4.2. The amount of information exchange

This section focuses more specifically on the respondents' attitudes towards information sharing within their existing supply chain partnership structures. The format of information and the reasons why /why not information may be shared is elaborated.

5.4.2.1. Information file format

The results indicate that the information files used by respondents which include customer information, product descriptions/specifications, prices of goods to be bought/sold, inventory balances, production/shipping schedules and order history are mostly computerised. This could imply that information files' content is more accessible, more enabled to allow data transfer and more easily updated than the traditionally manual versions.

The different types of information files of the responding organisations have more than an 82% chance of being computerised, while only one (bills of lading) is observed at 77.78% frequency. This evidence suggests that an ease of use exists for respondents to interact electronically with their supply chain partners since the need for respondents to manually replicate applicable product/ shipping information every time it is required is non-existent.

Thus it would be reasonably safe to conclude that the information file type format can be ruled out as being a barrier to information sharing amongst supply chain partners.

Before the amount of information exchange is examined, it is necessary to shed more light on the types of administrative tasks that are involved between supply chain partners. These administrative tasks are all computerised but perhaps different functional areas of the respondent's job descriptions' would explain more the types of information they would share in their existing supply chains.

5.4.2.2. Types of administrative tasks

At this point of the discussion we recall that the first research objective has been met which was to identify the types of software used by the respondents. In order to obtain the other research objectives, the analysis presented here contrasts the main job descriptions with the administrative tasks that the respondents conduct and with the uses of the Internet, in order to identify any underlying patterns. This analysis will provide more insight into possible reasons why (or why not) respondents exchange information even though they are integrated with partners in their existing SCM structures.

Research objective 2 is to identify how often users from jobs in different functional departments (procurement, inventory management, operations, IT, quality control, finance, warehousing, amongst others) use the Internet in SCM activities such as marketing, routing, tracking and online payments, for example.

In order to comment on the variables linked to research objective 2, the analysis moves beyond the preceding descriptive approach towards one-sample based hypothesis testing in order to test for significant differences between the observed and the expected distributions of data among the main job description categories.

If we refer back to the "main job description" variable discussed in the demographics section of the chapter, the respondents have been re-categorised to form group one, which is **logistics/operational staff** (LOS) and group two which is **administrative/executive staff** (AES). Recall that group one consists of respondents whose main job descriptions include purchasing/procurement manager, an inventory manager, forecasting, operations, logistics, manufacturing/production, warehousing or quality control– manager. Group two includes the IT, financial/administrative, general or "other" managers. This grouping increases the usefulness of the Chi-square (λ^2) test of significance since not more than 20% of the expected frequencies can be smaller than 5. (Cooper & Schindler, 2003: 537).

Research objective 2 and administrative tasks

Chi-square (λ^2) tests are the most widely used non-parametric test of significance (Cooper & Schindler, 2003: 536). The greater the difference between the categories of business organisations or the difference between functional activities *(such as administrative tasks)* of the respondent organisations, the less is the probability that these differences can be attributed to chance and therefore the larger the chi-square value. If we do not reject the null hypothesis when the calculated evidence suggests that we should, we are committing a Type I error (Cooper & Schindler, 2003: 525) and when we do reject the Ho when we should not have, it will be a Type II error. The results that follow are based on applying the tests of significance form the administrative tasks to the existing null and alternate hypotheses:

- In light of Ho, it means that we expect that *there are no significant differences* between respondents when comparing frequencies from one administrative task to the next. The alternate hypothesis applied to administrative tasks means that there are significant differences between respondents when comparing frequencies from one administrative task to the next.
- The *statistical test* to be used is the one-sample chi-square since there are sufficient observations between the two categories of job descriptions.
- *Significance level:* Alpha (α) = 0.05
- *Critical test values* will be interpreted at degrees of freedom = 2.

When presenting the variables of the two main job groups and each administrative task variable the degrees of freedom are consistently equal to 2. *The calculation for the degrees of freedom (DF) is obtained by using the following equation:*

DF: rows minus 1 (r- 1) times columns minus 1 (*c*-1)

= (*r*-1) X (*c*-1) and this equals= (2-1) X (3-1) to yield degrees of freedom=2.

The proposed null hypothesis states that there are no significant differences between respondents when categorised into the two major job description groupings and

thereafter compared to the observed specific administrative task frequencies. Subsequently, the 11 respective chi-square calculations, which were conducted at an alpha level of 0.05 yielded the results summarised in Table 5.9. below.

At alpha (α) level of 0.05, where the researcher needs to be 95% sure of the significance of the results obtained, the probability (p-value) of accepting the null hypothesis is $p < 0.05$. Any results obtained will only be considered significant if the chi-square tests yield a *p*-value of less than 0.05.

Table 5.9. is presented on the following page.

Table 5.9: Cross tabulation (Chi-square contingency table) results of main job descriptions versus the frequency of administrative tasks.

Administrative tasks	Logistics/operational staff (row percentages)				Admin/executive staff (row percentages)				**The λ^2 p-value**
Variable	n	N	S	O	n	N	S	O	
V39 forecasting	52	11.54	23.08	65.38	54	12.96	22.22	64.81	0.9735
V40 portfolio analysis	51	**19.61**	**37.25**	**43.14**	53	**16.98**	**45.28**	**37.74**	**0.7078**
V41 client req'ts consolidation	55	**12.73**	**23.64**	**63.64**	54	**18.52**	**24.07**	**57.41**	0.6829
V42 order entry	53	**15.09**	**1.89**	**83.02**	52	**23.08**	**11.54**	**65.38**	0.0595 ^
V43 standardisation & consolidation of suppliers.	56	**5.36**	**33.93**	**60.71**	54	**14.81**	**33.33**	**1.85**	0.2411
V44 functional definition of requirements.	52	**11.54**	**23.08**	**65.38**	52	**17.31**	**26.92**	**55.77**	**0.5625**
V45 analysing the buyer centre	49	**10.20**	**26.53**	**63.27**	52	**21.15**	**38.46**	**40.38**	0.0616
V46 invoicing	49	**38.78**	**6.12**	**55.10**	54	**27.78**	**1.85**	**70.37**	0.2126 *0.173^*
V47 inventory management	51	**7.84**	**17.65**	**74.51**	53	**18.87**	**11.32**	**69.81**	0.2073
V48 routing and scheduling	51	**15.69**	**23.53**	**60.78**	53	**22.64**	**13.21**	**64.15**	0.3301
V49 warehouse consolidation	49	**38.78**	**26.53**	**34.69**	53	**30.19**	**22.64**	**47.17**	0.4346

Key: n = number of respondents

Admin = administrative

N= Never, S= Seldom, O=Often

λ^2 p-value = Chi-square test probability value

Note that ^ indicates that the Chi-square test was not appropriate and the Phi-coefficient had to become the indictor of significance.

The results from Table 5.9 indicate that no significant differences exist for any of the administrative tasks amongst either the LOS or the AES respondents, which confirms that Ho cannot be rejected. The values of the λ^2 tests is not significant at α=0.05 since the resultant p-values are larger than 0.05 for DF= 2. This means that Ho has to be rejected and implies that the two major groups of job descriptions exhibit similar behavioural patterns when conducting their respective administrative tasks.

The only observable difference is that the LOS practise administrative task of portfolio analysis more "often" than the AES who complete it on average more "seldom" than "often".

From the variables 42 and 46 (^) listed above, results indicate that the observed value of the λ^2 is relatively close to the critical value obtained from the Table of the Chi-square distribution, however not significantly so at α = 0.05. The resultant p-value for the order entry (V42) and the invoicing (V46) variables are both larger than 0.05 for DF= 2. This would imply that Ho still has to be rejected, however since 33% of the matrix cells have counts too low for the λ^2 test to be valid, it is necessary to refer to the two corrective tests for the chi-square, the values of which are simultaneously calculated by the SAS program. The range between 0 (no relationship) and +1 (strong relationship) indicates the *strength of association* between the variables. Both the Phi coefficient (ϕ) and Cramer's V give the same results (v42=0.2319 and V46 = 0.1734), which suggest a moderate relationship between the main job descriptions and the tasks of order entry and invoicing respectively.

Given that SC organisations have to realistically manage a myriad of suppliers for the various types of goods ordered, it would be expected that both groups of LOS and AES standardise and consolidate suppliers in more or less the same way. The results from Table 5.9. therefore confirm that Ho cannot be rejected and implies that

the two major groups of job descriptions (LOS and AES) exhibit almost identical tendencies towards their administrative tasks.

5.4.2.3. Current use of the Internet

The results of the Chi-square tests on variables 57-68 demonstrate that the amount of information exchanged is not significantly different between respondents and their organisations when investigating the information file format, nor the administrative tasks involved according to the above-mentioned finding. Perhaps the current uses of the Internet could further expand our snapshot of the SCM respondents in the discussion that follows.

In this section of the discussion, respondents were asked to complete the statement "We use the Internet…." by rating the selection of variables that apply to what business SCM respondents could possibly do with the Internet in their respective job areas and business organisations. By scoring "never, seldom or often" on a three-point Likert rating scale, the frequency of their Internet use is obtained. The same hypothesis testing is applied as discussed in section 5.4.2.2. above in order to extend the major job descriptions into the current use of Internet in the continued effort to address the research objectives.

Research objective 2 and Internet usage

Chi-square (λ^2) tests are the most widely used non-parametric test of significance (Cooper & Schindler, 2003: 536). The greater the difference between the categories of *main job descriptions and Internet usage* of the respondent organisations, the less is the probability that these differences can be attributed to chance and therefore the larger the chi-square value. If we do not reject the null hypothesis when the calculated evidence suggests that we should, we are committing a Type I error (Cooper & Schindler, 2003: 525) and when we do reject the Ho when we should not have, it will be a Type II error. The results that follow are based on the existing null and alternate hypotheses:

- According to Ho. we anticipate that there are no significant differences between respondents when comparing frequencies from one Internet use to the next. Stated in the alternative hypothesis, it implies that there are significant differences between respondents when comparing frequencies from one Internet use to the next.
- The *statistical test* to be used is the one-sample Chi-square since there are sufficient observations between the two categories of job descriptions.
- *Significance level:* Alpha (α) = 0.05
- *Critical test values* will be interpreted at degrees of freedom = 2.

Table 5.10. is presented on the following page.

Table 5.10: Cross tabulation (chi-square contingency table) results of main job descriptions versus the frequency of Internet use.

Internet use	Logistics/operational staff (row percentages)				Admin/executive staff (row percentages)				**The λ^2 p-value**
Variable	n	N	S	O	n	N	S	O	
V57 marketing	55	7.27	41.82	50.91	50	14.00	30.00	56.00	0.3215
V58 search for lower prices	55	**10.91**	**36.36**	**52.73**	51	**27.45**	**43.14**	**29.41**	***0.0223**
V59 take part in auctions	52	**78.85**	**19.23**	**1.92**	49	**71.43**	**22.45**	**6.12**	**^0.4883** **(ϕ)*0.1191***
V60 to place orders	53	**26.42**	**30.19**	**43.4**	50	**24.00**	**36.00**	**40.00**	0.8213
V61 to receive orders	52	**28.85**	**36.54**	**34.62**	50	**42.00**	**20.00**	**38.00**	0.1509
V62 manage inventory online	53	**54.72**	**28.30**	**16.98**	49	**44.90**	**34.69**	**20.41**	**0.6117**
V63 track goods in transit	55	**21.82**	**40.00**	**38.18**	50	**38.00**	**24.00**	**38.00**	0.1112
V64 to schedule routes	53	**50.94**	**18.87**	**30.19**	48	**50.00**	**25.00**	**25.00**	0.7104
V65 to pay electronically	55	**9.09**	**16.36**	**74.55**	51	**7.84**	**15.69**	**76.47**	^0.9660 **(ϕ)0.0255**
V66 to receive payment elect'y	54	**12.96**	**14.81**	**72.22**	51	**11.76**	**19.61**	**68.63**	0.8065
V67 to manage cust. relations.	53	**15.09**	**33.96**	**50.94**	52	**26.92**	**28.85**	**44.23**	0.3296
V68 to manage supply relations	53	**18.87**	**43.40**	**37.74**	51	**23.53**	**41.18**	**35.29**	0.8438

Key: n = number of respondents

Admin = administrative

N= Never, S= Seldom, O=Often

λ^2 p-value = Chi-square test probability value

(ϕ) = The Phi-coefficient, which is equal to Cramer's V

The interpretation of the results displayed in Table 5.10. verifies that no significant difference is exhibited by LOS and AES in terms of the frequency of their Internet use in their organisations and therefore the null hypothesis cannot be rejected based on the evidence of LOS and AES and the frequency of their Internet use.

5.4.2.4. Main business area (MAB1 and MAB2) & type and benefits from Internet-use

In examining the types of benefits derived from Internet use (variables 51-57), it is found that no significant differences exist between the suppliers and manufacturers (MAB1) and the rest (MAB2).

Table 5.11: Cross tabulation results of main business areas and the types of Internet benefits derived from use.

Benefits derived from Internet use	Suppliers and Manufc's (MAB1) (row percentages)				Other areas of the SC (MAB2) (row percentages)				**λ^2 p-value**
Variable	n	N	S	O	n	N	S	O	
V51 Less use of printing paper.	59	10.17	59.32	30.51	45	17.78	46.67	35.56	0.3577
V52 Decrease in human errors	59	**10.17**	**33.90**	**55.93**	46	**13.04**	**54.35**	**32.61**	**0.0554**
V53 more accurate info.	58	**3.45**	**13.79**	**82.76**	46	**10.87**	**21.74**	**67.39**	**0.1472**
V54 Decreased inventory levels.	54	**20.37**	**42.59**	**37.04**	43	**23.26**	**44.19**	**32.56**	0.8855
V55 Faster delivery times.	57	**8.77**	**38.60**	**52.63**	45	**15.56**	**40.00**	**44.44**	0.5117
V56 Decreased lead order times.	58	**8.62**	**48.28**	**43.10**	45	**13.33**	**48.89**	**37.78**	**0.7029**

Key: n = number of respondents

Manufc's = manufacturers

N= Never, S= Seldom, O=Often

λ^2 p-value = Chi-square test probability value

(ϕ) = The Phi-coefficient, which is equal to Cramer's V

An "almost significant result" is obtained on the variable that indicates a decrease in the amount of human errors made where MAB2 experienced this benefit more seldom and MAB1 experienced this benefit more often.

MAB1 also experienced more accurate information more often than group two, although the pattern was similar. All main job areas acknowledge that their respective organisations seldom experienced decreased inventory levels as an Internet-use benefit. It appears that the faster delivery times benefit is experienced by both groups often enough at the p-value of 0.5117.

Perhaps there would be any significant differences between MAB1 and MAB2 in comparing how often the Internet is used for specific activities as indicated in Table 5.12. presented on the following page.

Table 5.12. is presented on the following page.

Table 5.12: Cross tabulation results of main business areas and the frequency of different uses of the Internet.

Benefits derived from Internet use	Suppliers and Manufc's (row percentages) MAB1				Other areas of the supply chain (row percentages) MAB2				λ^2 p-value
Variable	n	N	S	O	n	N	S	O	
V57 marketing	56	5.36	33.93	60.71	44	18.18	36.36	45.45	0.0912
V58 search for lower prices	57	**10.53**	**42.11**	**47.37**	44	**29.55**	**38.64**	**31.82**	**0.0423 *signf't**
V59 take part in auctions ^	52	**67.31**	**30.77**	**1.92**	44	**84.09**	**9.09**	**6.82**	**0.0219 *signf't**
V60 to place orders	55	**12.73**	**41.82**	**45.45**	43	**37.21**	**23.26**	**39.53**	0.0121 ***signf't**
V61 to receive orders	54	**27.78**	**31.48**	**40.74**	43	**41.86**	**25.58**	**32.56**	0.3471
V62 manage inventory online	55	**45.45**	**32.73**	**21.82**	42	**54.76**	**30.95**	**14.29**	**0.5575**
V63 track goods in transit	57	**21.05**	**36.84**	**42.11**	43	**39.53**	**23.26**	**37.21**	**0.1057**
V64 to schedule routes	54	**48.15**	**18.52**	**33.33**	42	**50.00**	**28.57**	**21.43**	**0.3248**
V65 to pay electronically	56	**5.36**	**23.21**	**71.43**	45	**13.33**	**8.89**	**77.78**	**0.0838**
V66 to receive payment elect'y	55	**9.09**	**23.64**	**67.27**	45	**15.56**	**11.11**	**73.33**	**0.2071**
V67 to manage customer relations.	56	**19.64**	**26.79**	**53.57**	44	**22.73**	**38.64**	**38.64**	**0.3069**
V68 to manage supply relations	54	**14.81**	**38.89**	**46.30**	45	**28.89**	**46.67**	**24.44**	**0.0533**

Key: n = number of respondents

Manufc's = manufacturers and ***signf't = significant**

N= Never, S= Seldom, O=Often

λ^2 p-value = Chi-square test probability value

(ϕ) = The Phi-coefficient, which is equal to Cramer's V

The result obtained ^ for variable V59 (taking part in auctions) shows that the Chi-square test is significant at α = 0.05 level, however it must be mentioned that the frequencies are low. It is not clear whether the result would have been significant if the 15 respondents who did not indicate their Internet uses on this question, could have affected the pattern between MAB1 and MAB2. From Table 5.12 a shift in responses is experienced when dealing with variable 66 "receiving money online" where the majority responses lie in the category "more often" using the Internet than "seldom/never" using the Internet to receive money.

Another obvious benefit derived from the Internet uses is "to manage supplier relations" and raises the question if marketing /customer relationship management is done more in the offline world and in a different form than what would be possible for respondents to do currently online. Further investigation means examining whether the number of employees that influence the size of the organisation displays any significant differences? This question is answered in the following section.

5.4.2.5. Organisational size and Internet benefits

Recall that large organisations have more than 200 employees and the medium classification has between 51-200 full-time employees. A comparison is made to test whether medium business organisations differ from their large market players when it comes to the benefits they derive from using the Internet.

Table 5.13 is presented on the following page.

Table 5.13: Size of the organisation according to employee numbers and the type of benefits derived from Internet-use

Benefits derived from Internet use	Large organisations (row percentages)				Medium organisations (row percentages)				λ^2 p-value
Variable	n	N	S	O	n	N	S	O	
V51 Less use of printing paper.	90	14.44	53.33	32.22	17	17.65	47.06	35.29	0.8839
V52 Decrease in human errors	91	**10.99**	**42.86**	**46.15**	17	**5.88**	**52.94**	**41.18**	**0.6795**
V53 more accurate info.	91	**6.59**	**18.68**	**74.73**	16	**6.25**	**12.50**	**81.25**	0.8304
V54 Decreased inventory levels.	85	**21.18**	**43.53**	**35.29**	14	**28.57**	**50.00**	**21.43**	0.5763
V55 Faster delivery times.	89	**12.36**	**38.20**	**49.44**	16	**12.50**	**50.00**	**37.50**	0.6447
V56 Decreased lead order times.	90	**11.11**	**47.78**	**41.11**	15	**20.00**	**53.33**	**26.67**	**0.4518**

None of the results from Table 5.13 are significant however some comment is necessary to provoke future research questions. Perhaps the business environment is still a long way away from having a "paperless" society since less use of printing paper is not experienced as often by both groups of organisations. It is noted that having less employees appears to have *less decrease* in the amount of human errors experienced for medium organisations than having more employees and therefore more human errors experienced.

The variable indicating more accurate information is a mutual benefit derived by both medium and large organisations although the Internet is 10.not really recorded as showing decreased inventory level by either. Faster delivery times is experienced more often by large organisations than by the medium organisations but the two groups are again similar on the decrease in lead order times, which is recorded as an Internet derived benefit experienced more seldom than often. In short, the size of the organisation does allow for a slight change in benefits experienced by medium and

large organisations, however not significantly so. It also is affected by which variable is being compared according to Table 5.13 shows.

5.4.3. Summary on supply chain interaction

The results confirm that there are few significant differences between the different categories of job descriptions, software technology type users, the different sizes of business organisations and the main areas of business. This answers the research objectives from 1-3 completely. The uses of the Internet and the benefits derived from the Internet also point to the decision in most cases to reject the null hypothesis (Ho= there are significant differences between business organisations). The use of the 2 sample and k-sample Chi-square tests confirm their usefulness as tests of homogeneity since they tested the different groups of the sample for similarity with regard to the characteristics of interest (Cooper & Schindler, 2003: 180).

The search for lower prices, participating in auctions and placing orders yielded the only significant results, which suggests that *the vastly differently sized organisations are more homogenous in their SC partner interaction as previously put forward*. All that remains would be to complete the full picture for research objectives 4 and 5 and simultaneously test the validity and reliability of the research instrument. This means that the level of integration and information sharing amongst respondents will be investigated in the following section.

5.4.4. Level of integration between SCM partners and reasons not to share information

In question 13 respondents were asked whether they agree or disagree with certain statements about their information sharing practices with their respective trade partners. All the statements were stated in the affirmative (i.e. to indicate that respondents do share information) but the trading partner kept on changing to demonstrate the relationship with a different type of trading partner and therefore it meant sharing different types of information as well. Table 5.11. demonstrates that

the respondents' answers were also skewed towards the positive and affirmative "agree" options.

Table 5.14: Statements about information sharing with supply chain partners and the relevant frequencies.

Variable or statement about supply chain partners.	Percent Agreeing	Percent disagreeing	Total number respondents *n*= 111
V69 we share information with suppliers	82.88	17.12	111
V70 we share scheduling information with suppliers	79.25	20.75	106
V71 we share shipping information with customs' agents	73.33	26.67	105
V72 we share information with other manufacturers	54.21	45.79	107
V73 we share production information with our warehouses	73.58	26.42	106
V74 we share sales information with distribution centres	75.00	25.00	104
V75 we share promotion information with retailers.	71.43	28.57	98

From Table 5.14 above it can be concluded that most respondents agree about sharing information with their trade partners with the exception of the highest percentage of non-agreement at 45.79% for variable 72. This observation could indicate that most organisations are not in collaborative manufacturing agreements with other market players. For the rest of the variables respondents' results were split into three quarters in "agreement "versus the other quarter in "disagreement" about sharing information.

Of more relevance to this research study, would be to examine the reasons why respondents would *not* be sharing information even if they are regularly interacting and technology enables them to integrate with each other. This leads the discussion to question 14 below.

5.5.1. Reasons not to share information

The eight variables in question 14 that indicate reasons not to share information with the trade partners include: - a lack of trust, not using the same software, not being in a long term contract, not being allowed to share information by management, having no training to integrate technologies, having no information sharing training, confidential knowledge and the fear that competitors may use the information against one. These variables are indicated as V76-V83 on the research instrument.

5.5.1.1. Validity and reliability of the instrument

Factor analysis was conducted on question 14, where respondents scored their reasons for not sharing information with their supply chain partners on a five point Likert scale. Two significant underlying factors appeared from the 8 variables tested. The question was linked to a dichotomous scale (question 13) preceding it and therefore only 68/111 respondents' questionnaires were completed in full and usable for the factor analysis test. Blanks in the data are treated as missing.

The number of meaningful factors is limited to the number of eigenvalues *greater than 1* and two eigenvalues of 3.72516 and 1.33071 respectively identified two main underlying constructs, called factor 1 and 2 as displayed in Table 5.15. below.

Table 5.15: Eigenvalues for reasons why not to share information

1	2	3	4	5	6	7	8
3.72516	1.33071	0.931475	0.703644	0.528021	0.399929	0.298345	0.827106

The two factors together account for 52% of the data and the variance explained are 40% and 12% respectively for factor 1 and factor 2. Factor 1 (which consists of

variables 80, 81, 77, 76 and 78) is named “Confidence” to indicate that respondents are confident in sharing data due to their training and level of trust towards their trading partners. Factor 2 is named “Confidentiality” and consists of variables 83, 82 and 79. The correlation matrix for the two factors are summarised by Table 5.16 which is presented on the following page.

Table 5.16: The rotated factor loadings (pattern) of reasons why respondents do not share information.

Variable	**Factor 1 named Confidence**	**Factor 2 named Confidentiality**
V76 lack of trust	0.350	0.227
V77 do not use same software	0.549	-0.133
V78 not in long term contract	0.426	0.190
V79 not allowed to share information	0.159	0.494
V80 not trained to integrate technologies	0.911	0.037
V81 not trained to share information	0.884	0.151
V82 knowledge is confidential	0.161	0.771
V83 competitors may use info. against us	-0.129	0.772
Cronbach Alpha	**0.8062**	**0.7309**
Factor correlations for rotated factors		
FACTOR 1	1.000	
FACTOR 2	0.4380	1.000
Mean	2.7265	3.1667
Standard deviation	0.9056	1.0965

The total variance is defined as the sum of the positive eigenvalues of the correlation matrix (SAS program). This means that the variances estimated before in chapter 4, can now be explained by the factor loadings in Table 5.16 above, which merely indicates how far away each variable is for the mean provided and in a positive or negative direction in the frequency distribution (Cooper & Schindler, 2003: 636).

The results indicate that the research instrument is measuring what is supposed to measure (i.e. it has construct validity) and seems to capture the characteristic of interest about information sharing within their supply chain structures. Recall that validity can also indicate reliability but reliability cannot indicate validity (Diamantopoulos & Schlegelmilch, 2003: 34).

Reliability is indicated by the Cronbach Alpha score which is the standardized Alpha, computed from correlations. In this question it would indicate an assessment of the degree of consistency with the multi-item (multivariate) measure which was administered to the respondents (Diamantopoulos & Schlegelmilch, 2003: 36).

The first Alpha is calculated using all variables and the value is 0.8255. The Alpha for each individual factor is calculated using only certain variables chosen for their loadings in the rotated factor loading matrix. For each factor, the calculation uses only the variables displaying a positive rotated factor loading on that factor, as well as a zero loading on all other factors. Note that Alpha is undefined if only one variable is used. If no random error existed in the measurement then the reliability would equal zero (Diamantopoulos & Schlegelmilch, 2003: 33), however in this research study factors 1 and 2 respectively have Cronbach Alpha scores of 0.8062 and 0.7309.

The random error can be contributed to either misleading questions or the omission of alternatives in the questionnaire itself. Situational factors or temporary respondent characteristics could also be possible sources of error to cause the *R*-scores.

The results on variables 76-83 (as univariates) include the following patterns for the reasons why respondents would not share information:

- There is no outright lack of trust of their suppliers (disagreement highest at 37.14%).
- There is a definite barrier to sharing information by respondents NOT having the same software at 42.47%.
- The need for a long-term contract is split evenly amongst respondents agreeing at 27.03% and disagreeing at 25.68%, and neither agreeing nor disagreeing at 21.62%. Therefore no outright conclusion can be made about whether this variable will encourage or discourage information sharing amongst supply chain partners.
- The eigenvalue of 0.494 for v79, is explained by respondents denying that management is the main reason for not sharing information (24.32 strongly disagree and 31.08 disagree that management prohibits information sharing) but is backed up by v82 where the confidentiality of respondents' knowledge is emphasised (26.67 agree and 30.67% strongly agree). Thus the underlying construct of confidentiality is consistent with factor 2 appearing from the factor analysis.
- It is not a lack of training that prevent respondents not to integrate technologies nor to share information since on both variables more than 50% of respondents disagree with the reasons given. This shows that there is a technical capability confidence amongst respondents to share information even if prevented by doing so due to confidentiality.
- The seriousness of supply chain competition is evident in that respondents agree (at 16.22%) and strongly agree (at 41.89%) that the perceived risk is that competitors may use the shared information against the respondents' businesses.

Regardless of the fact that only 68 out of the 111 respondents questionnaires were used for the factor analysis, the results still indicate some meaningful findings of the

respondents' SCM and IBIT realities. The descriptive statistical findings and hypotheses testing results are summarised in the conclusion which follows.

5.5. CONCLUSION.

The 111 respondents were skewed towards males since they were split in a 87% male and 13% female ratio, which suggest that females are underrepresented at managerial levels with SCM. Seventy five percent of respondents are employed by business organisations with less than 3500 employees although the highest number is 65000 employees for the sample.

Most organisations (67%) have SCM information systems technologies that are less than 4 years old, which is remarkable for this study that focused on the time period from 1990 to 2006, which is when the usage of the Internet grew in South Africa. Regardless of having the latest technologies on hand, most respondents still use the fax or e-mail to order goods (mostly raw materials and completed products) from their suppliers.

The most significant difference between the suppliers and manufacturers (MAB1) and other parts of the supply chain (MAB2) for using the Internet for administrative tasks is that MAB 1 search for lower prices and place orders more often than MAB2 respondents.

Based on the factor analysis the two underlying constructs that govern respondents' SC interaction and in particular their information sharing activities would be confidence and confidentiality. Confidence is suggesting a willingness to share information from a training or technology integration perspective, since most admit that SC partners do not use the same software. However the Confidentiality construct reveals the reality of competitive supply chain activities amongst the sample and their SC partners, since the risk of competitors using the information against them is enough to limit information sharing. The implications of these statistical findings are discussed in the successive chapter together with recommendations for future research endeavours.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1. INTRODUCTION

The aim of the research study was to investigate the self-reported extent to which South African firms are utilising their SCM information technologies to integrate and share information with their trading partners and to determine whether barriers exist that prevent them from benefiting from Internet based technologies. Put in simple terms, the question is whether organisations are utilising their SCM information technologies to share information with internal and external partners and to integrate information technology systems over the medium of the Internet.

This research study seeks to identify possible barriers that may exist within organisations and prevent the full acceptance, integration and utilisation of software technologies, as is required by the new information age. By conducting an empirical research investigation into the perceptions of managerial level users in different functions of supply chain management activity, the intention is to help organisations capitalise on their investment in information technology systems by identifying barriers to its usage after implementation.

Out of 2568 questionnaires distributed to SCM business organisations, the response rate of 4.4% yielded 113 questionnaires over a period of four months. Of these 111 were used in the statistical analysis. This chapter serves as a collective discussion of the entire research study with emphasis on the most important findings and relevant observations that will enable a small contribution to be made to SCM practitioners and researchers alike.

6.2. REVIEW OF LITERATURE

According to Philip Kotler (2001:8), time and technological developments have changed the marketplace in which organisations operate to the extent that the digital economy is impacting on supply chain management practices. In the time span of 4

decades, between 1960 and the year 2000, the marketplace has evolved from focusing on lower price competition, to a focus on quality, business process re-engineering, logistics, information technologies and ultimately the convergence of all these into the current market environment (Kotler, 2001: 8). Since the start of the 21st century, it became necessary to investigate the logistics decision areas after implementation of information technologies, such as SCM systems.

The targeted respondents are assumed to have installed IT systems within the last 17 years (between 1990-2006) since the accessibility of the Internet and the World Wide Web became universal during this time and enabled South African business entities to capitalise on its benefits. The results showed that most respondents had IBIT of less than 4 years of age installed for their use.

Chapter 2 gave a short overview of the history of development of the SCM discipline by the progression from purchasing, materials management and logistics management towards SCM. The link between the value chain (VC) and the traditional supply chain (SC) was highlighted and is based on the premise that internally a firm will optimise their VC before participating in the SC being formed with external trade partner organisations.

Since the discussion followed a timeline of events, it was to be anticipated that the markets in which the research from the literature reviewed originated, have experienced a shift in the traditional understanding and operational business practice of SCM. This enlightened understanding is due to the influence of the new demand side approach of SCM and the growth of the Internet and SCM information technologies. *Results cannot prove the existence of a demand side approach in practice in the South African context.*

The research study questioned respondents only on the current practices involving SCM information technologies when executing activities such as ordering, inventory management, warehousing, transport management and billing. This helped identify

what barriers exist to prevent the business organisations from embracing the use of Internet-based systems in their SCM practices.

Chapter 3 gave a brief overview of the history of the Internet (1969), the web (1989) and the development of electronic commerce. A short discussion was given from the evolution of the purchasing process as it changed from paper-based, manual processes to incorporate automated electronic data interchange (EDI) and Internet based technologies. The integration of the supply chain management functional activities and its accompanying technologies was discussed from the perspective of the value chain that extends towards the supply chain, which consists of all business organisations' value chains together. A similarity was drawn between how the intranet capability of an organisation is like the value chain while the extranet capability represents the supply chain system.

The literature reviewed in chapter 3 describes how in the time period 2000-2006, business organisations were coming to terms with the new information technology systems and the impact of the Internet and e-commerce on supply chain management. Especially noticeable was that the practice of information sharing or exchange was as important as partner technology integration, which the questionnaire revealed as two underlying constructs viz. confidence and confidentiality.

6.3. IMPLICATIONS OF EMPIRICAL RESEARCH

It appears that the availability of the Internet and world class IT systems are not fully exploited within the SCM realm of local business organisations. Regardless of whether the organisation is involved with supplying and manufacturing or is located elsewhere in the supply chain, the benefits realised from the use of the Internet such as less human errors made, fade when it has been revealed that 89% of respondents place orders via e-mail and 95% of respondents fax orders more than three times per month. Electronic data interchange, considered to be a costly legacy system of the pre-1990 era, is also used by 83% of respondents about three times per month.

There appears to be a combination of means and ways to interact with suppliers and this is facilitated by the information format being electronic with very few exceptions amongst the respondents. The confidentiality of information may be the only limiting factor to information sharing but not automatically prohibiting partner integration, which is highly likely to be in place. There is no lack of confidence displayed by respondents, which means that the technical skills are more than sufficient to allow information sharing with trade partners to further interaction at all job levels. The reality of competition is also a barrier to limitless information sharing and partner integration, which is definitely a worldwide phenomenon and is not only applicable to South African SCM organisations.

6.4. RESEARCH OBJECTIVES AND HYPOTHESIS REVISITED

From the literature reviewed from both the SCM and the challenges presented by the e-business IBIT chapters, one primary research objective was formulated supported by five secondary research objectives. All the research objectives were achieved from the research sample data analysis.

6.4.1. Primary research objective

To investigate the extent of barriers to Internet usage amongst South African supply chain management organisations.

6.4.2. Secondary research objectives and outcomes

Each of the five research objectives is presented with the results of the research investigation simultaneously explaining its implications.

The level of significance was set at $\alpha = 0.05$ which means that the researcher can be 95% sure of getting statistically significant results. Any probability or p-value obtained that would be smaller than 0.05 would be a significant difference between the groups of respondents being compared on any particular variable from the research results. *Any significant differences are to be interpreted in context of the*

specific variables that were being compared throughout the data analyses. The hypothesis tests were conducted with the view of answering or attaining the following research objectives below:

- **To identify the types of information technologies currently in use amongst users in supply chain management.**

Respondents use SAP systems, well-known branded of-the-shelf packages and in-house custom designed packages the most. The results were obtained by using a five point Likert scale on the technology type's question.

- **To determine how often users from functional departments (finance, IT, purchasing, manufacturing, warehousing) use the Internet in SCM activities.**

The logistics and operational staff (LOS) includes purchasing and procurement managers; inventory, forecasting, operations, production, warehousing and quality control staff and at the 5% level of significance, they do not differ significantly from the practices of the IT, financial, administrative and "other" managers [this group is the administrative/executive staff or AES].

With the exception of the task of portfolio analysis for AES, most of the tasks are done often and unsurprisingly, the Internet is often used by both groups in order to pay and receive money electronically, more than any other Internet use. LOS use the Internet more than AES in searching for lower prices on the Internet, which is the only significant difference that appeared from analysing the results statistically at the 95% confidence level (tests are always two-tailed under the given null hypothesis of no difference).

- **To investigate the relationship between organisational size and the use of Internet-based SCM technologies.**

The respondents were categorised into medium and large organisations according to the South African SMME definition where 200 plus employees would classify an organisation as large. The size of the organisation, which in this research study could range from 3 to 65000 full-time employees, does allow slight change in Internet benefits derived, although none are statistically significant. More accurate

information is a variable that represents an Internet benefit experienced by both sizes of organisations and unexpectedly the benefit of using less printing paper is experienced seldom, which confirms that the "paperless" society is not an automatic benefit of operating in the current digital information society.

- **To investigate the level of integration between external SCM partners and the respondent organisation.**

The results indicate that there are no definite barriers to integration in terms of the format of the information being electronic across the board and therefore few respondents would cite manual documents as a barrier to SCM integration. Regardless of the availability of Internet technologies and the absence of a lack of training on how to integrate, 80% of business organisations still use the most basic functions of faxes and e-mail to place orders on their suppliers

- **To investigate the amount of information exchange between partners in the supply chain.**

From the factor analysis used to detect any underlying constructs, the questionnaire validity is confirmed and the two factors named confidence and confidentiality together account for 52% of the variance of the data. The Cronbach-alpha values for the two factors exceed 0.7, which is a good indication of the reliability of the research data.

The results of the statistical analyses indicate that *there are not enough significant differences between business organisations, nor between the various SC functional levels and job descriptions to claim any definite barriers towards the use of IBIT in the South African context.* Although there is no apparent lack of trust between supply chain trading partners, the concern of confidentiality of information and competitor threats are possible reasons not to share 100% of information even if SCM IBIT are integrated.

6.4.3. Hypothesis revisited

The statistical tests of significance were based on the following basis null and alternate hypothesis in order to test whether the results obtained from a comparison between the expected values of the respondents' results and the actual observed results. The level of significance was set at $\alpha = 0.05$ which means that the researcher can be 95% sure of getting statistically significant results. Any probability or p-value obtained that would be smaller than 0.05 would be a significant difference between the groups of respondents being compared on any particular variable from the research results. *Any significant differences are to be interpreted in context of the specific variables that were being compared throughout the data analyses*. The hypothesis tests were conducted with the view of answering or attaining research objectives discussed above.

Null hypothesis: Ho: There are no definite barriers that influence the adoption and use of supply chain management information technologies amongst users in business organisations.

Alternative hypothesis: Ha: There are definite barriers that influence the adoption and use of supply chain management information technologies amongst users in business organisations.

After conducting the research study and statistical analyses the decision is that **Ho cannot be rejected.** The results indicate no *definite* barriers that influence the adoption and use of SCM information technologies. The underlying constructs of confidence and confidentiality identified in the study served to confirm the construct validity of the questionnaire but from one user to the next and from one business organisation to the next, it cannot be predicted or replicated as definite barriers.

6.5. RECOMMENDATIONS

The value of this research study shows that there are no definite barriers to the adoption and use of SCM information technologies and allows SCM practitioners to

have a tiny glimpse into the IBIT uses amongst some of their trading partners and their peers. It can possibly create a sense of reassurance to some industry players that somewhere in South Africa a counterpart is using the Internet to search for lower prices and to exchange money electronically. What is disconcerting is that many orders are still placed in an inefficient manner via fax or e-mail although the technologies exist to integrate systems over the Internet and decrease unnecessary delays in order fulfilment.

While the Internet is useful for both customer and supplier relationship management, the South African industry is still a long way off from decreasing their inventory levels as a direct benefit of IBIT systems, not to mention the practice of demand management and real-time inventory replenishment. It is not possible to generalise across the board from the results of this cross-sectional study, however customer service levels do not seem to be improved by the investment of IBIT and real-time information flows.

6.6. LIMITATIONS OF THE STUDY

The results of this IT and SCM study could present a measure of “damning evidence” in terms of functional or administrative ways of using the IBIT in business organisations however the reality may not be as grim as it appears. In other words any conclusions that would place a label of being “backward” or archaic in terms of SCM practices should be avoided. Instead the respondent organisations may have been presented with thought provoking questions in light of answering the questions posted in the research instrument that can only elevate them to new levels of partner integration and information sharing.

6.7. FUTURE RESEARCH OPPORTUNITIES

The results of this study and the contribution to the multi-discipline research area could be improved by future studies taking an even larger sample of the sample population to include more heterogeneous technology users in the study. This could

facilitate the extrapolation of the results to the South African SCM market with more certainty.

A different research angle would focus on the significant difference that occurred between respondents in the administrative task of their search for lower prices in procurement. This places the emphasis more on the upstream part of the supply chain and could possibly also include the practice of auctions on the Internet as a means of achieving lower prices in the purchasing process. In line with procurement this study would then become an investigation on the global procurement practices of South African SCM organisations.

A research project with an interest in the customer relationship management (CRM) activities of the respondents would shed new light from a supply chain management perspective since great customer service is usually seen as the trade-off with increased inventory carrying costs and therefore a higher total cost to SCM. While CRM studies abound in the literature, they are usually studied from the marketing perspective only while the value of its contribution could benefit from the IT and SCM inputs in future.

In terms of the actual IT applications, more in-depth studies would be required to investigate whether the EDI systems have not migrated onto the Internet platform within the South African marketplace since the offline versions would still require massive investments that not all trading partners would be able to make for partner interaction and integration to happen.

6.8. CONCLUSION

The aim of the research study was to investigate the self-reported extent to which South African firms are utilising their SCM information technologies with their trading partners and to determine whether barriers exist that prevent them from benefiting from Internet based technologies. Put in simple terms, the question was whether

organisations are utilising their SCM information technologies to share information with internal and external partners and to integrate information technology systems over the medium of the Internet. All the research objectives were achieved from the research sample data analysis.

The value of this research is to assist South African businesses in competing with global players, since competitive advantage depends on competent supply chains in today's digital economy according to Philip Kotler (2001: 3). Competent supply chains means that all partners including amongst others the buyers, suppliers, manufacturers, distributors, administrators and retailers, must be integrated in an effort to create the best customer value otherwise they will be unable to sustain their business competitiveness for too long.

All of the B2B definitions confirm that this research investigation, where SCM and information technology are being combined, should be placed into the context of the 21st century, where technology links the businesses of the world by the click of a button. The theory highlighted e-commerce benefits for businesses that include reduced costs of handling enquiries in a pre-purchase scenario, lower input prices, less inventory and reduced transaction costs through more efficient payment mechanisms such as the EFT. E-commerce is also seen to contribute to economic efficiency in five important ways by shrinking distances and timescale, by lowering the distribution and transaction costs; by speeding up product development; providing more information to and sellers and by enlarging customer choice and supplier reach (Gunasekaran, *et al.*, 2002: 186).

From the empirical research, South African organisations are utilising their IBIT to search for lower prices, pay and receive money electronically but still underutilise the IBIT order placement functions. Eighty percent of respondents still use the fax and e-mail facilities the most in order placement, which is an operational barrier since their documentation is automated and they do not lack the technical know-how to become more integrated with their supply chain partners.

The research investigation was done by electronically distributing the structured research instrument (the questionnaire) to 2568 respondents in the business sample compiled from the members of the Institute of Purchasing South Africa (IPSA), the Council for Supply Chain Management Professionals (CSCMP), the training company, Intenda, the software company, SAP, and the manufacturing concerns listed on the Johannesburg Securities Exchange obtained from the BFA McGregor database.

From the 2568 questionnaires sent out via e-mail, 113 responded and of these, 111 were usable and fully completed questionnaires. This put the response rate at 4,4%, which is considered low, but the sample size of 111 was not considered too small for the statistical analyses to be completed. The statistical analysis included finding summary statistics on all univariates to determine the measures of location and variability and to investigate the frequency distributions of all the responses. The 111 respondents were skewed towards males since they were split in a 97: 14 ratio with female participants, which suggest that females are underrepresented at managerial levels with SCM. Seventy five percent of respondents are employed by business organisations with less than 3500 employees although the highest number is 65000 employees for the sample.

Most organisations (67%) have SCM information systems technologies that are less than 4 years old, which is remarkable for this study that focused on the time period from 1990 to 2006, which is when the usage of the Internet grew in South Africa. Regardless of having the latest technologies on hand, most respondents still use the fax or e-mail to order goods (mostly raw materials and completed products) from their suppliers.

The most significant difference between the suppliers and manufacturers (MAB1) and other parts of the supply chain (MAB2) for using the Internet for administrative tasks is that MAB 1 search for lower prices and place orders more often than MAB2 respondents.

Based on the factor analysis, (to test the validity of the questionnaire) the two underlying constructs that govern respondents' SC interaction and in particular their information sharing activities was found to be confidence and confidentiality. This is in alignment with the literature reviewed and the premise that either the technical skills or the company policies would become barriers to information sharing and partner integration. Confidence is suggesting a willingness to share information from a training or technology integration perspective, since most admit that SC partners do not use the same software. However the Confidentiality construct reveals the reality of competitive supply chain activities amongst the sample and their SC partners, since the risk of competitors using the information against them is enough to limit information sharing.

Researchers can examine a number of future research opportunities from this study since it combines the disciplines of supply chain management studies, information technology acceptance studies and the challenges of Internet based business to business interactions. The results of this study and the contribution to the multi-discipline research area could be improved by future studies taking an even larger sample of the sample population to include more heterogeneous technology users in the study. This could facilitate the extrapolation of the results to the South African SCM market with more certainty.

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