

SUPPLY CHAIN COLLABORATION WITHIN THE WEB PRINTING INDUSTRY

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ABSTRACT

The purpose of this project report was to develop a conceptual model that could be used to examine collaboration within its particular supply chain for the Web Printing industry. Although the model is based on literature not necessarily related to the Web Printing industry, it is suited for any industry that needs to improve collaboration within its supply chain.

The findings from the research show that the industry in question can benefit by investigating the proposed model. For effective collaboration, information sharing is of cardinal importance.

Respondents have indicated through the questionnaires that firstly, trust and commitment do not exist for all members in the supply chain.

Access to information and on-line information in particular is limited. This affects much needed supply chain visibility that is vital for collaboration. Another important factor is the lack of an integrated information infrastructure to support information sharing.

The industry's access to technologies for improved supply chain collaboration is also a major factor impeding successful communication and thus collaboration within and across the supply chain.

DECLARATION

I, Chris Lazanakis, declare that this project report is my own, unaided work. It is submitted in partial fulfilment of the requirements for the degree of Masters of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Chris Lazanakis

Date: _____

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Glossary

ABC	Activity Based Costing
API	Application Programming Interface
APS	Advanced Planning and Scheduling
ASP	Application Service Provider
B2B	Business-to-Business
B2C	Business-to-Consumer
CPFR	Collaborative Planning, Forecasting and Replenishment
CR	Continuous Replenishment
CSFs	Critical Success Factors
CTP	Cape Transvaal Printers
DAMA	Demand Aided Manufacturing Architecture
DOMS	Dell Order Management System
DPS	Dell Product Services
EAN	European Article Numbering
ECR	Efficient Consumer Response
EDI	Electronic Data Interchange
ER	Efficient Replenishment
ERP	Enterprise Resource Planning
FedEx	Federal Express
GE	General Electric
GM	General Motors
IBM	International Business Machines
IRB	Information to Run the Business (IRB)
ISO	International Organisation for Standardisation
IT	Information Technology
JIT	Just-in-time
MIT	Massachusetts Institute of Technology
PC	Personal Computer
POS	Point-of-Sale
PSAs	Product and Service Agreements
PTX	Private Trading Exchange
QR	Quick Response
R&D	Research and Design
RFID	Radio Frequency Identification
SCM	Supply Chain Management
SRM	Supplier Relationship Management
TPMs	Third Party Maintainers
TPN	Trading Process Network
VICS	Voluntary Interindustry Commerce Standards Association
VMI	Vendor Management Inventory
WMS	Warehouse Management Systems
XML	Extensible Markup Language

1. INTRODUCTION

1.1 Context of the Research

Supply chain management (SCM) has become an integral concept in many organisations today. However, after almost 15 years of existence, it continues to be poorly understood and badly implemented in most organisations (Monczka & Morgan, 1997).

SCM involves more than just managing material and supply purchases. It involves the process of managing everything outside the organisation that affects profitability and customer satisfaction.

Let us take the Web Printing industry as an example. In terms of SCM, the paper and inks supplier, the printing company, and the retailer who is running product specials or selling newspapers all become members of the supply chain. The paper supplier is at the one end of the chain, the printer is in the middle and the customer is at the other end. The distributor also plays a role in moving goods from supplier to printer and from printer to customer. All four parties must work in harmony to eliminate extra cost and delays in getting the product to the customer.

One of the greatest challenges in industry today is that it takes too long to get a product through the supply chain to the customer. Having said this, one thing that can be counted on is that the customer will find the quickest and most economical way to satisfy his or her needs (Dossenbach, 1999). By using SCM, organisations are able to ensure that they are one of the best options that a customer has to consider.

Looked at another way, if organisations are not effectively managing the supply chain, they are foreclosing on some important competitive advantages and, at the same time, losing ground to those competitors who are acting aggressively in this area (Quinn, 1998).

Figure 1
Typical Supply Chain for the Web Printing Industry

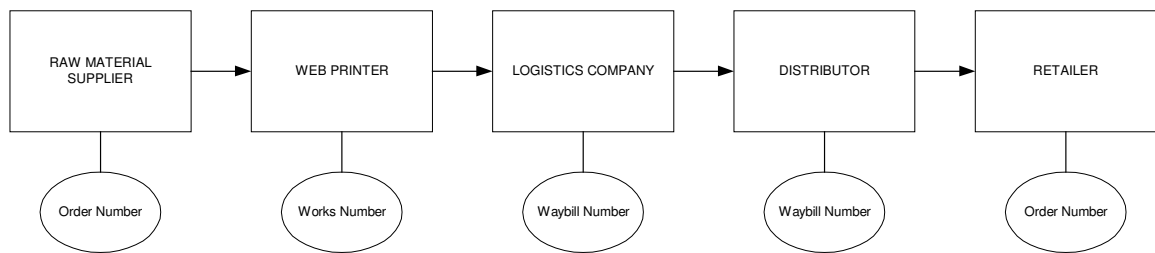


Figure 1 shows a simplified supply chain as it currently stands for the Web Printing industry in South Africa. The raw material supplier would typically be Sappi or another supplier of paper. The Web Printer would represent a company such as Cape Transvaal Printers (CTP) or Paarl Web while the logistics and distribution company for example Kargo International Logistics would handle the warehousing and transporting of printed materials. The retailer would be a company such as Pick ‘n Pay or Shoprite Checkers who would sell the newspaper or other printed material to the final consumer.

Each company within the supply chain has various processes in place to handle and process an order. Some of these companies have their own unique order numbers in place while the distributor, for instance, works with a waybill number.

Currently, collaboration or communication between organisations is mainly limited to phone calls, faxes and emails with limited Internet usage. The result is that there is no true collaborative means for the retailer to check when a particular product will be delivered to a particular store or whether it is on the shelf already. Other than telephoning the store itself or the transporting company, the retailer is in the dark and so are other members of the supply chain. The problem is further exacerbated by the fact that there is no unique order number that can be quoted upstream or downstream in the case of a query.

Upstream members cannot forecast future demand unless they find an alternative time-consuming way of communicating with downstream members for relevant data and information.

“Just-in-time” (JIT) is another issue that features prominently in the Web Printing supply chain. Printed materials have to be on the shelf at a particular time and/or date.

Problems with the current supply chain creates a threat whereby foreign companies may enter the local market with more efficient supply chains based on American and European experience in the same industry.

Web printing is best defined as newspapers or multi-page pamphlets that are printed on a press using a giant (half a ton for instance) roll of paper that is intricately fed through, or “webbed” on a large press. The printing process covers all pages at once and folding equipment folds the pages into a finished newspaper or pamphlet. The process is very fast compared to Sheetfed Printing but takes time to set up and reconfigure.

1.2 Significance of the Research

The research was intended to develop a collaborative supply chain model and to determine what constitutes a collaborative supply chain together with Critical Success Factors (CSFs) for such a supply chain. This information can be used by organisations to assist them in improving the operation of their supply chain.

SCM is not too complex to understand. Although complexity is a problem, there are various issues that need to be examined by organisations (Monczka & Morgan, 1997). Among these issues are:

- Fragmentation in the way that SCM is understood and applied
- Failure of companies to develop true integration of the processes used to achieve SCM
- Organisational resistance to the SCM concept

- Lack of buy-in and support for improvement initiatives by many of the top corporate managers
- Lack of measurement systems
- Lack of good and sufficient information
- Lack of integrated information systems and electronic commerce linking different organisations in the supply chain
- Failure of supply management thinking to push beyond the bounds of individual companies

Even in the best of organisations there are few processes that are fully integrated horizontally. This integration problem extends to suppliers and customers of the organisation.

Many organisations have embarked on an outsourcing drive to try to overcome this issue. This may aggravate the problem if there is weak integration between the outsourcing party and other members within the supply chain.

1.3 Purpose of the Research

The purpose of this project report is to develop a conceptual model that can be used to examine collaboration within the supply chain for the Web Printing industry. The model is developed on the basis of information gathered from a review of current literature on SCM.

1.4 Problem and Sub-problems

The aim of the research was to develop a model that indicates collaborative options for the Web Printing industry within its particular supply chain.

The following sub-problems were associated with the research. These were to:

- i. Derive a collaborative supply chain from current literature.
- ii. Identify current supply chain technologies for collaboration

- iii. Identify the CSFs for collaboration
- iv. Identify and describe the current supply chain as it happens in the Web Printing industry in South Africa today
- v. Identify the CSFs for collaboration within the Web Printing supply chain
- vi. Evaluate the Web Printing industry's supply chain against a collaborative supply chain identified in the literature. Also evaluate this industry's CSFs against the CSFs identified by the literature
- vii. Develop a collaborative supply chain model that can be used by the South African Web Printing industry

1.5 Limitations

In order to allow the supply chain to be more easily researched, this research was limited to primary members of the Web Printing supply chain. To clarify this, an explanation of what is meant by primary and supporting supply chain members is required.

The primary members of a supply chain are all those independent companies or strategic business units who carry out operational and/or managerial value-adding activities. These activities are executed within the business processes designed to produce a particular output for a particular customer or market (Croxtton, García-Dastugue, Lambert & Rogers, 2001).

Supporting members represent companies that merely offer resources, knowledge, utilities or assets for the primary members of the supply chain (Croxtton *et al*, 2001).

Examples of supporting companies include those that lease trucks to the manufacturer, institutions that lend money to a retailer, or the landlord of the building that provides warehouse space. These supply chain members support the primary members.

Although various activities within the supply chain are discussed in the research, the focus of the research is on inbound logistics, operations and outbound logistics as they pertain to the movement of goods and information.

The research did not examine the details of the various business processes within the supply chain. Rather it focused on a high level view of the supply chain with emphasis on collaboration.

SCM spans the whole supply chain from the raw material supplier through to the end consumer. The focus of this report was on Business-to-Business (B2B) rather than Business-to-Consumer (B2C) collaboration within the supply chain.

The main focus of collaboration was in terms of technology rather than business processes or human relationships.

In terms of methodology, the researcher included senior managers who are involved in the SCM process of their organisations.

1.6 Assumptions

The research makes the following assumptions:

- i. The research participants have sufficient knowledge concerning supply chain management to enable them to provide relevant information regarding their current supply chain as well as CSFs for the supply chain in which they operate.
- ii. Participants' views are representative of the views of the sector that they were drawn from.
- iii. Integration within the supply chain, as far as members or collaboration technology is concerned, is synonymous with the context in which collaboration is discussed in this study.

1.7 Structure of the Project Report

Chapter Two examines the most current and important literature that deals with the topics of collaboration and SCM. The chapter also looks at current problems in SCM as well as the motivation for collaboration.

Various supply chain technologies are discussed in the same chapter. These technologies are currently used in various industries and their purpose is to improve or optimise collaboration within their supply chains. The chapter then discusses CSFs for collaboration, and concludes with a discussion of successful supply chains.

Chapter Three identifies a collaborative supply chain model derived from the literature reviewed in Chapter Two. The different steps and components of this model are discussed in this chapter.

Chapter Four explains the research methodology followed for this project report.

Chapters Five and Six contain the presentation and interpretation of the results from the questionnaires respectively, while Chapter Seven forms the conclusions and makes recommendations.

2. LITERATURE REVIEW

2.1 Supply Chain Management Theory

There has been a growing emphasis on SCM as a vehicle through which organisations can achieve competitive advantage in markets. A large number of examples in the 1990s, both successful and unsuccessful, show how companies have made great investments to streamline their supply chains for the improvement of customer satisfaction and the enhancement of internal productivity (Dyer, Cho & Chu, 1998).

Christopher (1992) states that it is not actually individual companies that compete with each other nowadays; rather, the competition is between rival supply chains. Those supply chains that add the most value for customers with the lowest cost in the chain make up the winning network of individual companies.

There is a great deal of confusion regarding exactly what SCM involves. Most people using the name “supply chain management”, treat it as a synonym for logistics or as logistics that includes customers and suppliers. Although these terms in essence represent the same management discipline, it is important to understand that there are fundamental differences between the concepts of SCM and logistics (Bowersox, Closs & Stank, 1999; Lambert, Stock & Ellram, 1998).

Christopher (1992) defines logistics management as the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory. Information flow related to the above must also be seen as part of the process. These activities must be viewed as a single process that moves through the organisation and its marketing channels in such a way that current and future profitability are maximised through the cost-efficient fulfilment of orders.

Christopher (1992) maintains that there are two critical aspects in their definitions that differentiate the concept of “logistics management” from “supply chain management”. First, logistics management focuses mainly on a company’s internal processes and, second, it pursues profitability targets through cost-efficiency. SCM

goes far beyond this in terms of objective setting and scope and can be clearly distinguished from traditional logistics management.

SCM, as a more holistic concept, is a collaborative-based strategy to link interorganisational business operations in order to achieve a shared market opportunity (Bowersox *et al*, 1999). The objective of SCM is to achieve an integrated supply chain to enhance end-customer value (Bowersox, Closs & Stank, 2000) and to focus on cost-efficiency targets throughout the whole supply chain (Christopher, 1992).

Christopher (1992) defines SCM as the management of upstream and downstream relationships with suppliers and customers, with the objective to deliver superior customer value at less cost to the supply chain as a whole.

This definition concisely points out the two main aspects that distinguish SCM from logistics management. The first aspect is the objective of providing superior customer value with minimum costs to the entire chain. The second aspect deals with the inter-organisational relationships and interactions in a chain that is made up of a number of upstream and downstream companies.

Successful SCM requires cross-functional integration of key business processes within an organisation, and across the network of organisations that make up the supply chain. The challenge is to determine how to accomplish this integration successfully (Cooper, Lambert & Pagh, 1997).

2.1.1 Supply Chain Business Processes

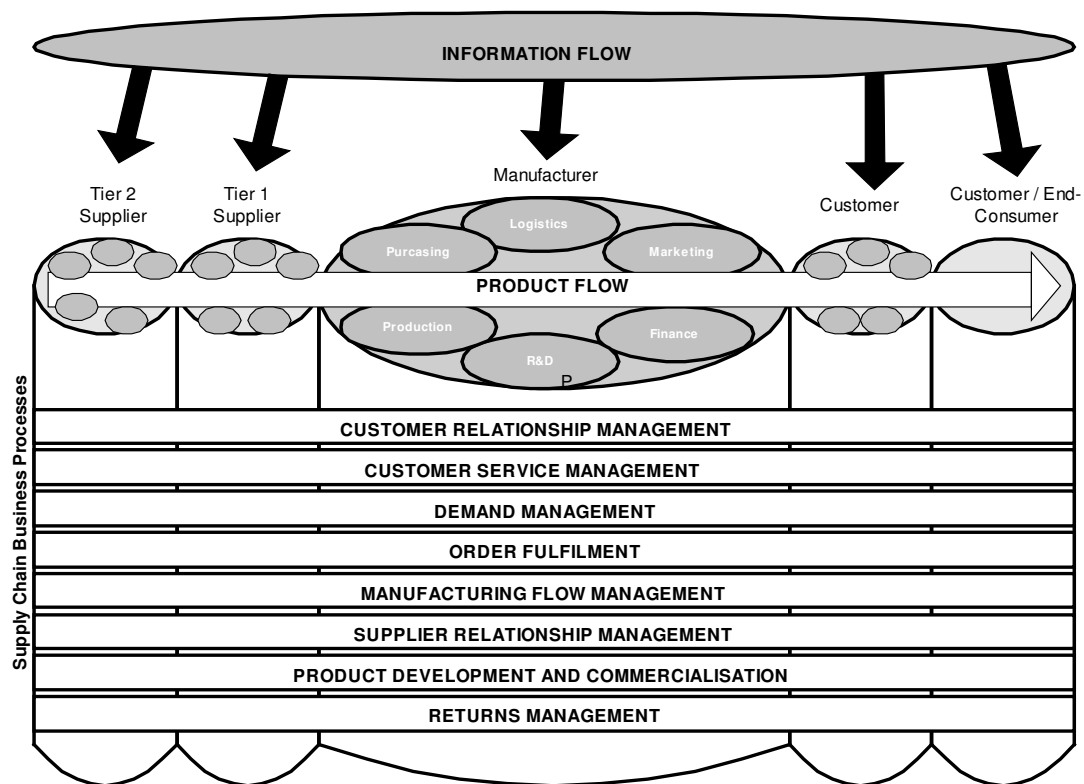
Supply chain business processes could become very complex depending on the industry. For the purposes of this research, the researcher has made use of the model developed by the Global Supply Chain Forum in which eight key processes that make up the core of supply chain management, have been identified (Croxtton *et al*, 2001).

These processes are:

- Customer relationship management
- Customer service management
- Demand management
- Order fulfilment
- Manufacturing flow management
- Supplier relationship management (procurement)
- Product development and commercialisation
- Returns management

Figure 2

Supply Chain Management: Business Processes Across the Supply Chain



Source: (adapted from Lambert, Cooper & Pagh, 1998:2)

Figure 2 depicts a simplified supply chain network structure, the information and product flows, and the key supply chain business processes penetrating functional silos within companies as well as corporate silos across the supply chain. These business processes become supply chain business processes that are linked across intra- and inter-company boundaries. From this, it is evident that collaboration between the various members of the supply chain is crucial for efficiency and effectiveness.

A description of each of the processes shown in Figure 2 follows below (Croxtton *et al*, 2001):

Customer Relationship Management

Customer relationship management provides the structure for building and maintaining the relationship of the supply chain members with the customer. In any organisation there are key customers and customer groups that need to be targeted. Product and Service Agreements (PSAs) are developed to meet the needs of key accounts and of other customer segments. In addition, these PSAs stipulate levels of performance.

Customer teams within organisations work with key customers, improve processes, and eliminate demand variability and non-value-added activities. Often, these organisations have to collaborate with other members of the supply chain in order to come up with the best solution for a customer or group of customers. Profitability of individual customers, as well as the financial impact on the customer is measured by performance reports.

Customer Service Management

Customer service management is the firm's face to the customer. It provides the first line of contact for administering the PSA. Customer service provides the customer with real-time information on promised shipping dates and product availability through interfaces with the supplier firm's functions, such as manufacturing and

logistics. This process could also include assisting the customer with product applications.

In the above instance, information flow is key as members within the supply chain need visibility and synchronisation of disparate systems and data. If a customer has a query pertaining to a shipment, the information needed to effectively answer the query might need to include data from three or four different members across the supply chain. A product being imported from Korea, for instance, would probably change hands a few times while moving through different warehouses and transportation vehicles before reaching its final destination.

Demand Management

Hewlett-Packard's experience indicates that inventory is either essential or is variability driven (Davis, 1993). Essential inventory includes work-in-progress on the factory floor, as well as products in the pipeline moving from one location to another. Variability stock is found because of variance in the process, supply, and demand. Customer demand is by far the largest source of variability and stems from irregular order patterns. This variability in customer ordering shows that demand management is key to effective SCM.

Demand management must balance the customer's requirements with the firm's supply capabilities. One of the components of demand management is for a member of the supply chain to try to determine what and when the customer will purchase. Point-of-sale (POS) and other "key" customer data could be used to identify patterns in customer demand and thus reduce uncertainty and provide efficient flows throughout the chain.

Marketing requirements and production plans should be co-ordinated on an enterprise-wide basis. In very advanced applications of demand management, customer demand and production rates are synchronised to manage inventories in disparate locations.

Order Fulfilment

Implementation of the order fulfilment process requires integration of the firm's manufacturing, logistics and marketing plans. Partnerships should be developed with key supply chain members and carriers to meet customer requirements and to reduce total delivered cost to the customer. The objective is to develop a seamless process from supplier to organisation and then on to its various customer segments.

Manufacturing Flow Management

Manufacturing in make-to-stock organisations traditionally produced products and supplied them to the distribution channel based on historical forecasts. Products were pushed through the plant to meet a schedule. This resulted in unwanted inventories, excessive inventory carrying costs, mark-downs and transshipments of product.

With SCM, customer needs dictate that the product is pulled through the plant. Manufacturing processes must be flexible enough to respond to market changes. This requires the flexibility to perform rapid changeover to accommodate mass customisation. Orders are processed on a JIT basis in minimum lot sizes. Production priorities are driven by required delivery dates. Manufacturing planners collaborate with customer planners to develop strategies for each customer segment. Changes in the manufacturing flow process lead to shorter cycle times, which result in improved responsiveness to customers.

Supplier Relationship Management

As in the case of customer relationship management, a company will build close relationships with a small number of its suppliers, and manage arm-length relationships with others. Each supplier will sign a PSA that will define the terms of the relationship. Supplier relationship management is about defining and managing these PSAs. Strategic plans are developed with key suppliers to support manufacturing flow management, and product development and commercialisation.

Suppliers are categorised according to several dimensions such as their contribution and criticality to the organisation.

Smart (1996) explains how General Electric (GE) is a prime example of an organisation that excels in supplier relationship management. The company buys components through its Trading Process Network (TPN). On the TPN, parts specifications are posted electronically and many pre-qualified suppliers can bid for the job.

Although there is little face-to-face interaction, costs are exceptionally low. For instance, GE estimated that the cost of processing a traditional paper purchase order was more than \$50, while the cost on the TPN dropped to \$5. Furthermore, the length of the bidding process at GE decreased from 21 days to 10 days, leading to reduced cycle times (Smart, 1996).

Product Development and Commercialisation

It is crucial that customers and suppliers are integrated into the product development process in order to reduce the time it takes for a product to reach the market. As product life cycles shorten, the right products must be developed and successfully launched within limited time frames for organisations to remain competitive.

Co-ordination with customer relationship management is needed to identify customer needs. Also the importance of the supplier relationship management process cannot be underestimated when it comes to selecting materials and suppliers, and the best supply chain flow dictates close collaboration with manufacturing.

Returns Management

Effective returns management is an important part of SCM and provides an opportunity to achieve a sustainable competitive advantage. Effective returns management enables identification of productivity improvement opportunities and breakthrough projects.

At Xerox, returns are managed in four categories: equipment, parts, supplies, and competitive trade-ins (Clendenin, 1997). “Return to available” is a speed measure of the cycle time that is required to return an asset to a useful status.

In the case where customers are given immediate replacement in the event of product failure, this metric becomes particularly important.

On 3 November 2002, Amazon.com launched an apparel store in partnership with a number of clothing companies (Spieler, 2002). Amazon.com provides the traffic and takes a commission for every sale. This also means that Amazon needs to manage refunds and credits.

Spieler (2002) states that Amazon.com may have underestimated the complexity of resolving returns, which is a major headache for every clothing retailer. Gartner also estimates that fees for returns range from \$3.00 to \$12.00 per item, depending on how the customer and retailer interact. Because of the high turnover of apparel, the cost of processing a return reduces or in some cases eliminates the profit on each item and cuts deeply into the overall profit margin.

This example highlights the importance of an organisation’s returns management processes.

2.1.2 Supply Chain Collaboration

According to Cooper *et al* (1997:5), the characteristics of SCM are:

- SCM evolves through numerous stages of increasing intra- and inter-organisational integration and co-ordination spanning the entire chain from supplier to ultimate consumer.
- It involves many independent organisations, which requires the management of intra- and inter-organisational relationships.
- It includes the bi-directional flow of products (materials and services) and information, and the associated managerial and operational activities.

- By making use of resources, and building competitive chain advantages, it attempts to provide high customer value.

These characteristics highlight the importance of effective collaboration within the supply chain. Information, material and services flow throughout the chain on a continuous basis and different entities need to operate in a collaborative manner to meet customer demand with reliability in terms of delivery times at reduced costs.

Collaboration is essential in making connected processes, collective decision making, information transparency, common metrics and lowered barriers of entry for new partners possible. A truly collaborative approach requires automating supply chain systems so that both customers and suppliers can communicate with organisations and with each other.

Bowersox *et al* (2000) state that companies collaborate in terms of leveraging benefits to achieve common goals, while Anthony (2000) suggests that supply chain collaboration occurs when two or more companies share the responsibility of exchanging common planning, management, execution, and performance measurement information.

Collaboration takes the form of sharing information that impacts on inventory levels and merchandise flow. In a planned and carefully designed collaborative environment, the business partner and the retailer can see the same information that is used for business decisions. The collaboration partner agrees to future actions and adjusts internal operations accordingly. These types of environments allow partners to see the performance metrics in real time, which lowers uncertainty and creates an atmosphere of no surprises (Bowman, McKinney & Morgenstern, 2000).

By looking at the business processes of a supply chain, one can see that it is virtually impossible to achieve SCM without collaboration. According to Lee (2000), the three key dimensions to supply chain integration are information, co-ordination and organisational linkage. None of these can be achieved without effective collaboration.

The collaborative business model that is used between trading partners is based on the depth of their trading relationship. For example, within inventory replenishment there are multiple models for how the customer orders and item quantities are determined. The simplest trading relationship for replenishment is based on a pull model where the customer determines the appropriate item balances and places an order with the supplier when the goods drop below minimum inventory levels (Anthony, 2000). (Please refer to Appendix C for a summary of supply chain collaboration initiatives.)

There are various forms of collaboration within the supply chain. The following sections will discuss Quick Response (QR), Efficient Consumer Response (ECR), Vendor-Managed Inventory (VMI) and Collaborative Planning, Forecasting and Replenishment (CPFR).

2.1.3 Quick Response

QR was developed at the end of the 1980s for general merchandise retailers and their suppliers as a response to the very low overall efficiency of these supply chains (Kurt Salmon Associates, 1993). In essence it is a follow-on of the JIT philosophy to provide the right product in the right place at the right time.

QR is a partnership strategy in which retailer and supplier work together to respond rapidly to consumer needs by sharing POS information. This is then used to forecast future demand for items to be replenished jointly, and to monitor trends continually to detect opportunities for new items (Fisher, 1997).

Operationally, both parties use Electronic Data Interchange (EDI) to speed up the flow of information. Activities are jointly reorganised to minimise lead times and costs. EDI enables retailers to:

- Automatically generate and transmit orders directly from POS data
- Increase their reorder frequency
- Substantially reduce both safety stocks and sales lost to stock outs

According to Christopher (1992), QR is a classic case of the substitution of information for inventory.

2.1.4 Efficient Consumer Response

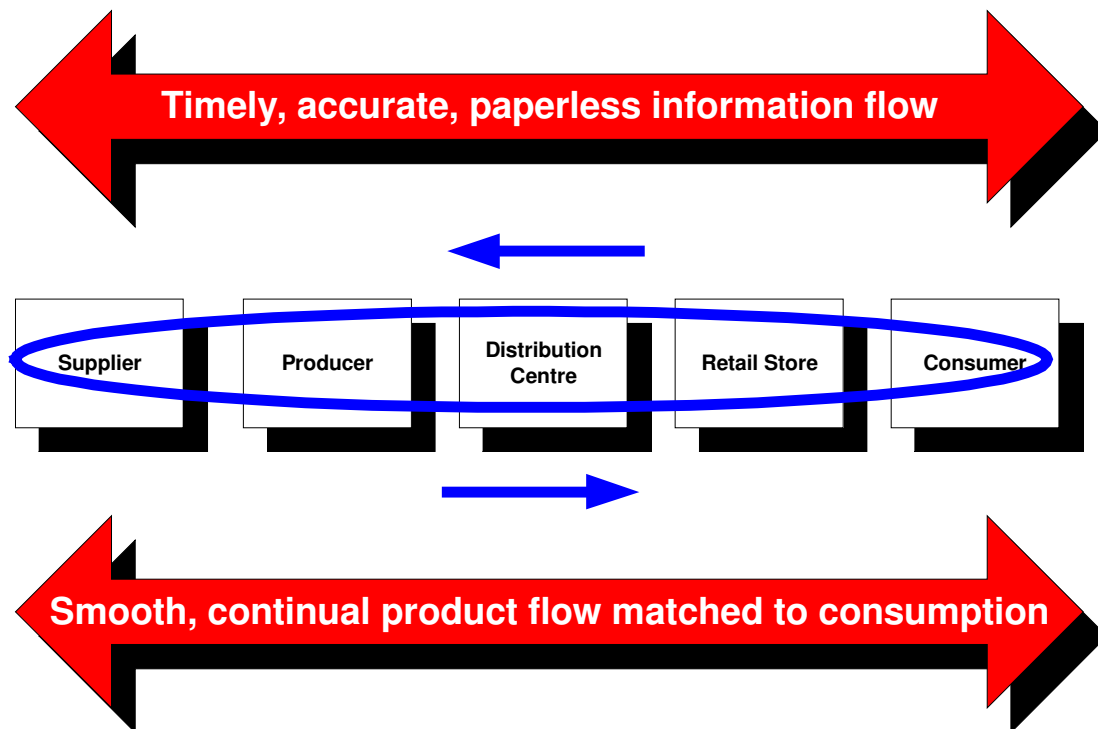
When the principles of QR were transferred to the grocery supply chain, this led to ECR, in which distributors and suppliers work closely together to offer better value to the grocery consumer.

By jointly focusing on the efficiency of the total grocery supply system, rather than on the efficiency of individual components, total system costs, inventories, and physical assets are reduced while the consumer's choice of high-quality, fresh grocery products is improved.

In accordance with SCM the ultimate goal of ECR is to achieve a responsive, consumer-driven system in which distributors and suppliers work together as business allies to maximise consumer satisfaction and minimise system cost (Figure 3).

Accurate information and high-quality products flow through a paperless system between manufacturing line and check-out counter with minimum degradation or disruption both within and between trading partners (Kurt Salmon Associates, 1993).

Figure 3
The ECR System



Source: (adapted from Kurt Salmon Associates, 1993)

Kurt Salmon Associates (1993) were the first to publish research on ECR. Their publication reports the findings of an ECR working group comprising a group of industry leaders such as Coca-Cola, Kraft General Foods, Procter & Gamble, Campbell and Safeway in the United States.

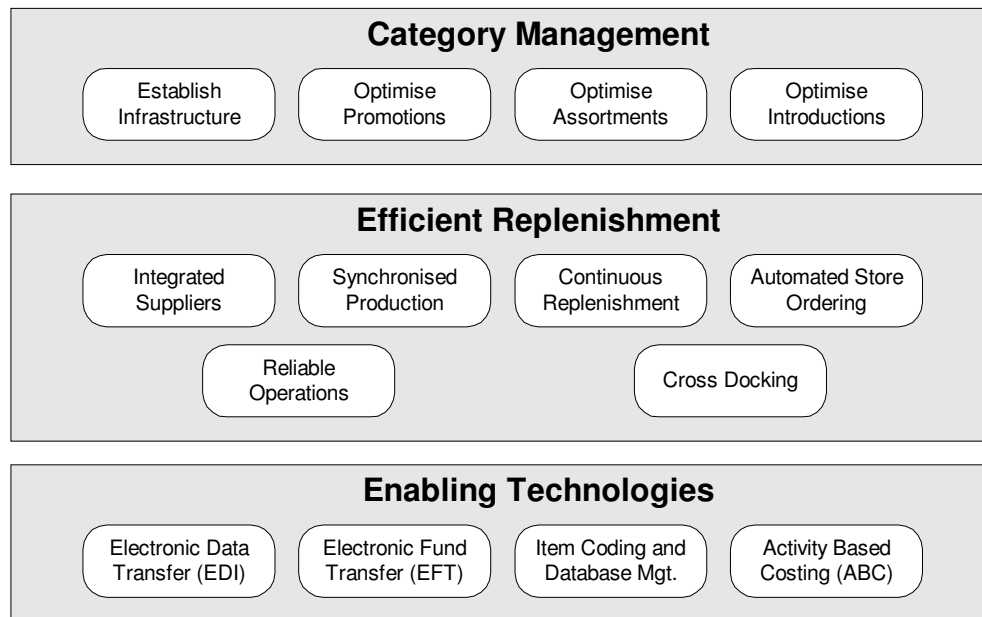
This working group was charged with investigating the grocery supply chain and its trade practices to identify possible opportunities for changes in practices or in technology that could increase the competitiveness of the supply chain (Van Der Vorst, 2000).

The ECR working group developed five guiding principles that articulate the ECR strategy (Kurt Salmon Associates, 1993). These principles are listed below.

1. Persistently focus on providing better value to the grocery consumer: enhanced product, quality, assortment, in-stock service and convenience with reduced costs to the total supply chain.
2. ECR needs to be driven by committed business leaders who are determined to replace the old paradigms of win/lose trading relationships with win/win mutually beneficial and profitable business alliances.
3. Accurate and timely information must be used to support effective marketing, production and logistic decisions. This information will flow externally between partners through EDI and will internally effect the most productive and efficient use of information in a computer-based system.
4. Product flow must maximise value-adding processes throughout the supply chain to ensure that the right product is available at the right time.
5. A common and consistent performance measurement and reward system must be in place to focus on the effectiveness of the total system.

Coopers and Lybrand (1996) took it a step further by translating these guiding principles into a family of 14 ECR improvement practices categorised into three clusters concerning marketing, logistics and Information Technology (IT) (Figure 4).

Figure 4
ECR Performance Improvement Concepts



Source: (Coopers and Lybrand, 1996)

Category management focuses on product management for the optimisation of assortments, product introductions and promotions. Typically, food industries and retailers jointly work on providing consumers with the right product that has the right specifications, which aims at resulting in the purchase of the product.

The partners in the supply chain formulate a consumer-oriented strategy for each product category. They start with the assumption that establishing chain partnerships can reduce the costs of these activities (Van Der Vorst, 2000).

The objective of Efficient Replenishment (ER) is to ensure an optimised product flow through the supply chain – optimised in the sense that one is able to respond to issues such as changing demands, low inventories, quality and required service levels.

Partners in the SC can achieve these objectives by changing the method of operational co-operation and collaboration within the chain. This is supported by a free flow of accurate and timely information, integrated with the flow of product throughout the supply chain.

ER consists of secondary improvement concepts, which, when implemented together, should result in responsive, flexible, customer-order-driven supply chains (Coopers & Lybrand, 1996). These secondary improvement concepts are:

- Automated store ordering: Store orders are generated automatically based on actual scanning data, in-house inventory and sales forecast.
- Continuous replenishment: The inventory of the retailer is managed by more frequent and smaller deliveries from the supplier, based on actual sales and forecasted demand.
- Cross docking: This eliminates the storage of products at the retailer distribution centre by transferring, re-consolidating and distributing products within 24 hours to the stores.
- Synchronised production: Production is synchronised to consumer demand by only producing those products and levels of product that are actually required, by the consumer.
- Reliable operations: This involves improving process reliability (reducing manufacturing down time) and improving delivery reliability.
- Integrated suppliers: Continuous replenishment, reliable operations and synchronised production are implemented by all upstream members of the supply chain.

In tests with four retailers, Campbell Soup found that Continuous Replenishment (CR) reduced inventories in retailer distribution centres by fifty percent, while increasing service slightly from ninety eight point seven percent to ninety nine point five percent (Cachon & Fisher, 1997).

Finally, and in order to facilitate the above-mentioned ECR concepts, enabling technologies are needed. Large amounts of data have to be collected, exchanged and processed for ECR. Therefore, a mutual infrastructure that provides standard techniques is needed. These standard techniques, according to Coopers & Lybrand (1996), are listed below:

- Item coding and database maintenance aid in collecting and processing POS data. The European Article Numbering (EAN)-code system offers the opportunity to register each product uniquely, which is a prerequisite for tracking and tracing the product as it moves through the supply chain.
- Electronic Data Interchange (EDI) facilitates the standardised exchange of data between companies.
- EFT is the electronic exchange of account and invoice information between trading partners.
- Activity-Based Costing (ABC) provides insight into the costs of activities within the supply chain, which in turn facilitates the calculation of financial consequences of changes per individual activity and chain partner.

ECR in itself is not a new phenomenon, but it offers a “total package” of concepts that can analyse and optimise supply chain collaboration (Van Der Vorst, 2000). Although ECR should be viewed as a sub-concept of SCM as it relates to the food industry, it provides invaluable insight and information into optimising SC collaboration within any industry.

2.1.5 Vendor-Managed Inventory

VMI takes place when a supplier has access to information on inventory levels at a customer’s site. In addition, the supplier takes responsibility for maintaining the customer’s inventory levels. With suppliers having access to inventory information of various members up and downstream in the supply chain, lean manufacturing becomes a possibility because of the strict control of these inventories. Via effective collaboration, VMI can lead to raw materials and other components being supplied on a daily or even hourly basis (Basta, 2003).

VMI agreements with customers have been growing primarily because of oversupply and excess inventory in the market caused by weak or non-existent collaboration within the supply chain (Roos, 2002).

2.1.6 Collaborative Planning, Forecasting and Replenishment

CPFR is a standard methodology for two or more companies that exist in the same supply chain, to work together in order to reduce costs while increasing revenue and customer satisfaction for each company (Harrington, 2003).

Harrington (2003) writes that CPFR is a way of synchronising the ideas of the supply chain partners or members regarding how much product is demanded at any given time. It is also a method of aligning the various demand forecasts into a single plan.

Companies are getting more proactive about the way they develop relationships. All members of the supply chain are looking at improved customer service from the supplier right through to the retailer, and a higher in-stock position from the retailer through to the consumer. This is virtually impossible without effective collaboration. CPFR nurtures, enables and initiates trusting relationships and shared information between players (McCrea, 2003).

One of the most visible efforts behind supply chain collaboration is the CPFR process model proposed by the VICS association. It was started in 1990 by Wal-Mart and Warner-Lambert, and supported by SAP Systems Analysis and Program Development (SAP) and Manugistics. This project included increasing forecasting efforts on a certain product category in order to better match the production capacity of the suppliers to the actual demand. The pilot was a success, resulting in increased sales, better availability of products and reduced inventory (Smaros, 2002).

The nine steps of the CPFR process model as proposed by VICS are as follows (VICS, 1998):

1. Develop Front-End Agreement: the retailer/distributor and manufacturer establish the guidelines and rules for the collaborative relationship.

2. Create Joint Business Plan: the manufacturer and retailer exchange information about their corporate strategies and business plans in order to collaborate on developing a joint business plan.
3. Create Sales Forecast: retailer POS data, causal information, and information on planned events are used to create a sales forecast that supports the joint business plan.
4. Identify Exceptions for Sales Forecast: the items that fall outside the sales forecast constraints set jointly by the manufacturer and distributor are identified.
5. Resolve/Collaborate on Exception Items: collaborative negotiations between the retailer/distributor and the manufacturer are carried out to resolve item exceptions.
6. Create Order Forecast: POS data, causal information, and inventory strategies are combined to generate a specific order forecast that supports the shared sales forecast and the joint business plan.
7. Identify Exceptions for Order Forecast: any items that fall outside the order forecast constraints set jointly by the manufacturer and distributor, are identified.
8. Resolve/Collaborate on Exception Items: if necessary, the parties negotiate again to produce an adjusted order forecast.
9. Order Generation: this marks the transformation of the order forecast into a committed order.

Mazel (2002:11) states that collaboration, especially with key or critical supply chain trading partners, is no longer a question of “should we do it?” but rather one of “when do we begin and with whom?”.

Within the collaboration philosophy, CPFR is gaining a foothold and driving many of the new initiatives. The strong trend for collaboration (CPFR) between supply chain partners is projected to double from twenty percent today to forty percent in 2005 (La Londe & Ginter, 2003).

Mazel (2002) lists the benefits of CPFR as:

- Better forecast accuracy as measured by the number of changes made to the sales forecast during and beyond the freeze period
- A reduction in days of supply at the retail level by as much as twenty percent
- An increase in sales, as high as thirteen percent for the category, and fifty percent for individual items
- A decrease in shrinkage
- An increase in case-fill performance
- An increase in profit dollars and margin measured at retail

2.2 Current Problems in Supply Chain Management

Various reasons for why companies should engage in collaborative efforts can be found in the literature. For example, rapid shifts in demand and/or supply often cause even greater shifts in profitability. This is a problem that should be driving companies towards co-operation.

The fact that products often have long production lead times implies that production must be started well in advance of the expected demand. Starting production well in advance means that production resources can be better allocated because of the predictability of demand. In most cases, forecasting is currently a manual process, which involves very distinct methods and tools in different companies.

Decision making is so divided that consensus between the different members of the supply chain becomes almost impossible. This causes results to vary even though they might be based on the same information. Additionally, the data on which the decisions are based is very often inaccurate. Since the communication lead times are also often

high, despite the available information technologies, decision making is often based on false data.

Finally, companies often exaggerate their demand forecasts to ensure deliveries during periods when supplies are tight. This rather uncharacteristic feature, leads to inefficiencies on both the supplier and the customer side.

2.2.1 Asymmetric Information

Various members within the supply chain have different information at their disposal. With companies utilising different sources of information, false and inaccurate information surfaces across the supply chain.

Members within the supply chain have no knowledge of their partners' production schedules, sales figures, demand forecasts and other relevant information. As many companies see this information as a competitive advantage, they are reluctant to share it for fear of losing their position in the chain.

The information asymmetries cause a significant deterioration in the performance of the supply chain. Processes and procedures become almost trivial if the information on which decisions are based is not accurate and available to all members (Patosalmi, 2003).

2.2.2 Forecasting

Forecasting is one of the most widely discussed topics in SCM. Because of the lack of accurate information regarding future sales, companies have to make forecasts of demand in order to make decisions relating to production capacities and inventory levels.

With each link making its own decisions on the basis of information available, the result becomes distorted, and orders are even amplified as they are passed upstream. This phenomenon is known as the bullwhip effect (Lee, Padmanabhan & Whang, 1997).

The improvement in the accuracy of forecasts can significantly improve the effectiveness of the entire chain (Lee *et al*, 1997). In order to improve the performance of the supply chain under uncertain demand, companies need to share information and make forecasts and decisions in coordination.

Inaccurate forecasting and the negative impact of uncertainty can be substantially reduced through collaborative efforts (Lee *et al*, 1997).

2.2.3 Conflicts in Supply Chains

Simatupang & Sridharan (2002) consider that conflicts in supply chain lessen the overall effectiveness of the chain. Since supply chains consist of several independent and interdependent companies, it is more than likely that the interests of the members do not always coincide. The resulting conflict stems from the rivalry that exists among companies, as well as from mutual distrust and co-operative difficulties.

2.2.4 Managerial Inertia

Managerial inertia is also a cause of inefficiency in SCM, and stems from managers' inability to adapt new or different business environments.

Simatupang & Sridharan (2002) suggest that the basic reason for the existence of managerial inertia is outdated procedures. At the same time, they write that it could also be because of the lack of updated procedures for a new level of co-operation between multiple partners that requires a global viewpoint to effectively manage the supply chain.

The opportunistic behaviour of managers often overrules the longer-term decisions required for effective co-ordination of the supply chain. No means exist to encourage competitors or partners to behave according to what is best for the performance of the entire supply chain. Rather, managers make decisions according to what is best for them or their individual companies.

2.2.5 Supply Chain Risk Management

The Cranfield University School of Management (2002:2) have undertaken a vast research project on global supply-chain vulnerability, which they define as “an exposure to serious disturbance, arising from risks within the supply chain as well as risks external to the supply chain”. The definition includes all types of risks whether they are disruption, demand uncertainty or internal risk that arises from interaction between constituent organisations across the supply chain.

Supply chain risk management is defined as “the identification and management of risks within the supply chain and risks external to it through a co-ordinated approach amongst supply chain members to reduce supply chain vulnerability as a whole (Cranfield University School of Management, 2002:2).

Stauffer (2003) states that risks lie along the entire length of supply chains. These risks are very diverse and include political instability, exchange rates, carriage capacity, shelf life and customer demand. He also claims that risk is introduced by the need for increased product differentiation where organisations have to rely and depend on third parties within the supply chain.

The MIT Research Group on Supply Chain Response to Global Terrorism (Caniato, Fleck, Rice & Sheffi, 2003) have shown that companies normally focus on the type of disruption in a supply chain and not the source thereof.

The same group has identified six types of failure modes. These are as follows:

Table 1
Supply Chain Failure Modes

Failure Mode	Description
Disruption in supply	Delay or unavailability of materials from suppliers, leading to a shortage of inputs that could paralyse the activity of the company.
Disruption in Transportation	Delay or unavailability of the transportation infrastructure, leading to the impossibility to move good, either inbound or outbound.
Disruption at Facilities	Delay or unavailability of plants, warehouses and office buildings, hampering the ability to continue operations.
Freight breaches	Violation of the integrity of cargoes and products, leading to the loss or ruining of goods which could be due to theft or tampering with criminal purpose.
Disruption in Communications	Delay or unavailability of the information and communication infrastructure either within or outside the company, leading to the inability to coordinate operations and execute transactions.
Disruption in demand	Delay or disruption downstream can lead to the loss of demand, temporarily or permanently, thus affecting all the companies upstream.

Source: (Caniato, Fleck, Rice & Sheffi, 2003)

2.3 Motivation for Collaboration

The previous section explained some of the current problems that exist in SCM. Collaboration goes a long way towards solving or, at least, assisting in overcoming many of these problems.

Increased information visibility is probably the single most often mentioned result of collaboration. Companies are said to benefit from the reduction of uncertainty and variability in the supply chain.

According to (Patosalmi, 2003), the most often cited benefits of collaboration in SCM are:

- There is reduced variability in demand across the supply chain.
- The risk of inventory obsolescence is reduced.
- Suppliers can increase customer service level without increasing inventory risk.
- Collaboration allows dynamic pricing across the supply chain.
- Better visibility through customers' changing demand patterns results in reduced overproduction and improves allocation accuracy.
- Collaboration and optimisation throughout the supply chain allow for efficient use of fixed capacity and facilitate the planning of capacity.

Patosalmi (2003) identifies one of the key benefits of collaboration as the opportunity to use time in the supply chain differently. Supply chains usually contain periods of slack time where the product or process is waiting for something else to happen, hence producing no added value.

There are various ways in which the slack time can be transformed into something valuable. An example would be where the customer's inventory is handled by the supplier. This means that the supplier has real time information available about the inventory status of the customer. Based on this information, the supplier can make its own forecasts of future demand of its products, and can utilise this information in planning its own production capacities.

Kotler (2000) defines the supply chain as the collection of activities that are performed to obtain, market, deliver and support a product or service. Marketing researchers have divided these activities into nine strategically relevant activities that create value in a business. Five of these are viewed as primary activities and four as secondary activities.

The primary activities are as follows (Witte, Grunhagen & Clarke, 2003):

- 1) Bringing materials or products into the business (inbound logistics)
- 2) Actual operations
- 3) Getting products where they are needed (outbound logistics)
- 4) Marketing and sales
- 5) After sales servicing of products

The secondary activities, according to Porter (1998), include:

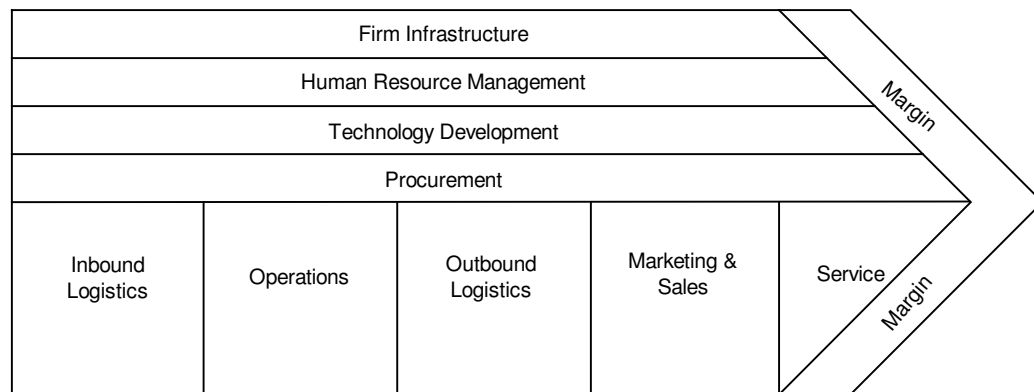
- 6) Procurement or purchasing of products
- 7) Human resources functions
- 8) Infrastructure activities to support the firm (accounting, finance, planning)
- 9) Activities concerned with developing and using new technologies

A company's success depends on the co-ordination of these activities not only across departments, but also with suppliers and manufacturers within the supply chain, as competition is seen as taking place between entire value-creating networks rather than within individual companies (Kotler, 2000).

Kotler (2000) also notes that one of the key requirements for vigorous SCM, as he puts it, is rapid and accurate communication among members of the supply chain so that their activities can be better co-ordinated.

Porter (1990) describes the above-mentioned activities as a system of interlinked processes resulting in a company's value chain. He stipulates that every activity in the value chain adds value to the product or service, as shown in Figure 5.

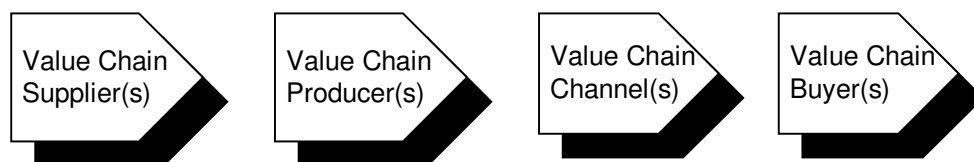
Figure 5
Porter's Value Chain



Source: (Porter, 1990:46)

Porter (1990) extends this concept and, in line with the value chain of a single company, he states that several companies can form a value system in which the value chains of individual companies are linked. This is shown in Figure 6.

Figure 6
Porter's Value System



Source: (adapted from Porter, 1990:46)

2.4 Supply Chain Technologies for Collaboration

Zuckerman (2002:5) states that “as technology evolves, the supply chain is evolving with it into a network of collaborative trading partners who are all linked electronically”.

She contends that manufacturers and suppliers are increasingly becoming a single enterprise. While this single enterprise is forming, collaborative-supply-chain-communities are witnessing the breakdown of boundaries between businesses (Zuckerman, 2002). The goal is reducing cycle times, improving customer relationships and increasing productivity. Benefits are obtained when companies are able to share forecast data so that the different members within the supply chain know how much to produce, how much to ship and when to do so.

Collaborative technologies are becoming more and more important. Companies that have outsourced much of their product manufacturing and logistics functions are now looking to collaboration and supply chain technologies in order to tie together disparate suppliers with their own R&D (Research and Design) teams. Future collaborative technologies must be systems that are flexible, in order to address the ways individuals work, and comprehensive, to address the ways that distributed connected companies are doing business (Zipperer, 2002:54).

2.4.1 Collaborative Commerce

Chediak (2001:87) defines collaborative commerce (c-commerce) as follows:

Evolving out of many established lines of enterprise software, c-commerce is a new class of web-based software that helps different companies work together, enabling manufacturers, suppliers and distributors to predict supply and demand as a group.

Collaborative commerce aims to extend capabilities such as Enterprise Resource Planning (ERP) and Advanced Planning and Scheduling (APS) solutions beyond the

walls of the enterprise, and in doing so, to allow companies to share planning responsibilities and transaction processing with trading partners (Borck, 2001).

Vendors are rolling out enhanced supply chain planning and forecasting tools, as well as Supplier Relationship Management (SRM) technologies that provide real-time access to the demand, inventory, price and sourcing and production data while optimising collaboration and sharing of data between supply chain members (Harreld & Jones, 2001).

Borck (2001) shows that c-commerce helps to breed stronger integration and also creates a unified, virtual enterprise with mutual sales and operational and business goals by providing real-time access to information relating to production schedules and inventory.

Hyperpartnering also known as “any-to-any” c-commerce, which is a form of supply chain collaboration, is designed to help companies jump at B2B market opportunities as they appear. For example, if there is a sudden surge in demand for a particular product, a manufacturer could almost simultaneously forge the supply chain partnerships needed to double the supply of raw materials needed to produce that product. This avoids costly hardware and software deployments, while making supply chain collaboration possible (Harreld, 2001).

2.4.2 Web Services

Chediak (2001:87) defines web services as follows:

An emerging class of software, web services provide disparate applications with a standard way of exchanging data over the Internet and allow businesses to mix and match components without developing a lot of new software code.

Web services, as applied to collaboration, act as a workflow bridge between internal systems and systems outside a company’s firewall which, under normal circumstances, cannot “talk” with one another. For large enterprises with massive

development staffs, web services are proving vital for tying together disparate component architectures (Karpinski, 2001).

General Motors (GM) faces one of the largest systems-integration challenges on the planet (Knorr, 2003). It has more than 80 factories around the world, each with its own mix of enterprise applications. Web services are used to collaborate between and integrate all these factories with their disparate applications, without having to upgrade every factory to one common ERP system.

2.4.3 Enterprise Resource Planning Systems

Many of the ERP vendors, such as SAP, Oracle and PeopleSoft Inc., have added planning, scheduling and collaborative optimisation capabilities to their products. APS vendors, on the other hand, are adding expanded functionality onto their product lines as they encroach on ERP territory. This is going to result in a wave of mergers and acquisitions as vendors try to sustain market share and round out their products to deliver more encompassing functionality (Sheridan, 1998).

Traditionally, ERP systems have lacked the external web based collaboration needed within a supply chain. This has forced many members to write their own interfaces in order to collaborate with fellow members. Gartner Inc. coined the term ERP II, which expands contemporary ERP systems to create true on-line collaboration and responsive supply chain processes between various members (Chen, 2001). Table 2 below shows the difference in characteristics between ERP and ERP II, also called New-world ERP.

Table 2
A Comparison of ERP and New-world ERP

ERP Characteristics	ERP	ERP II
Role	Enterprise optimization	Value chain participation, optimization and e-commerce enablement
Domain	Manufacturing and distribution	All sectors and segments of business
Function	Manufacturing, sales, distribution and finance processes	Cross-industry, industry sector and specific industry processes
Process type	Internal, hidden	Externally connected
Architecture	Web-aware, closed, monolithic	Web-based, open, componentised
Data	Internally generated and consumed	Internally and externally published and subscribed

Source: (Chen, 2001:59)

Most of the major ERP vendors have started rolling out Internet-enabled modules and versions to support and optimise supply chain collaboration. This type of technology now allows customers, suppliers and other channel partners real-time on-line access to ERP information (Chen, 2001). The ultimate idea is to give all channel partners direct on-line links to back-end systems and processes, such as order and inventory management, as well as customer relationship management.

ERP systems are often industry or sector specific. Different members in the supply chain could belong to different industry sectors. Many organisations go for a best-in-breed solution whereby different software packages are selected for different functional components within the company. Dell, for instance, started out by using SAP across the whole organisation. After realising that SAP did not fulfill all their requirements, the company chose i2 Technologies to manage raw materials, Oracle for order management and Glovia for manufacturing (Austin, Cotteleur & Escalle, 1999).

It is becoming increasingly more difficult to distinguish between ERP, SCM and APS systems. As explained above, vendors are encroaching on each other's territory by providing products and/ or modules that include added functionality. While products such as Manugistic's supply chain planning software are targeting increased collaboration and supply chain visibility, SAP is in the process of releasing a product called NetWeaver, which contains real time visibility capabilities that allow disparate technology integration (Songini, 2003).

Boyson & Corsi (2002) have charted out the evolution of SCM software in different phases from the year 1995 through to 2010. Each of the phases is broken down into SCM software models as well as their characteristics (Refer to Appendix D for a complete view of this evolution).

2.4.4 The Internet

Until recently, there have been few alternatives to EDI that offered speed, standardisation and acceptance in the global business community (Witte *et al*, 2003).

Internet-based electronic data interchange systems offer the potential to trim the costs and complexity of traditional EDI (Corbin, 1998). These systems are so flexible that companies can send EDI, e-mail, audio and visual effects (Corbin, 1999).

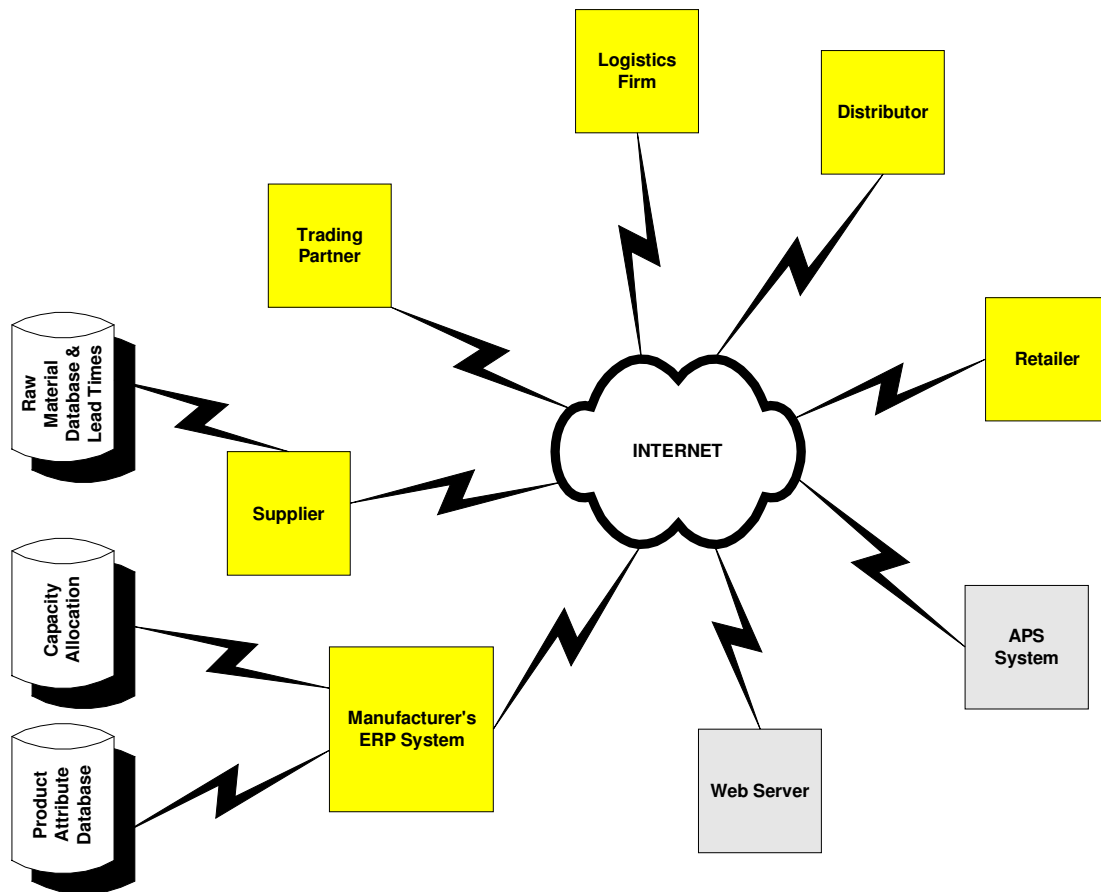
At the one end of the spectrum, the Internet has revolutionised the supply chain by providing a pipeline for transmitting data. At the other end, companies are buying or developing client applications that can be projected via the web to remote locations (Witte *et al*, 2003).

The ability to track and trace inventory and merchandise across the entire supply chain has evolved through new technologies supported by the Internet. The following are some of the developments (Siegel, 2003):

- **Radio Frequency Identification (RFID)**
Smart chips embedded in individual products, packaging and displays enable supply chain members to follow items from the warehouse to the store shelf. Companies such as Procter & Gamble and Tesco have already tested variations of this technology, which provides vital information relating to inventory levels.
- **Software add-ons**
These work on top of existing Warehouse Management Systems (WMS) and accomplish two things: they make tracking easier to set up, and reduce the strain on the WMS. Data are collected from the WMS and anomalies in the supply chain are highlighted. An example would be that a batch of inferior product could be easily recalled as manufacturers would know exactly where the product was situated within the supply chain.
- **Internet-based applications**
These overcome the costly and proprietary issues of EDI systems. These systems also make it possible for third parties to input data directly into a company's SCM system without the expense of actually installing the software.

The Internet has allowed for better applications integration, thus permitting better co-ordination and collaboration between supply chain partners. This has led to enterprisewide benefits for members operating within the supply chain (Borck, 2001).

Figure 7
Optimised Collaboration via the Internet

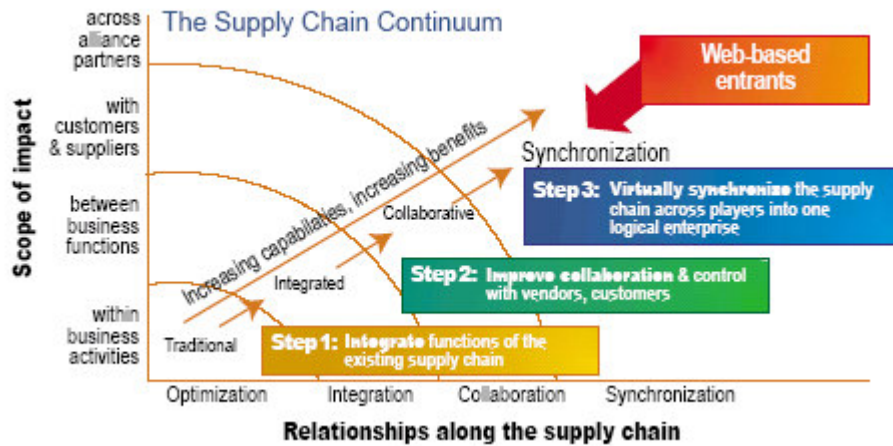


Source: (adapted from Chapman, Lathon & Petersen, 2000:12-13)

Chapman *et al* (2000) show that collaboration data can be managed in a domain shared by the trading partners, or that it may exist within one of the partner's domains, giving access to the other supply chain trading partners via the Internet (Figure 7).

Anderson & Lee (2000) state that shorter time-to-market, enabled by collaborative design, is of immense value to most companies. This is because of the fact that in the initial stages of the product life cycle, profit margins are greatest and the potential sales gains from being the first to reach the market are even greater. Internet-enabled technology provides real-time linkages between the relevant supply chain partners. The ability to conduct collaborative design means that companies can iterate many more design alternatives with suppliers.

Figure 8
Collaboration and Synchronisation via the Internet



Source: (Anderson & Lee, 2000:2)

Figure 8 shows how the Internet has allowed the supply chain to move from the traditional optimisation model to an integrated model and then to a collaborative one that leads to a fully synchronised supply chain. This has evolved the channel members into a single virtual enterprise making collaboration and communication super efficient (Anderson & Lee, 2000).

2.4.5 Private Trading Exchanges

A Private Trading Exchange (PTX) is a way of doing business over the Internet that prevents companies from having to manage thousands of individual web sites. It brings together many collections of internal systems and makes it possible for supply chain members to extract relevant information and to collaborate with one another (Bermudez, 2002).

A number of ERP vendors have already released software that allows for the deployment of PTXs that can be integrated with an enterprise's existing ERP system. The likes of SAP, Oracle and J.D. Edwards & Co. all have their own versions of PTXs already (Chen, 2001).

PTXs allow for the streamlining of product development, purchasing, inventory management, logistics and customer services by combining the power of multiple corporations across and within industries (Sengupta, 2001). The collaborative processes are considerably improved as seamless integration takes place between the disparate systems of all these companies.

According to Bermudez (2002), many companies have realized that their ERP and SCM systems are never going to stretch across the entire organisation, especially when the organisation is the size of GM, IBM or GE. Bermudez (2002) claims that PTXs and the Internet allow these companies to connect all their internal systems to a PTX and, in doing so, have one point of entry for all other upstream and downstream members of the supply chain.

Public or e-Market exchanges also continue to serve a vital, limited role in fostering collaboration among multiple trading partners. An example of an e-Market exchange would be Covisint, which includes DaimlerChrysler, Ford Motor Co., GM, Renault, Nissan, Peugeot and Citroen together with IT partners Commerce One and Oracle. This is an exchange where automotive production parts are purchased and sold by the various supply chain partners (Bowman, 2003).

2.4.6 Extensible Markup Language

Udell (2003) explains that Extensible Markup Language (XML) originated from a community that was inspired by a dream of universal access to information.

According to the World Wide Web Consortium (1999), XML is used for structuring data. Structured data include spreadsheets, address books, configuration parameters, financial transactions and technical drawings. The consortium claims that XML is not a programming language but instead that it can be defined as a set of rules (guidelines and questions) for designing text formats to structure data. These rules:

- Make it easy for computers to read and generate unambiguous structured data
- Avoid the common pitfalls found in language design

- Are extensible and platform-independent, while supporting internationalisation as well as localisation

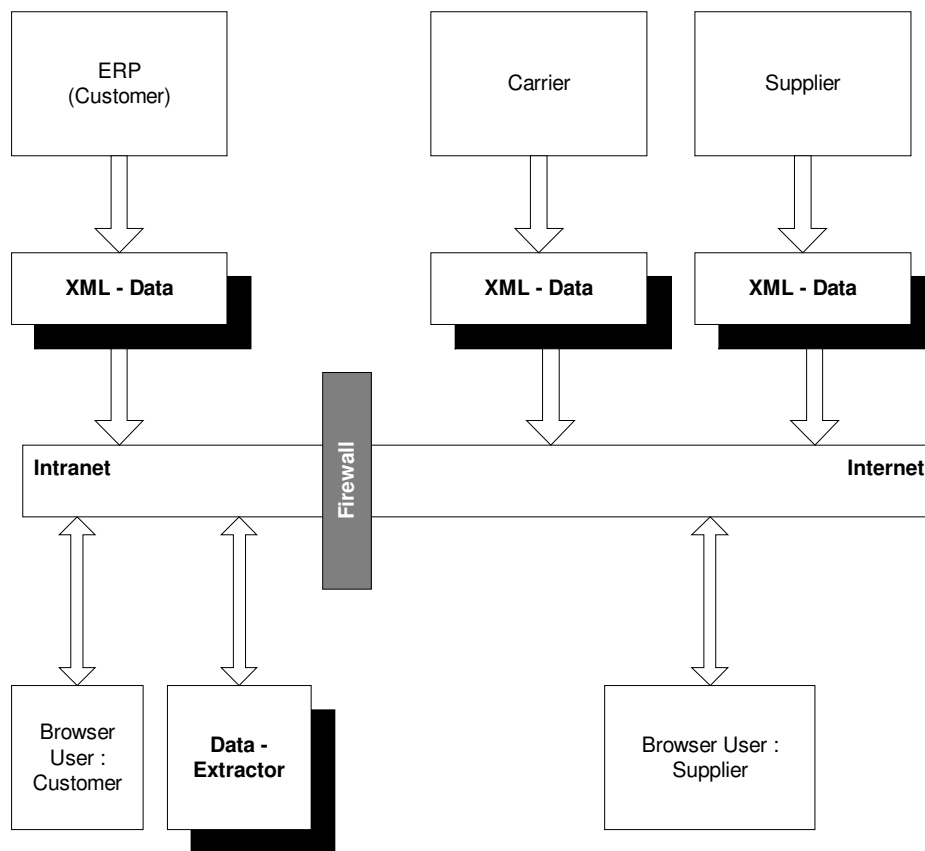
According to (Witte *et al*, 2003), XML acts as a starting point for the integration of the current patchwork of information systems in the supply chain. XML integrates this patchwork into a seamless consistent and uniform system while contributing to improved supply chain collaboration.

Witte *et al* (2003) explains that this improved collaboration is achieved by making it easier to agree on a standard message format taking into account the different requirements of supply chain participants. Its flexibility also allows for the application of message formats between supply chain partners, thus further developing the supply chain step by step.

Apart from transaction data, other information such as electronic catalogues and design specifications can also be exchanged between channel members. In addition to this, XML can handle language translations so that non-English-based companies can trade and exchange documentation with other members within the supply chain, using their own languages (Witte *et al*, 2003).

Figure 9 depicts the XML architecture based on Internet technology. Because the internal systems of suppliers and carriers within the supply chain are not equal, it is necessary to extract relevant data, which is usable to all members. The Data-Extractor converts disparate information, and it is responsible for the transmission of this information between the different systems. This makes collaboration possible. The firewall is necessary to guarantee a high secure-level of sensible industrial data between the Intranet and the Internet (Furst & Schmidt, 2001).

Figure 9
XML System Architecture



Source: (Furst & Schmidt, 2001:530)

2.5 Critical Success Factors

Supply chain collaboration and its success is heavily dependent on the supply chain itself. There is no general consensus regarding critical success factors for collaboration or SCM. The following CSFs have been taken from the literature:

- Information technology must support multiple levels of decision making across the supply chain. In addition to this, IT systems should express a clear view of the flow of products, services, and information (Quinn, 1999).
- Information integration, co-ordination of resource sharing and organisational relationships are critical to SCM (Lee, 2000).

- Collaboration and process integration between trading partners eliminate costs and decrease response time to consumer demand (Chapman *et al*, 2000).
- Collaborative supply chains are not successfully implemented overnight. Changes in business practices and small-scale proof of concept pilots are required before they can be implemented successfully in a large-scale manner (Chapman *et al*, 2000).

Deloitte Consulting (1999) conducted a survey amongst more than 200 companies that represented a cross section of industries in the United States and Canada. The survey revealed the following obstacles to achieving breakthrough supply chain performances:

- Few companies have established a management environment or adequate information systems to support the integration required for effective SCM. They remain functionality oriented, with a lack of trust and credibility among the supply chain members.
- Very few organisations take a value-based management perspective of supply chain performance that assesses the impact of initiatives on revenues, costs, investments and cost flows to ultimately drive shareholder value.
- There is a need for a better way to measure supply chain performance. Performance metrics are not aligned with corporate objectives. Furthermore, companies are not using the most dynamic tools available for planning and controlling activities along the supply chain.

In a 1992 article, Lee & Billington describe the pitfalls of supply chain inventory management together with corresponding opportunities, drawing upon knowledge and experience of SCM at electronics, computer and automobile companies (Appendix B). The following CSFs have been drawn from the above-mentioned article:

- Supply chain objectives and install and monitor performance measures.
- Delivery performance in terms of completed orders rather than product lines (measure the total response time and average lateness).

- Accurate data and information which should be visible to all the relevant supply chain participants.
- Efficient and effective information systems and architecture to support all the collaborative processes needed.
- Dynamic inventory policies to reduce stock outs and backlogs of orders.
- Create service measure for all internal customers.
- Co-ordination between supplying divisions to complete an order.
- Consideration of manufacturing and distribution in product-process design.
- Understand the operational environment and the needs of immediate and ultimate customers.

Relationships within any supply chain are crucial to the success of the supply chain and to the supply chain members in general. Partnerships between two or more members or partnerships across the supply chain become a vital issue that must be considered by organisations participating in the supply chain.

Table 3 below provides an overview of aspects that are relevant in determining if a partnership is appropriate. The duration, breadth, strength and closeness of the partnership will vary from time to time and from case to case (Van Der Vorst, 2000).

Table 3
Critical Success Factors for Partnerships

Drivers for partnerships	Main partnership facilitators	Successful partnership characteristics
Asset-cost efficiencies (cost reduction)	Strategic complementarity	Joint planning
Customer service (e.g. shorter cycle times)	Corporate compatibility (culture and business goals)	All encompassing supply chain controls
Marketing advantage (e.g. entrance into new markets)	Compatibility of managerial philosophy and techniques	Systematic operational information exchange (rapid and accurate transfer)
Profit stability / growth	Mutuality (joint objectives, share sensitive information)	Sharing of benefits and burdens
	Symmetry in power	Trust and commitment
		Extendedness (the relationship will continue into the future)
		Corporate culture bridge building

Source: (Van Der Vorst, 2000:39).

2.6 Successful Supply Chains

2.6.1 Federal Express

Federal Express (FedEx) is a leading model of simultaneous processing across an extended supply chain. The company employs real-time data transmission to assist in routing and tracking packages (Boyson & Corsi, 2002).

Simultaneous processing occurs in the context of a single event triggering multiple real-time actions throughout the supply chain.

Information that is recorded by handheld bar-code scanners is transmitted to a central database. The information is then made available to all employees and customers. The FedEx corporate communications network is one of the world's most sophisticated

and most reliable, processing nearly 400,000 customer-service calls and tracking the location, pickup time, and delivery time of 2.5 million packages every day (Boyson & Corsi, 2002).

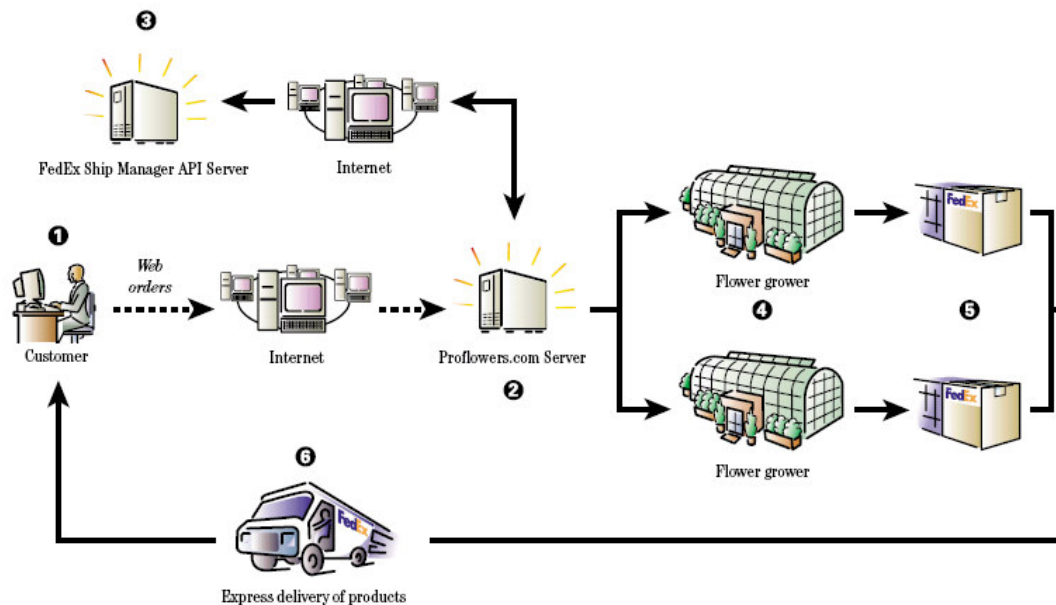
According to Boyson & Corsi (2002), FedEx is as much an information firm as a transportation company and the company's business model is now dedicated to:

- Increasing transaction speed (single transaction triggers multiple enterprise actions)
- Connecting systems and customers, globally
- Shrinking costs (shifting processing load onto the customers)
- Improving information control (available to employees, customers, and between customers)
- Providing solutions beyond the immediate business case (through re-engineering the supply chain, and through alliance strategies)

An example of how FedEx improves collaboration within the supply chain would be its alliance with Proflowers.com, an Internet company that runs a portal for ordering fresh flowers. Once Proflowers receives an order over the web, the company's web server simultaneously records the transaction and sends a message to FedEx. Based on this message, FedEx generates both a shipping label (that is returned to the Proflowers web server and downloaded to the grower) and a request to its fleet to pick up the order at the grower's site.

When the pickup occurs, the FedEx shipping label with all the required customer information is already on the carton of flowers to be shipped. The complete process is graphically shown in Figure 10. With this, all the relevant information is immediately available to all relevant members of the supply chain (Boyson & Corsi, 2002).

Figure 10
Collaboration between FedEx and Proflowers.com



1. Proflowers.com customer places an order via the Internet at www.proflowers.com.
2. Proflowers.com systematically selects the appropriate grower for the order, on the basis of the flower arrangement and distance from the customer. Proflowers.com then sends the appropriate delivery information to FedEx via the Internet to process the shipment.
3. FedEx Ship Manager API server conorganisations service availability, processes the transaction and returns a laser-printable shipping air waybill to Proflowers.com via the Internet.
4. Proflowers.com sends a computer-generated fax directly to the grower's fax machines. The fax contains both the purchase order and the shipping air waybill.
5. The grower prepares the arrangement, packs the order and places the shipping air waybill on the package.
6. FedEx picks up the order and delivers it within 24 hours.

Source: (www.fedex.com/us/ebusiness/ecommerce/proflowers.pdf?link=4)

2.6.2 Cisco Systems

Cisco has employed the Internet to reengineer processes across its whole span of operations and has become a global networked organisation. Every step of the company's supply chain, from customer order self-service/product configuration to supplier management employs Internet-based processes (Boyson & Corsi, 2002).

This has worked so well that Cisco's per employee revenue is almost three times that of competitors such as Lucent. The company has reaped massive benefits from successfully and seamlessly integrating the fundamental technologies and components of the Internet on an enterprise-wide basis (Boyson & Corsi, 2002).

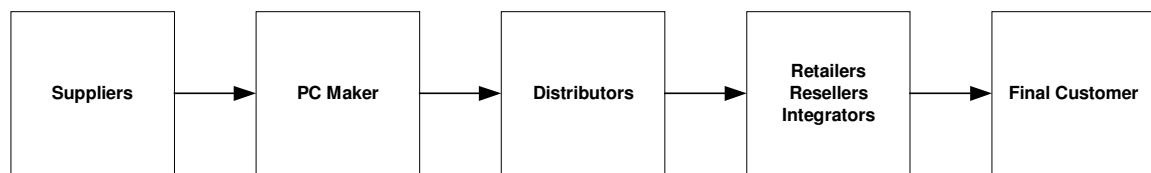
Cisco is an example of a successful company in terms of supply chain integration. It has used the Internet to lower its cost of doing business by more than \$560 million per year. It now receives more than fifty percent of its product orders via the Internet. Its customers use 24-hour web based applications to price, configure, validate, and order products. By automatically trapping errors at the configuration stage, Cisco has reduced orders that require reworking from fifteen percent to two percent. On the supply side, Cisco's e-commerce applications automatically notify a group of suppliers when incoming orders deviate from forecasts (Boyson & Corsi, 2002).

Boyson & Corsi (2002) state that by increasing responsiveness to customers, Cisco has been able to improve revenue capture by \$100 million annually. By integrating suppliers earlier in the ordering process, the company has reduced lead times from an average of 40 days to between 7 and 21 days.

2.6.3 Dell Computer Corporation

Figure 11 shows the traditional distribution system of the Personal Computer (PC) industry. It is an indirect model, which is often referred to as “the channel” (Kraemer, Dedrick & Yamashiro, 1999).

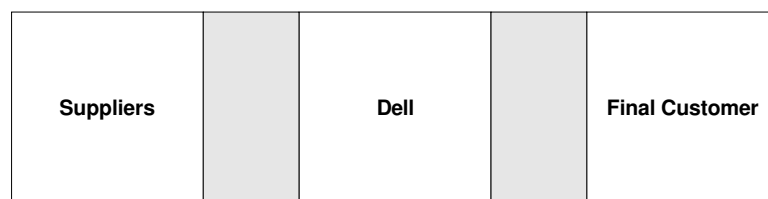
Figure 11
Indirect Distribution Channel of the PC Industry



Dell's Direct Distribution Channel



Dell's Virtual Integration blurs Traditional Boundaries and Roles in the Value Chain



Source: (Kraemer *et al*, 1999:9, Magretta,1998)

The indirect model has inherent weaknesses that left it vulnerable in a time-based competitive environment. Issues such as reliance on market forecasting to drive production and excess inventories that clogged the distribution channels were causing

havoc within the supply chain. Collaboration was made difficult by the lack of collaborative technologies spanning the supply chain and including the final customer.

Dell adapted this business model by selling directly to the final customer (Figure 11), and in doing so, removed two links from the supply chain. Orders are placed and produced once payment has been received from the final customer (Kraemer *et al*, 1999).

Dell's process of accepting and processing an order is explained in detail in Appendix E.

The company uses its collaborative infrastructure to drive information up and down the supply chain. Table 4 shows how Dell optimises collaboration by making use of technology to communicate effectively with customers and suppliers (Kraemer *et al*, 1999).

Table 4
Optimising Collaboration within Dell's Supply Chain

Strategy	Information Links	Applications	Effects
Direct Sales	• Customer orders transmitted to Dell • Program performs a second check for technical and financial feasibility	• Call center automation • Premier Pages • Dell On-Line • Dell Product Services (DPS)	• Accurate demand forecasting • Segmentation of demand • Early indication of demand shifts
Build to order	• Order information travels with product through the whole process enabling inventory control, special customer requirements, custom software installation etc.	• Dell Order Management System (DOMS) • Email • Lotus Notes	• Better control of operations • Reduced inventory and transit points • Better communication during build process • Improved monitoring and evaluation of production and supplier quality
Direct distribution	• Information sharing notifies suppliers to ship monitors to arrive with PC • Aggregation of information regarding orders, inventory, turnover, production, throughput, supplier quality, on-time distribution	• Dell Logistics System • Lotus Notes • Email • Information to Run the Business (IRB)	• Accelerated outbound logistics • No inventory • Optimise production, quality & distribution globally and locally

Source: (adapted from Kraemer *et al*, 1999:20)

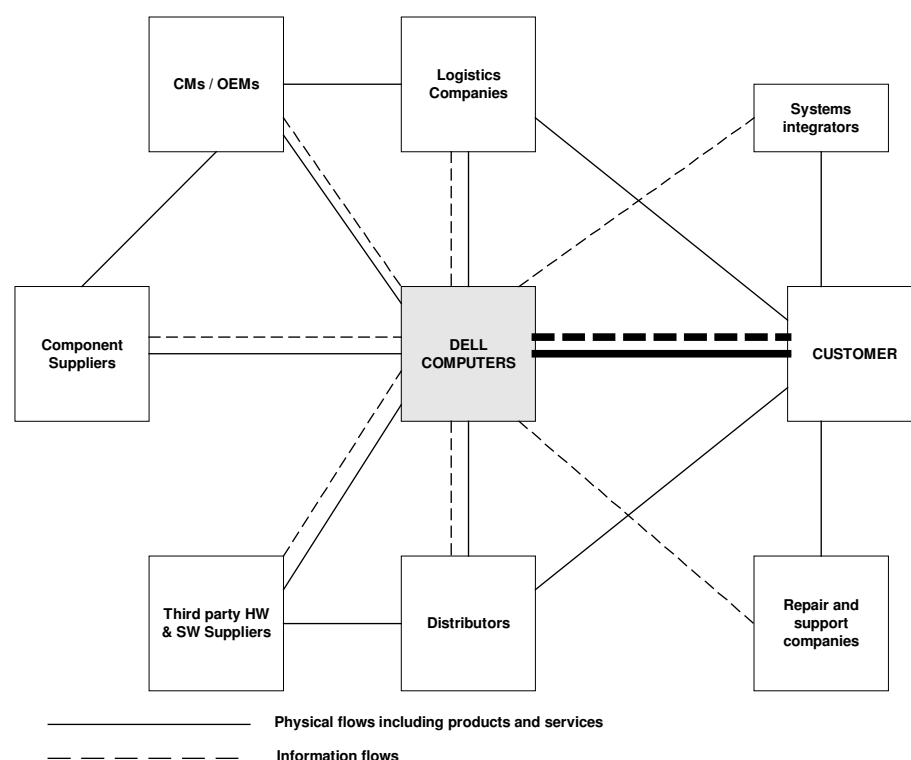
Kraemer *et al* (1999) state that Dell also uses information to manage relationships with customers. The company outsources customer service but operates as a broker between the customer and third party maintainers (TPMs). Typically, a customer's problem taken by the call centre will trigger one electronic message to the supplier to

ship the parts needed and another to despatch a TPM to the customer. This allows Dell and other chain members to have real-time visibility into the supply chain and to be proactive by spotting problems of any kind early on in the process.

As Dell started making use of more and more subcontractors, the company expanded its boundaries beyond that of being a mere PC reseller. The simple value chain has been replaced with a new model known as the value web or the virtual corporation (Magretta, 1998).

In an interview with Magretta (1998), Michael Dell defines virtual integration as “stitching together a business with partners that are treated as if they’re inside the company, sharing information in real-time fashion” (Magretta, 1998:75). This concept is illustrated in Figure 12.

Figure 12
Value Web: Dell’s Virtual Company



Source: (Kraemer *et al*, 1999:10)

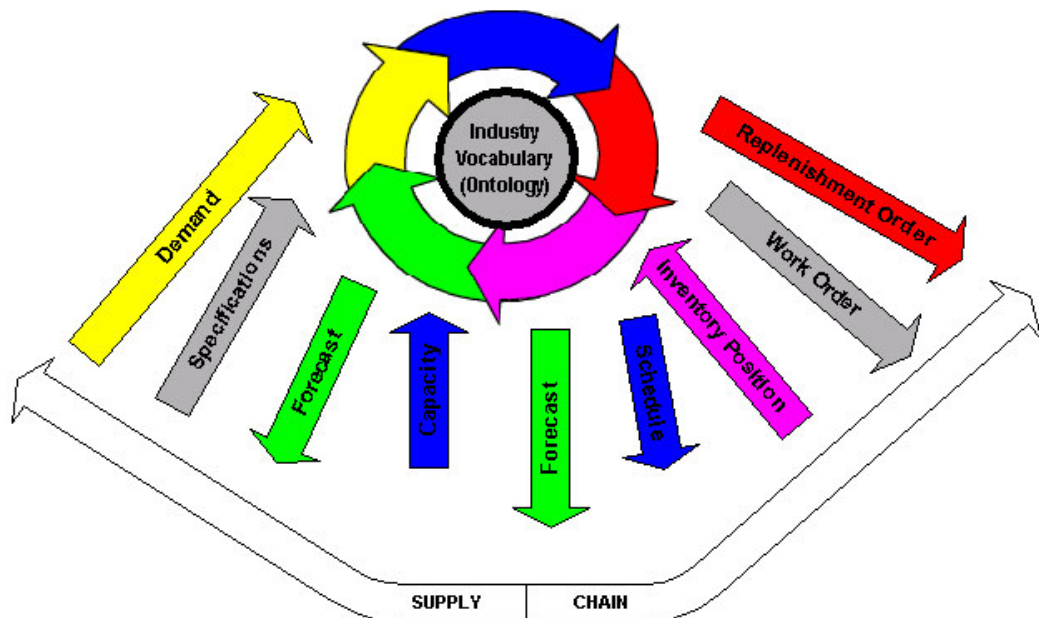
Figure 12 shows that Dell's supply chain has evolved from the direct model into a hub-and-spoke model. The company can provide whatever the customer wants or needs through efficient collaboration with all the relevant members of its supply chain. Dell's powerful co-ordination, communication, and information flows within the supply chain make this possible (Kraemer *et al*, 1999)

3. A COLLABORATIVE SUPPLY CHAIN MODEL

From the literature reviewed in the previous chapters, it is apparent that a model needs to be developed that can guide companies to improved collaborative business across the supply chain. This is the objective of this chapter. The model can be viewed in two parts, firstly the supply chain utility and secondly, the execution of supply chain collaboration. The model is referred to as the Collaborative Supply Chain Model.

The researcher has decided to draw up a collaborative model based on the Demand Aided Manufacturing Architecture (DAMA) model for collaboration (Chapman, Lathon & Petersen, 2000). This model has been found to encapsulate most of the characteristics of supply chain collaboration presented in the literature discussed so far, in a concise model that can be adapted for the Web Printing industry.

Figure 13
Supply Chain Utility



Source: (adapted from Chapman, Lathon & Petersen, 2000:14)

Supply chain collaboration should include a course of action where by the trading partners initialise a supply chain utility. The technical infrastructure plays a massive role in the way in which the utility is implemented. The main purpose of the utility is to support secure data sharing of product definitions, supply chain planning, and supply chain visibility.

The supply chain utility (see Figure 13) must provide an integration framework to allow a set of generic, open standards-based technology applications to interoperate and to provide a collaborative product definition, forecast visibility, planning, scheduling, and execution of orders (Chapman, Lathon & Petersen, 2000:14).

Each member has to provide the supply chain with relevant information, which will be made available to the appropriate players within the supply chain.

The ontology or common industry standards referred to in Figure 13 constitute a set of formal definitions of information being shared. Each industry has its own set of ontology information.

The information made available through the supply chain utility requires each trading partner to provide or make available initial information in the following areas (Chapman, Lathon & Petersen, 2000:15):

- Manufacturing (lead times, process times, and transport times);
- Capacity allocation to the partnership;
- Manufacturing capability (product lines, bill of material for products, product specifications, attributes and boundary constraints) and
- Exception criteria.

The information provided to the supply chain utility must be protected in a select and secure manner by making use of technologies such as XML for data transfers.

As not all partners would need to have access to all of the information in a supply chain, the initial business planning agreements must define who has access to what

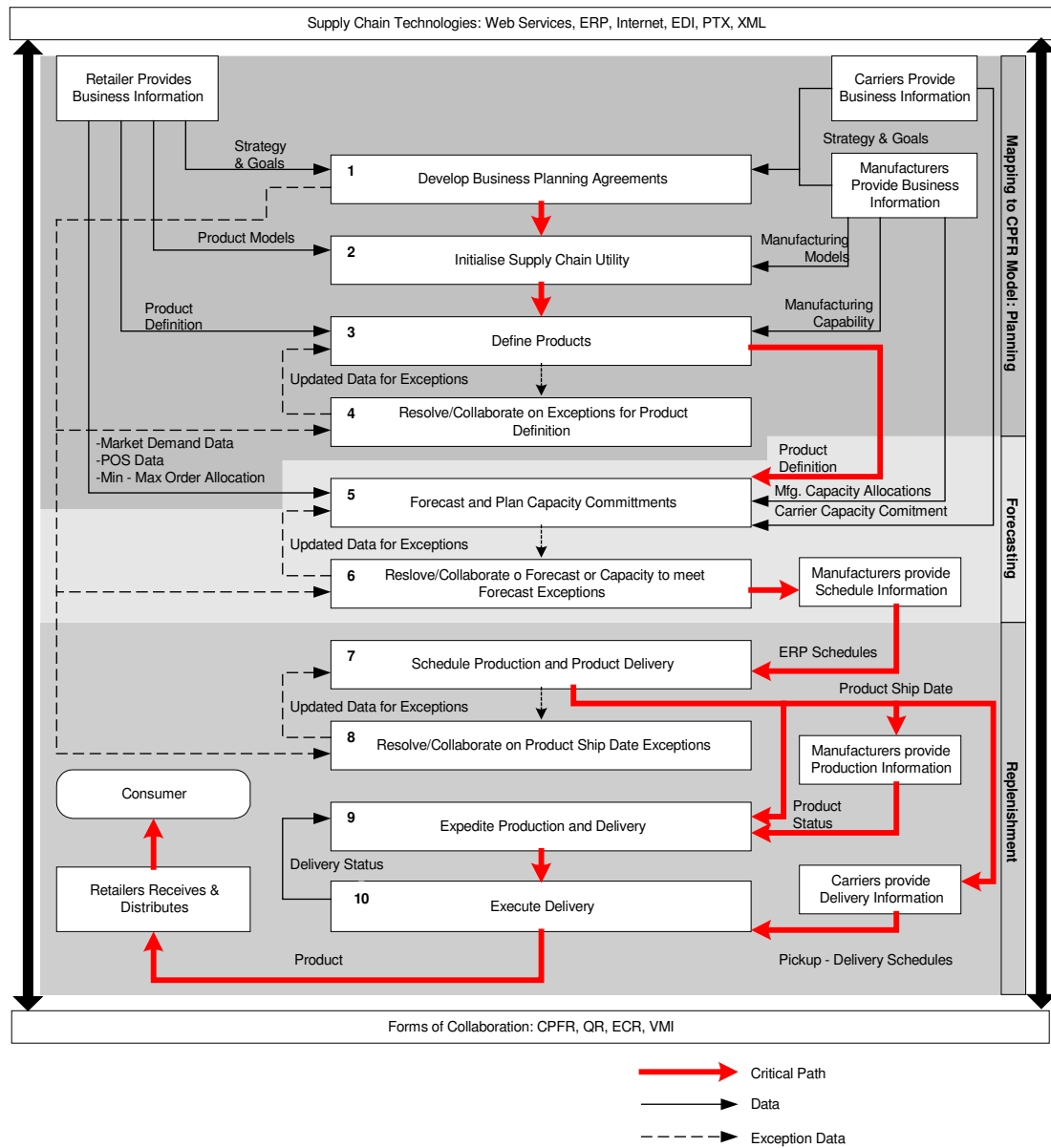
information. Supply chain members also need to agree on the frequency and type of updates required to support the collaborative relationship.

This information would include the following (Chapman, Lathon & Petersen, 2000:15):

- Inventory levels available to promise for the partnership
- Production status
- Ship status
- Changes to the initial data (e.g. a new product line is added, or process times are increased or reduced)

Chapman, Lathon & Petersen (2000) state that the understanding of exception criteria and metrics to measure the success of the collaborative relationship is highly dependent on the maturity of the ontology. For example, is “one day late” defined as 8 hours, or 24 hours? Is a day considered a working day? The purpose of the supply chain utility is to provide supply chain visibility for all members while making available the necessary information they need to meet the goals of the collaborative effort.

Figure 14
Executing Supply Chain Collaboration



Source: (adapted from Chapman, Lathon & Petersen, 2000:16)

The process for executing the Collaborative Supply Chain model incorporates all members of the supply chain, and the different steps or processes within the model are summarised in Table 5.

Table 5
Executing the Steps in Supply Chain Collaboration

<u>Step</u>	<u>Process Name</u>	<u>Description</u>
1.	Develop Business Planning Agreements	Information that is required to execute this step is obtainable from and thoroughly documented in the CPFR Guidelines. Each company accesses its own strategy and goals in order to make sure that these are incorporated in the partnership agreements. A win-win situation for all players is the goal of this step. This requires sharing of some risk and rewards, in addition to sharing common goals.
2.	Initialise Supply Chain Utility	Each supply chain member participating in the collaborative relationship provides data to support the area of collaboration defined in the business planning agreements such as product definitions, manufacturing capability and capacity allocations to the partnership. The supply of this information to the supply chain is an ongoing process. As agreed upon by members, this information can be updated on a daily or weekly basis depending on agreements as well as the needs of the supply chain. The technical infrastructure will determine how this information is made available. It could be via objects loaded onto a central server or through an XML server and application.
3.	Define Products	Products for orders are defined using the data that is loaded in the supply chain utility. The utility can determine if the product is available; otherwise, the utility will determine the lead-time required to produce the product. From this information, the product definition order

		is generated.
4.	Resolve/Collaborate on Exceptions for Product Definition	An exception is generated when a specific product attribute is not available. Resolution and/or collaboration of the exception may be executed via phone, email, or on-line interaction. A company may decide to add a product or manufacturing capability by changing its product mix or outsourcing to a third party supplier who may or may not be a member of this collaborative partnership.
5.	Forecast and Plan Capacity Commitments	As consumer demand and forecasts are generated, all members of the supply chain have access to this information. Information about the allocation of a product (e.g. a partnership agreement guarantees fifty percent of a product line to a manufacturer, who in turn guarantees seventy five percent of that same line to one of its suppliers) has to be included in the supply chain utility. According to the estimated forecast, each supply chain member will commit a certain capacity allocation to the product line in this collaborative agreement.
6.	Resolve/Collaborate on Forecast or Capacity to Meet Forecast Exceptions	A forecast may exceed / fall short of original capacity commitments. When this exception occurs, partners must collaborate and either seek third party sources for an increase in demand or share associated risk with a reduction in forecasts. Agreements concerning the partnership should provide guidelines to handle these exceptions.
7.	Schedule Production and Product Delivery	The supply chain utility, containing information regarding base manufacturing capabilities and capacity allocation commitments as well as exception updates and firm orders, will generate work orders for each of the manufacturers while at the same time generating a shipment forecast for the carrier(s). Each company will then process the work order into its internal ERP or Operations system, generating a ship date for the

		product order. Ship dates that vary within a specified tolerance of the initial work orders and retail cancel date will generate exceptions.
8.	Resolve/Collaborate on Product Ship Date Exceptions	In the case of the Web Printing industry, a late ship date on a particular type of paper would impact all customers along the supply chain. However, one of the paper suppliers might have paper in stock that was not previously entered into the supply chain utility (it may have been reserved for a customer outside of this trading partner agreement). The supply chain utility processes the updated data for exceptions.
9.	Expedite Production and Delivery	Visibility of the supply chain product ship dates allows each member of the supply chain to expedite production and delivery as they relate to its position in the chain. Each member of the supply chain will be providing status updates for the delivery and production status of the product.
10.	Execute Delivery	The carrier, who provides delivery status information, handles the execution of delivery. To determine if target ship dates are being met, the supply chain utility uses these delivery status updates. All relevant members thus have visibility of this process as with all other processes.

Source: (adapted from Chapman, Lathon & Petersen, 2000:17-18)

The following is a summary of the major Critical Success Factors that have been drawn from the literature discussed in the previous chapters:

- An integrated management environment between supply chain members
- Integrated information systems internal to companies as well as between companies
- Accurate data and information that is visible to all the relevant supply chain participants

- Joint planning between supply chain participants
- Trust and commitment between supply chain members

4. RESEARCH METHODOLOGY

4.1 Method

The method of research that was used for this project report was of a qualitative exploratory nature. Various bodies of literature had been studied and analysed in order to identify and present a collaborative supply chain model.

The research focused on organisations that are known for their successful or efficient supply chains and/or SCM. Research was also carried out in order to identify and establish CSFs for a collaborative supply chain.

Saunders, Lewis & Thornhill (2000:2) state that people undertake research in order to find things out in a systematic way, thereby increasing their knowledge. The authors also describe exploratory research as studies used to establish what is occurring, seeking new insights and assessing new phenomena in a new light (Saunders *et al*, 2000:97). Literature reviews are a useful tool when conducting exploratory research. The focus is initially on the broader issues and gradually becomes consecutively narrower as the research continues.

In Chapter Two and Chapter Three, exploratory research was used in the form of literature review. This was achieved through the collection of secondary data from searches done in textbooks, publications, journals and the Internet.

Cooper & Emory (1995) show that questioning is an effective way in which to learn about opinions (qualitative) and attitudes. This was the reason that a questionnaire was chosen as the method for this study.

A questionnaire is an instrument for data collection that formally sets out the questions designed to extract the desired information. The questionnaire then follows the research process that starts with the identification of the problem where after it moves onto specifying the information needed to solve the problem. The process also

explains the selection of an appropriate method for collecting data and identifying the target population who can provide the information (Dillon, Madden & Firtle, 1987).

The questionnaire attempted to find out more about the current supply chain being investigated. This was to establish the state of SCM as it stands today within the Web Printing industry. Participants were also asked to rank critical success factors for effective SCM.

Two types of questions were used in the questionnaire, namely:

- Classification questions which are sociological-demographic variables that allow respondents' answers to be grouped
- Target questions which address the investigative questions of a specific study, these may include open-ended or closed questions (Cooper & Schindler, 1998).

4.2 Population and Sample

Samples are frequently studied in order to learn something of the characteristics of the larger groups (population) of which they are part. A sample is thus a sub-set of a larger grouping or population (Riley *et al*, 2000:75).

According to Riley *et al*, (2000:75), the sampling method and sample selection should explicitly reflect the objectives of the research project. The sample selection should be guided by the research objectives as well as the selected research instrument.

Convenience samples are non-probabilistic samples that can be selected to focus on particular issues. They are convenient specifically because they are, by definition, at the core of a study's concerns or because they meet the general parameter of a study's objectives (Riley *et al*, 2000:87).

Riley *et al*, (2000:87) defines convenience sampling as:

- A non-probability sample

- Not a sample at all in the sense that those selected are done so on the basis of some distribution of multiple characteristics, thus they share certain very clearly defined core characteristics
- Most often used where research objectives are inherently qualitative in nature and focus upon the elaboration of theoretical concepts and issues in micro-social contexts.

The major disadvantage of this type of sampling method is that it is unrepresentative in respect to the population from which it is drawn. This is likely to produce biased results because entire sections of the population are likely to have been omitted from the selection process (Wegner, 1999). This means that the possibility exists that the sample evidence could be misleading.

Non-probability samples are however useful in exploratory research in order to obtain initial impressions of the characteristics of a random variable under study (Wegner, 1999).

The Web Printing industry in South Africa is somewhat of an oligopoly. There are six players operating in this market and representatives from all six organisations were approached. This was, therefore, a convenience sample. The fact that most of the major players participated in the research findings, could be considered to represent the views of the Web Printing industry.

Respondents who participated in the research came from the following positions within their organisations:

Financial Director
 Production Director
 Logistics Director
 Logistics Manager
 Procurement Manager
 Despatch Manager
 Stores Manager

Sales Manager

Key Accounts Manager

IT Manager

Some of these job titles are indicative of the fact that some of the organisations do not have dedicated SCM departments or functions leading to SCM being bundled together with another department or function within the organisation.

The respondents came from the following organisations:

CTP Cape Town

CTP Johannesburg

Printability

Paarl Web Printers

Universal Web Printers

Kagiso BM Litho

4.3 Data Collection

A sample of twenty participants from the above mentioned companies were contacted, via telephone, to take part in this project. The questionnaires were either emailed or faxed to the participants. A total of twelve or sixty percent of participants responded to the questionnaire. The sample size as well as the responses are deemed reasonable because of the number of companies operating in the Web printing industry.

There are two types of questionnaires: self-administered and interviewer-administered. The faxed questionnaire as well as the emailed questionnaire was used in the case of this research. This method was chosen because it is the most reliable measuring instrument. Saunders *et al* (2000) confirm that a growing number of surveys, particularly in the area of market research, contact respondents and administer questionnaires in this way.

The questionnaire was considered to be valid externally and to include terminology that can be understood by respondents working in the fields of logistics and or SCM. The concepts applied in the questionnaire were portrayed as clearly and explicitly as possible in order to avoid misunderstanding and confusion that could lead to the unreliability of measurement. The questionnaire was considered reliable since it provided adequate coverage of the topic in question while the majority of the questions were drawn from the literature review.

Only respondents who were qualified to answer the questionnaire were selected. This meant that all respondents had to be involved in the supply chain processes of their companies and hold management or operational positions within their companies.

The purpose of the pilot test was to refine the questionnaire so that respondents would have no difficulties in answering the questions whilst eliminating any data-recording problems (Saunders *et al*, 2000). A pilot study was conducted with two participants to establish whether the questions were appropriate. Questions were adjusted for ease of interpretation and both the pilot study results were included in the analysis. (Refer to Appendix A for the questionnaire).

The objectives of the pilot study was to determine (Saunders *et al*, 2000):

- How long the questionnaire took to complete
- The clarity of the questions
- Which of the questions were unclear or ambiguous
- Which of the questions the respondents felt uneasy about answering
- Whether there were any significant topic omissions in the respondents' opinion
- Whether the layout was clear and attractive
- Any other comment

4.4 Data Analysis

In line with the research problem and sub-problems, the questionnaire sought to obtain data that would address these problems. Firstly, data from the questionnaire shows how respondents view their particular supply chains. This information has been consolidated to present an overview of the supply chain for the Web Printing industry.

Secondly, the questionnaire asks questions that relate to the collaborative supply chain model as discussed in Chapter Three.

Thirdly, a list of the most common CSFs was drawn from the literature and respondents were asked to rank these in order, from most important to least important.

Finally, open-ended questions were used to establish factors that impede a successful supply chain and those factors that impede successful communication within a supply chain.

Chapters Five and Six present the results of the study and evaluate the literature reviewed in Chapter Two against the data collected. The data are also used to evaluate the model presented in Chapter Three. The model attempts to show how collaboration and communication can be used to optimise the supply chain for the Web Printing industry.

5. PRESENTATION OF RESULTS

This chapter will give an explanation of each question that appeared in the questionnaire. It also describes the motivation behind each question. The results obtained from the respondents are presented mainly in the form of graphs and percentages.

5.1 Questions

Question 1

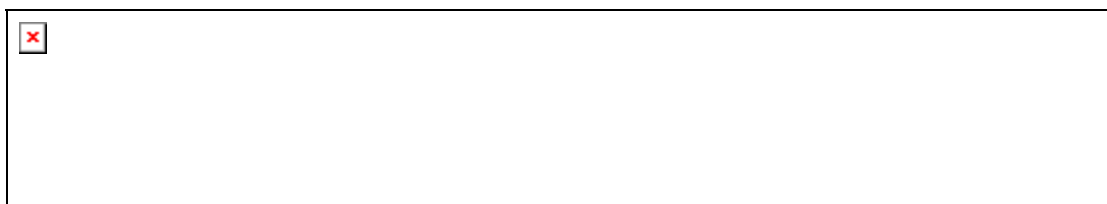
Identify the supply chain in which you operate. This would be from the raw material supplier to the customer. The supply chain members would be those whom you view as the most important to the success of the supply chain.

This question was designed to allow respondents to provide a holistic view of their perceptions of the supply chain in which their organisations operate.

Identifying the members along the supply chain was of particular importance to establish whom the respondents viewed as most important to the success of the supply chain.

After careful analysis of the different supply chains that were identified by the respondents, the following simplified supply chain represents the overall views and perceptions of the different respondents.

Figure 15
Supply Chain for the Printing Industry



Question 2

Are you considering introducing improved means of collaboration within your supply chain?

This question attempted to establish whether the companies were in the process of improving collaboration within their supply chains or were planning to introduce improved means of collaboration.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
6	2	4	12
50%	17%	33%	100%

The responses showed that the majority of respondents (fifty percent) were aware of the fact that their organisations were in the process of improving collaboration within their supply chains while thirty-three percent did not know whether any such plans existed.

Question 3

Does your organisation have a dedicated department in place that focuses on supply chain management?

The motivation behind this question was to determine whether a dedicated department existed for supply chain management. In many organisations, other functions of the business take charge of supply chain management.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
5	7	0	12
42%	58%	0%	100%

Forty-two percent of the respondents indicated that their organisations had a dedicated department in place for supply chain management, while fifty-eight percent showed that there was no such dedicated department in place.

Question 4a

Which of the following tools are utilised for collaboration and/or communication within your supply chain? Please rank these tools in order of importance, 1 being most important and 5 being least important.

Fax

Email

Internet

Intranet

Extranet

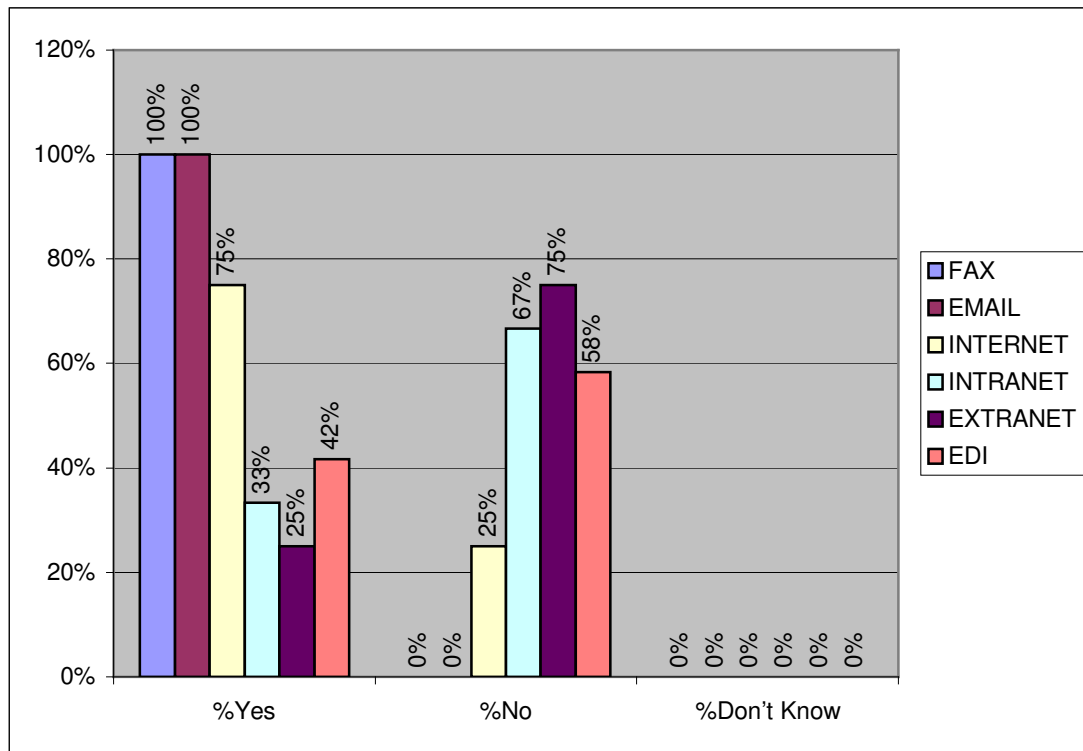
Electronic Data Interchange (EDI)

Other (Please specify)

This question was asked in order to determine the level of technology employed by the various organisations within their supply chains. It was of importance to establish to what extent the different technologies were utilised for discussions in the following chapter relating to the collaborative supply chain model presented in Chapter Three.

The frequency of responses was as follows:

Figure 16
Collaboration Tools



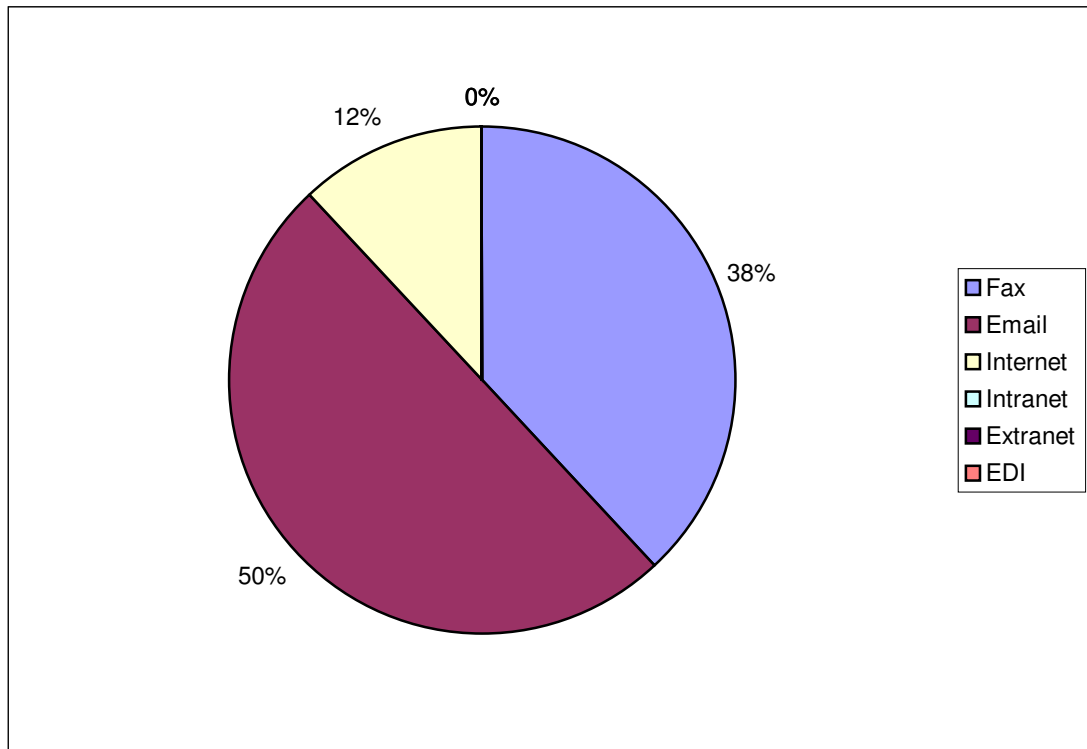
One hundred percent of respondents indicated that they made use of fax and e-mail facilities for collaboration within their supply chains.

Seventy-five percent versus twenty-five percent of respondents indicated that they made use of the Internet for supply chain collaboration.

The respondents showed that thirty-three percent as opposed to sixty-seven percent made use of an Intranet while twenty-five percent versus seventy-five percent used Extranets for supply chain collaboration.

Forty-two percent of respondents pointed out that they utilised EDI for supply chain collaboration while fifty-eight percent did not.

Figure 17
Ranking Collaboration Tools



Fifty percent of respondents ranked e-mail as the most important tool for supply chain collaboration. Thirty-eight percent ranked fax as the most important means for collaboration, while twelve percent wrote that the Internet was the most important collaboration tool.

None of the respondents ranked Intranet, Extranet or EDI as the most important tool for collaboration.

Question 4b

Which of the following forms of collaboration are utilised within your supply chain?

Quick Response (QR)

Efficient Consumer Response (ECR)

Vendor Managed Inventory (VMI)

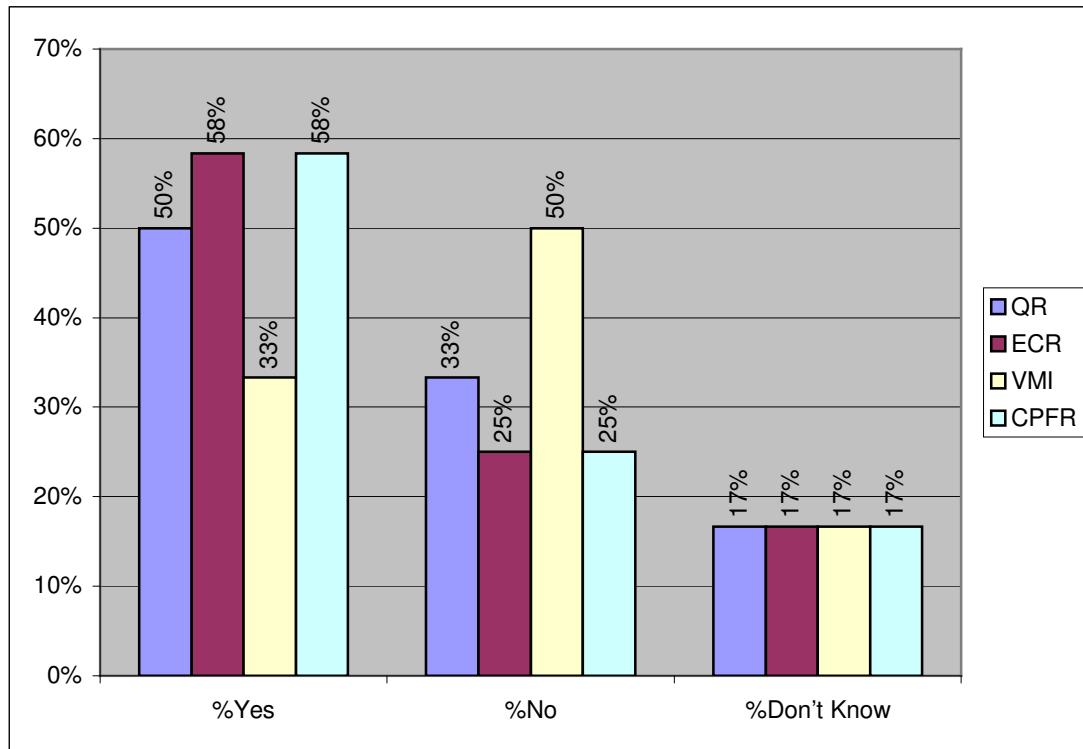
Collaborative Planning, Forecasting and Replenishment (CPFR)

This question determined what form or forms of collaboration were employed by organisations.

The types of collaborative forms or methods used by organisations generally determine areas of importance. For instance, if an organisation employs VMI as a form of collaboration, one could deduce that inventory or its control by upstream members of the supply chain is important to the organisation in question.

The frequency of responses was as follows:

Figure 18
Forms of Collaboration



Seventeen percent of respondents did not know whether a particular form of collaboration was used within the supply chain in which they operate.

Fifty percent of respondents stated that the QR method of collaboration was used within their supply chains while thirty-three percent did not list this method as a form of collaboration.

Fifty-eight percent versus twenty-five percent of respondents indicated that they made use of ECR within their supply chains.

As far as VMI and CPFR were concerned, thirty-three percent versus fifty percent of respondents indicated that they made use of VMI while fifty eight percent against twenty five percent employed CPFR as a method of collaboration.

Question 5

What are the major factors that would impede a successful supply chain?

Question 5 attempted to establish the general factors that could hinder a successful supply chain from operating successfully. The question was asked in such a way that respondents were not limited to specific areas of SCM, such as technology.

The following is a summary of major factors that would impede a successful supply chain as identified by respondents:

- Inadequate information systems (hardware as well as software) [4]
- Lack of planning of press room maintenance [4]
- Faulty communication internal to the organisation between people as well as across departments and communication within the supply chain [3]
- Unreliable and non-punctual distribution [3]
- Poorly trained staff as well as unskilled staff [2]
- Demotivated staff [1]
- Inaccurate information both within the organisations as well as within the supply chain [1]
- Incorrect forecasting of raw materials [1]
- Lack of trust between supply chain members [1]
- Political and economic instability in the Middle East [1]
- Port queues [1]
- Price fluctuation of paper [1]
- Rate of consumption of paper [1]

Question 6

What are the major factors that impede successful communication within your supply chain?

This question attempted to establish what factors would hinder a successful supply chain from operating successfully as far as communications is concerned. These factors could be based on communication in the verbal or in the technological sense.

The following is a summary of major factors that would impede successful communication within a supply chain as expressed by respondents:

- Unskilled and/or untrained personnel [4]
- Poor internal and external information systems as well as poor or non-existent networks between supply chain members [3]
- Delayed communications because of inadequate communications infrastructure [2]
- Last minute nature of the business [2]
- Unreliable email infrastructures [2]
- Duplication of information to different supply chain members [1]
- Insufficient integration between supply chain members affecting communication regarding production and delivery schedules [1]
- Lack of feedback from the supply chain [1]
- Lack of technology as an enabler for efficient communications [1]
- Not enough trust between supply chain members [1]

Question 7

Please rank the following critical success factors of a supply chain in order of importance, 1 being most important and 5 being least important.

- **Integrated Management Environment between supply chain members**
- **Integrated IT system between supply chain members**
- **Accurate data and information visible to all relevant supply chain members**
- **Trust and commitment between supply chain members**
- **Joint planning between supply chain members**
- **Other (please specify)**

CSFs were discussed at length in Chapter Two section 2.5. A list of CSFs was taken from the literature and this question asked respondents to rank these factors in order of importance.

The question then attempted to find out which CSFs had the biggest impact on an organisation's supply chain.

Respondents ranked CSFs as follows:

CSF	Ranking					
Integrated Management Environment between supply chain members	5	1	4	3	3	4
Integrated IT system between supply chain members	4	4	3	1	5	3
Accurate data and information visible to all relevant supply chain members	1	5	5	2	2	5
Trust and commitment between supply chain members	2	2	2	5	4	1
Joint planning between supply chain members	3	3	1	4	1	2

Twenty percent of respondents ranked an integrated management environment as the most important CSF. Another twenty percent ranked integrated IT systems as the most important CSF, while the same percentage of respondents ranked accurate data and information visible to all as the most important CSF. Forty percent of respondents ranked joint planning as the most important CSF, while none of the respondents ranked trust and commitment as the most important CSF.

It must be noted that out of a total of twelve responses, six of these contained rankings for CSFs while the rest did not participate in the question.

Questions 8a, 8b and 8c

These questions were asked in order to determine whether organisations had business planning agreements in place and whether key members of the supply chain understood each other's strategy and objectives.

The questions also attempted to establish whether strategies and objectives did exist for the overall supply chain.

a). Do you have business planning agreements in place with key members of your supply chain?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
6	3	3	12
50%	25%	25%	100%

Fifty percent of the respondents indicated that their organisations had business planning agreements in place while twenty-five percent wrote that no such agreements existed and a further twenty-five percent did not know about such agreements.

b). Do all the key members understand each other's strategy and objectives regarding the supply chain?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
7	3	2	12
58%	25%	17%	100%

Fifty-eight percent of the respondents indicated that key members had an understanding of one another's strategy and objectives. Twenty-five percent of respondent showed that they did not understand other members' strategy and objectives while seventeen percent were not sure about it.

c). Is there a strategy as well as objectives in place for the overall supply chain?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
10	1	1	12
83%	8%	8%	100%

An overwhelming eighty-three percent of the respondents answered that they are aware of the strategy and objectives for the overall supply chain, while eight percent of respondents said that no such strategy and objectives exist. A further eight percent indicated that they did not know about the existence of such a strategy and objectives.

Question 9

Do you have any agreements in place with other members of the supply chain such as planning-, supplier- and/or risk-sharing agreements?

Planning is a crucial part of a successful supply chain. Equally important, are the agreements that stipulate how this planning will be executed. Supplier and risk-sharing agreements are also essential to the success of a supply chain.

It is thus important for organisations to have such agreements in place and this question relates to these agreements.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
11	1	0	12
92%	8%	0%	100%

The majority (ninety-two percent) of respondents showed that they were aware of planning, supplier and/or risk-sharing agreements among members of the supply chain. Eight percent of respondents noted that no such agreements existed within the supply chain.

Question 10

Do you have information-sharing policies in place that describe what type of information needs to be shared between relevant members within the supply chain?

Information is a huge asset to any organisation. However, for a supply chain to run smoothly, certain information needs to be made available to upstream and downstream members of a supply chain.

Information sharing is key as far as collaboration is concerned. Policies that stipulate what type of information may be made available to other members of the supply chain need to be drawn up in order for organisations to be able to share such information.

This question asked respondents whether their organisations had such policies in place.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
6	4	2	12
50%	33%	17%	100%

Fifty percent of the respondents indicated that their organisations had information sharing policies in place while thirty-three percent did not and seventeen percent did not know whether such information sharing policies were in place.

Question 11

Do you feel that there is enough trust between the supply chain members to make relevant information available to each other?

The reason for this question was to find out whether organisations felt that there was enough trust between the supply chain members to make information available. Without trust, organisations will make as little information as possible available to each other.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
6	6	0	12
50%	50%	0%	100%

Half of the respondents felt that enough trust existed and the other half felt that there was not enough trust between members for these organisations to make information available to one another.

Questions 12a and 12b

Efficient collaboration contributes to a successful supply chain. Collaboration cannot take place without relevant information.

These questions attempted to find out whether organisations had access to information held by key members of the supply chain. The questions further explored whether this access was of an electronic nature. The reason behind the second half of the question was to establish the efficiency of this access to information.

a). Do you have access to information belonging to key members of the supply chain?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
6	6	0	12
50%	50%	0%	100%

Fifty percent of respondents answered that they had access to information belonging to key members of the supply chain, while the same number of respondents indicated that they did not have access to such information.

b). If your answer to question 12a is yes, do you have electronic access to this information?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
0	6	0	6
0%	100%	0%	100%

All respondents indicated that they did not have electronic access to information belonging to key members of the supply chain.

Question 13

Do you make use of a “common unique identifier” that spans the entire process from placing an order, to order fulfilment, across the entire supply chain (an example would be an order number on computer that is available right through the life cycle of an order to all members)?

Tracking and tracing of a product as it moves through the supply chain requires a unique identifier. This identifier, for instance an identification barcode number, has to be used throughout the supply chain by all members so that different organisations can collaborate by using the same global identification code and that any

misunderstanding regarding a particular product or batch within the supply chain is eliminated.

The question attempted to identify whether such a unique identifier, which is common to all supply chain members, existed.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
6	4	2	12
50%	33%	17%	100%

Fifty percent of respondents pointed out that their supply chains made use of common unique identifiers while thirty-three percent did not. A further seventeen percent of respondents did not know whether organisations within their supply chains made use of common unique identifiers.

Question 14

Do you have a set of standards that all members have to abide by for communication throughout the supply chain? An example would be a specific product code (ISO for example) that has one universal meaning to all members. This would then be updated on a regular basis as new products are developed and other products are discontinued.

This question required respondents to point out whether members within the supply chain worked according to specific standards set by some type of governing body for their particular industry.

This becomes important as there are products that get imported from foreign countries and because second and third tier members of the supply chain also have to start the collaboration process.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
9	2	1	12
75%	17%	8%	100%

Seventy-five percent of respondents indicated that their organisations abided by a certain set of standards for communication within the supply chain. Seventeen percent did not make use of such standards while eight percent did not know.

Questions 15a and 15b

Although it is possible that members have access (electronic or otherwise) to information, the integration of such an information platform is crucial to the collaboration process.

This allows for visibility deep into the supply chain, whether it is upstream or downstream. Full visibility means that all members participate on this platform so that no gaps exist in terms of the information needed.

a). Is there some infrastructure in place that provides for the integration of all members' information flow throughout the supply chain? This would typically be a system allowing for collaboration in terms of product definitions, forecast visibility, planning, scheduling and execution of orders?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
7	3	2	12
58%	25%	17%	100%

Fifty-eight percent of respondents answered that an integrated platform for information did exist within their supply chains while twenty-five percent felt that no such infrastructure existed and a further seventeen percent did not know whether such a platform existed within the supply chain.

b). If your answer to question 15a is yes, is this an IT system?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
6	1	0	7
86%	14%	0%	100%

Eighty-six percent wrote that the integrated information platform was an IT system, while fourteen percent indicated that it was not an IT system.

Questions 16a and 16b

The nature of the Web Printing industry is not immune to the daily difficulties faced by other industries. The bullwhip effect within the supply chain is worsened as upstream members run into problems.

A delayed production schedule originating from a raw material supplier will definitely affect the rest of the supply chain. Information relating to such issues must reach all members as soon as possible.

The process of distributing this information or informing members of the supply chain is crucial to the supply chain. The questions tried to establish whether such exception reporting systems did exist within the supply chain.

a). Is there some type of exception reporting in place to warn all relevant members of changes in products, capacity shortfalls, late deliveries and or other problems which might affect delivery performance?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
8	4	0	12
67%	33%	0%	100%

Sixty-seven percent of respondents showed that exception reporting did exist and another thirty-three percent indicated that no such exception reporting existed.

b). If your answer to question 16a is yes, is the reporting of an automated nature such as an automatic e-mail being sent to the relevant members?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
4	4	0	8
50%	50%	0%	100%

Fifty percent of respondents pointed out that the exception reporting process was of an automated nature and the other fifty percent showed that this was not the case.

Question 17

Do you collaborate with other members of the supply chain regarding forecasting, demand and capacity planning?

This question expected respondents to answer whether collaboration regarding forecasting, demand and capacity planning was exercised. Stock holding in this particular industry is a major factor.

Proper collaboration regarding forecasting, demand and capacity planning allows supply chain members insight into the supply chain and this can lead to improved capacity planning into the future.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
11	1	0	12
92%	8%	0%	100%

Ninety-two percent of respondents showed that their organisations did collaborate with other supply chain members regarding forecasting and demand and capacity planning. Eight percent of respondents indicated that their organisations did not.

Question 18

Are there any types of automated business processes relating to communication or collaboration within your supply chain? An example would be the automated response of a particular delivery of an important order once the delivery has been executed.

Depending on the horizontal length of the supply chain, there are many members that require access to information relating to delivery. Downstream members might require delivery information relating to an upstream member of the supply chain.

The question tried to ascertain whether such an automated process existed within the supply chain.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
7	5	0	12
58%	42%	0%	100%

Fifty-eight percent of respondents were aware of automated business processes relating to communication or collaboration within their supply chains while forty-two percent answered that no such processes existed within their supply chains.

Questions 19a and 19b

Production schedules are planned weeks and months in advance. Access to this type of information allows members to optimise their own individual production schedules to fit in and correspond with those of other key members of the supply chain.

These questions attempted to establish whether this information was available on-line.

a). Do you have access to information relating to the production schedules of other members within your supply chain?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
5	5	2	12
42%	42%	17%	100%

Forty-two percent of the respondents indicated that their organisations did have access to information regarding the production schedules of other members. Another forty-two percent showed that there was no access to such information in their organisations and seventeen percent of respondents did not know whether their organisations had access to this information.

b). If your answer to question 19a is yes, do you have on-line access to this information?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
2	3	0	5
40%	60%	0%	100%

Forty percent of the respondents pointed out that their organisations had on-line access to information regarding the production schedules of other members while sixty percent did not have on-line access to such information.

Questions 20a and 20b

The distribution and delivery aspect of SCM is crucial to the success of any supply chain. The collaborative process requires access to shipping dates as the product moves through the supply chain.

These aspects allow for members to collaborate with one another regarding shipping dates, especially when production schedules are affected. It may be possible that shipping dates could be brought forward as a result of production schedules that have been completed before specified times.

This could then lead to downstream members getting products earlier than originally expected, thus enabling them to deliver the products earlier to the final customer. Question 20b attempted to determine whether on-line access to such information was available to members of the supply chain.

a). Do you have access to information relating to shipping dates of products flowing throughout the supply chain that might impact production?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
7	3	2	12
58%	25%	17%	100%

Fifty-eight percent of respondents showed that they had access to information relating to shipping dates of products. Twenty-five percent answered that they did not have access to this information, while seventeen percent did not know whether access to such information existed.

b). If your answer to question 20a is yes, do you have on-line access to this information?

The frequency of responses was as follows:

Yes	No	Don't Know	Total
3	4	0	7
43%	57%	0%	100%

Forty-three percent versus fifty-seven percent of respondents indicated that they had on-line access to information relating to shipping dates of products.

Question 21

Do you have access to on-line information relating to the ongoing production status of a particular product?

This question fits in tightly with the previous one and attempted to determine whether members of the supply chain had access to one another's ongoing production status of a particular product.

The production status of a local product refers to the internal supply chain of an organisation as the product is manufactured locally by a certain member of the supply chain. This data allows downstream members' access to production information very early in the life cycle of a particular product.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
4	7	1	12
33%	58%	8%	100%

Thirty-three percent of respondents indicated that they had access to on-line information relating to the ongoing production status of a particular product, while fifty-eight percent did not have access to such on-line information and a further eight percent did not know whether their organisations had access to this type of on-line information.

Question 22

Do you have access to on-line information relating to the ongoing delivery status as the product moves through the supply chain?

Question 22 is identical to Question 21 with the exception that Question 22 focused on the ongoing delivery status of a product rather than on its production status.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
5	7	0	12
42%	58%	0%	100%

Forty-two percent of the respondents pointed out that their organisations had access to on-line information relating to the ongoing delivery status of a product as it moved through the supply chain, while fifty-eight percent showed that they did not have access to on-line information relating to the delivery status of a product.

Question 23

Do you use or have you considered using a Portal or an Application Service Provider (ASP) model as a collaborative platform for your supply chain due to issues such as cost or technology skills within your company? This would typically be a website that provides a platform for all supply chain members to communicate or alternatively outsourcing the collaborative platform to a third party.

Although there are a myriad of technologies available to allow for improved supply chain collaboration, the cost these technologies could be out of reach for certain members of the supply chain.

An ASP model is one example of technology that could make supply chain collaboration possible to all members of the supply chain. The question tried to establish whether organisations had looked at various options for collaboration because of limiting cost factors or other factors such as lack of access to technology.

The frequency of responses was as follows:

Yes	No	Don't Know	Total
2	6	4	12
17%	50%	33%	100%

Seventeen percent of the respondents pointed out that their organisations had considered using alternative means for a collaborative platform versus fifty percent who answered alternative means had not been considered. Thirty-three percent of respondents did not know whether alternative means for a collaborative platform had been considered.

Question 24

Please discuss any changes that you would like to see implemented regarding supply chain management, either internal or external to your organisation.

This question gave respondents the opportunity to discuss general issues that could improve the supply chain in which they operate.

The following is a summary of changes that users would like to see implemented as far as SCM is concerned:

- Barcode tracking of all shipments accessible via the web with a single ID number
- Efficient service
- Immediate invoicing following delivery of goods
- In-store merchandising of magazines and retail flyers. There is a need for specialist companies who can perform this function well.
- Integrated IT system suited for the industry
- JIT planning systems implemented internally to organisations as well as across the supply chain
- More information from upstream members regarding inventory and production schedules
- Motivation programme for all personnel
- Quicker turn-around times throughout the supply chain
- Secure IT systems

6. INTERPRETATION OF RESULTS

This chapter interprets the results that were presented in Chapter Five. These results are discussed under various headings ranging from the supply chain itself to the CSFs as they were ranked by the respondents in the questionnaires.

The results are interpreted based on the initial sub-problems stated in Chapter One. These sub-problems were to:

- a. Derive a collaborative supply chain from current literature.
- b. Identify current supply chain technologies for collaboration
- c. Identify the CSFs for collaboration
- d. Identify and describe the current supply chain as it happens in the Web Printing industry in South Africa today
- e. Identify the CSFs for collaboration within the Web Printing supply chain
- f. Evaluate the Web Printing industry's supply chain against a collaborative supply chain identified in the literature. Also evaluate this industry's CSFs against the CSFs identified by the literature
- g. Develop a collaborative supply chain model that can be used by the South African Web Printing industry

Sub-problem a

Derive a collaborative supply chain from current literature

Chapter Two of the literature review discusses successful supply chains. Three of the most successful supply chains are discussed under a heading with the same name. The first collaborative supply chain to be discussed is FedEx. The section describes the highly developed collaborative relationship between FedEx and Proflowers.com.

FedEx is a leading model of simultaneous processing across an extended supply chain. The company employs real-time data transmission to assist in routing and

tracking of packages. Simultaneous processing is explained as it occurs in the context of a single event triggering multiple real-time actions throughout the supply chain (Boyson & Corsi, 2002).

This event is in the form of an order being placed via the Internet. Messages are then automatically and electronically relayed to the various supply chain members from the farms that grow the flowers through to the company or depot that would fulfill the final delivery.

Cisco Systems is another organisation that was pointed out as a company with an excellent collaborative track record as far as its supply chain is concerned.

The company is described as a global networked organisation where every step of the company's supply chain, from customer order self-service/product configuration to supplier management employs Internet-based processes.

This seamless integration on an enterprise-wide basis has led to Cisco's per employee revenue to be almost three times that of its competitors while integrating suppliers earlier in the ordering process, the company has reduced lead times from an average of 40 days to between 7 and 21 days (Boyson & Corsi, 2002).

Dell Computer Corporation is another company that uses its collaborative infrastructure to drive information up and down the supply chain. The company optimises collaboration by making use of technology to communicate effectively with customers and suppliers (Kraemer *et al*, 1999). This model of collaboration is called virtual integration and the CEO of the company describes it as stitching together a business with partners that are treated as if they're inside the company, sharing information in real-time fashion (Magretta, 1998).

Although these companies may have different business models to those of the Web Printing industry, it is imperative to study their collaborative supply chains. Often, it is companies that operate in unrelated industries that become leaders in certain aspects of business. In this case, these companies have 'perfected' the concept of

collaborative supply chains and these proven concepts could be adapted for other companies or supply chains.

Sub-problem b

Identify current supply chain technologies for collaboration

Chapter Two discusses recent technologies for supply chain collaboration. Zuckerman (2002:5) states that “as technology evolves, the supply chain is evolving with it into a network of collaborative trading partners who are all linked electronically”.

Zuckerman (2002) also points out that manufacturers and suppliers are increasingly becoming a single enterprise, which leads to the breakdown of boundaries between businesses allowing for the sharing of forecast data so that the different members within the supply chain know how much to produce, how much to ship and when to do so.

The section on supply chain technologies also looks at Collaborative Commerce, Web Services, ERP systems, the Internet, PTXs and XML as tools that can be utilised for optimising supply chain collaboration.

It is evident from the responses that fax and email are used as the primary tools for communication and collaboration within the supply chain. The Web Printing industry lags behind regarding collaborative technologies such as Internet, Intranet and Extranets. The use of these technologies would certainly impact the efficiency of the collaboration process positively.

The Collaborative Supply Chain model cannot be successfully implemented without the use of the correct collaborative tools. A tight integrated collaborative platform is needed where relevant information can flow freely and provide visibility across the supply chain. This is in line with the view of (Zipperer, 2002:54) who states that collaborative technologies are becoming more and more important because of factors

such as outsourcing, and because these technologies enable the connecting of many disparate systems utilised by different members of the supply chain.

Sub-problem c and sub-problem e

Identify the CSFs for supply chain collaboration

Collaboration was studied not only from the point of general collaboration but also from the point of partnerships. This was deemed especially important as trust and commitment play a major role in collaboration as well as supply chain management.

From this angle a list of CSFs for supply chain collaboration were drawn from the literature and then further refined and reduced to five CSF's.

Respondents were then asked to rank the CSFs in order of importance. There was no general consensus on which CSFs were most important. The previous chapter discusses the rankings that emerged from the questionnaires.

A point worth mentioning is that fifty percent of respondents ranked trust and commitment between supply chain members as the second most important CSF, while IT and/or technology-related CSFs were ranked as most important by sixty percent of respondents.

Joint planning was ranked as the most important CSF by forty percent of respondents.

The issue at hand is that the CSF's being ranked by the respondents do not necessarily correspond to the realities emanating from the questionnaires. For instance, although respondents ranked joint planning as the most important CSF, there is not enough access to information to make this possible. The problem is further amplified by the fact that limited electronic access to information exists within the supply chain.

When investigating supply chain technologies, it is clear that the companies in the Web Printing industry are using legacy systems and primitive technologies while sixty percent respondents rate IT as the most important CSF.

The fact that there is no general consensus on the importance of CSFs should be of concern to the Web Printing industry. Organisations operating within the supply chain must be aligned to ensure movement into a particular direction. Understanding goals and objectives and even strategy is not enough to ensure a successful supply chain.

There are inherent critical areas and issues to any supply chain. These must be clear and important to all members so that the power of focus can be drawn upon them and in doing so, eliminate the uncertainties that lead to the dreaded bullwhip effect, which in turn will adversely affect downstream members.

Sub-problem d

Identify and describe the current supply chain as it happens in the Web Printing industry in South Africa today

Figure Fifteen in Chapter Five shows a typical supply chain for the Web Printing industry. Of particular importance are the raw material suppliers (inks, paper and plates). Another important aspect of the supply chain are the logistics providers. These logistics providers refer to providers of both inbound as well outbound logistics functions, such as warehousing and transportation. The press room also forms a major and critical part of the industry's supply chain.

The research only focuses on the industry's primary supply chain members. These are those companies or business units who carry out value-adding activities (operational and/or managerial) in the business processes designed to produce a specific output for a particular customer or market (Croxtan *et al*, 2001:7).

Many of the organisations interviewed for the purposes of this project report do not have a dedicated department in place that focuses on SCM. This could prove to have a

negative impact on the SCM process. Cooper et al (1997) states that cross-functional integration of key business processes within a firm and across the network of organisations is required for successful SCM. It is thus important for SCM to exist in its own right within these organisations.

SCM management has become an integral part of business. Christopher (1992) states that it is not actually individual companies that compete with each other nowadays; rather, the competition is between rival supply chains.

Sub-problem f

Evaluate the Web Printing industry's supply chain against a collaborative supply chain identified in the literature. Also evaluate this industry's CSFs against the CSFs identified by the literature

This particular sub-problem is discussed under the following headings:

6.1 Forms of Collaboration

The organisations interviewed use a hybrid of collaborative methods. Twenty-five percent of organisations do not make use of CPFR. This method of collaboration is ideally suited for the Web Printing industry.

Joint business planning and forecasting is a requirement when using CPFR for collaboration (VICS, 1998). The Collaborative Supply Chain model cannot function without the use of CPFR between supply chain members. This form of collaboration plays a huge role in establishing an integrated collaborative platform across the supply chain.

Some of the benefits of CPFR lie in important factors such as increased forecast accuracy, decreases in shrinkage and a reduction in days of supply (Mazel, 2002).

The CPFR form of collaboration is a tried and tested model for collaboration. There are many global companies using this form of collaboration and it is constantly refined and adapted. There are many case studies of organisations that employ this form of collaboration. The Web Printing industry needs to follow suit by investigating this form of collaboration for its own supply chain.

6.2 Business Planning Agreements

Half of the organisations indicated that they do have business planning agreements in place while the other half showed the opposite or claimed that they did not know if such agreements existed.

These agreements incorporate partnership agreements in which common goals, strategies and certain risks and rewards are made clear (Chapman, Lathon & Petersen, 2000).

The strategy and objectives for the overall supply chain are also stipulated in these business planning agreements so that each member who operates within the supply chain is clear about expectations.

In order for the supply chain to function in an environment where each member is informed regarding the overall goals and objectives, all members must be part of such an agreement. In the case of the Web Printing industry, all primary members must become part of this type of agreement for the Collaborative Supply Chain model to function efficiently.

The majority of organisations (ninety-two percent) pointed out that they have certain planning, supplier and/or risk sharing agreements in place. One of the ultimate goals of a successful supply chain is to have one single agreement in place that covers and encapsulates all other aspects of SCM relating to strategy and objectives as well as joint planning between organisations.

6.3 Information Sharing Policies

Supply chain members all need to make relevant information available to the supply chain. Fifty percent of respondents indicated that their organisations have policies in place that stipulate what type of information needs to be shared with the supply chain as a whole.

If such policies do not exist, members have no idea of what information to share and this can result in an overall shortage of much needed supply chain information.

Supply chain visibility is critical to the collaboration process and increased information visibility is probably the single most often mentioned result of collaboration. Companies benefit from the reduction of uncertainty and variability in the supply chain when information is accessible to all relevant members (Patosalmi, 2003).

The Web Printing industry needs to focus on their information sharing policies generating the guidelines and procedures for all members to adhere by. These policies must be put in place before the supply chain members can even consider sharing information. Uncertainty regarding the type of information and how the information should be made available, can be largely eliminated by implementing such policies across the supply chain.

6.4 Trust within the Supply Chain

Trust and trusting relationships go hand in hand with information sharing. When there is no trust between supply chain members, this has a definite negative impact on any supply chain. Trust affects a myriad of other factors such as joint planning and forecasting.

Only half of the respondents felt that there is enough trust within the supply chain for members to make relevant information available. This shows what little trust exists

within that supply chain. No supply chain can function efficiently without trust and commitment from members.

The CPFR model for collaboration becomes very important under these conditions as it nurtures, enables and initiates trusting relationships and shared information between players (McCrea, 2003).

Once again, the CPFR model for collaboration stands out as a mechanism that could be used by the Web Printing industry to foster trust between supply chain members by making use of the steps and procedure contained in this model. The first step of the model requires partners to develop front-end agreements relating to guidance and rules for a collaborative relationship while the second step asks from partners to create a joint business plan by exchanging information about each other's corporate strategies and individual business plans.

6.5 Access to Information

Collaboration cannot take place without access to information belonging to members of the supply chain. Fifty percent of respondents indicated that they have access to information belonging to key members of the supply chain. However, all respondents pointed out that they have no access to on-line information belonging to key members.

Although this fact is mitigated by answers to later questions in the questionnaire, whereby respondents indicate that they do have on-line access to certain types of information, the problem of on-line access is clearly highlighted.

The Collaborative Supply Chain model cannot function without members having electronic access to information pertaining to the supply chain. One can imagine the inefficiencies resulting from not having electronic access to information.

Increasingly, manufacturers and suppliers are becoming a single enterprise, while collaborative-supply-chain-communities are witnessing the breakdown of boundaries between businesses (Zuckerman, 2002:5).

Zuckerman (2002:5) also points out that the goals of most members of a supply chain lie in reducing cycle times, improving customer relationships and increasing productivity. The real benefits of access to information are obtained when companies are able to share forecast data so that the different members within the supply chain know how much to produce, how much to ship and when to do so.

By not having an adequate and enterprise-wide infrastructure in place to allow for this access to information, the Web Printing industry is ignoring one of the most critical and vital components of a successful supply chain.

6.6 Standards and Common Identifiers

A large number of organisations in the Web Printing industry make use of industry standards to communicate with one another. Although the integration platform for collaboration between different members is virtually non-existent, the fact that members are aware of these standards will go a long way towards making the collaborative process a smooth one.

Common unique identifiers are crucial to successful collaboration within the supply chain. Product identification cannot be achieved in any other way if this function is to be performed efficiently and effectively. As products move through the supply chain, different members need to identify products or product batches.

Siegel (2003) points out that the ability to track and trace inventory and merchandise across the entire supply chain has evolved through to new technologies such as RFID. This process becomes almost insignificant without common identifiers like barcode identification over the Internet. One can imagine the chaos that can be caused by members of the supply chain having a different method of identifying a product and the strain that this places on the collaborative process.

The collaborative supply chain model in Chapter Three of this study incorporates a set of common unique identifiers as a product moves through the supply chain. The main

purpose of the supply chain utility (Chapman *et al*, 2000:14) is to support secure data sharing of product definitions, supply chain planning, and supply chain visibility.

The standards and common identifiers do exist within the Web Printing industry. They might have to be refined and communicated throughout the supply chain but they are wasted if the collaborative process is not there to support these standards and keeping members informed of new and or altered common identifiers.

6.7 Infrastructure for the Integration of Information Flow

The collaborative supply chain model demands the full integration of all members' information. Supply chain visibility cannot be totally achieved without such integration.

As different pieces of information exist in different systems across the supply chain, the integration process needs an underlying IT infrastructure to carry the data to and from the different members.

Typically web-based applications over the Internet or Extranet would need to be utilised to connect these disparate systems. Even ERP systems would need to connect to one another over the Internet, making use of XML scripts to add or shave off pieces of data as the information passes through the supply chain from one member to another.

The ultimate idea is to give all channel partners direct on-line links to back-end systems and processes, such as order and inventory management, as well as to customer relationship management. This type of technology allows customers, suppliers and other channel partners, real-time on-line access to ERP information (Chen, 2001).

Once again, the Web Printing industry lacks an integrated infrastructure for the consolidation of information as well as the process of making this information available to supply chain members. The collaborative supply chain model cannot

function without such an infrastructure. If this infrastructure does not exist, the information becomes almost worthless in the sense that it cannot be shared by the relevant supply chain members while it exists in silos within each organisation.

6.8 Exception Reporting

Exception reporting attempts to forewarn supply chain members of out-of-the-ordinary events that might occur. This information could be important to various members whether they are situated upstream or downstream at any one time.

This type of reporting assists members in alleviating pressures caused by factors such as changes in products, capacity shortfalls and late deliveries. An automated early warning system allows members the opportunity to make alternative arrangements in order to combat the bullwhip effect as the problem amplifies itself the further it moves down the supply chain.

The collaborative supply chain model is not able to function effectively without such a system. The system also needs to be part of an infrastructure that is accessible to all members in the supply chain.

Although such exception reporting takes place within the Web Printing industry's supply chain, one must assume that it cannot be very efficient without an integrated infrastructure to carry this information throughout the supply chain. Exception reporting is generally based on triggered events and as something goes wrong, an event is triggered and sent in an electronic manner to other members within the supply chain. The concept work in the same way as Fedex's order processing system where a single event triggers multiple real-time actions throughout the supply chain (Boyson & Corsi, 2002).

6.9 Forecasting, Demand and Capacity Planning

Collaboration in order to achieve forecasting, demand and capacity planning, is critical in a supply chain. The majority of respondents indicated that they do indeed collaborate with one another for these purposes.

This is in line with the collaborative supply chain model in Chapter Three. An improvement in the accuracy of forecasts can significantly improve the effectiveness of the entire chain (Lee *et al*, 1997).

In order to improve the performance of the supply chain under uncertain demand, Web Printing industry members need to share information and make forecasts and decisions in co-ordination with other members. The lack of an integrated infrastructure, will once again, negatively impact the sharing of information.

6.10 Automated Business Processes

Automated responses relating to critical deliveries or other deviations from the norm are key to efficient collaboration and also to the success of the supply chain in general.

The collaborative supply chain model requires automated responses between organisations participating in the supply chain. The Web Printing industry has a long way to go with only fifty-eight percent of respondents pointing out that such a process exists.

The practicality and importance of one such automated process is well documented in the Proflowers.com example. Once an order is received, transactions and messages are automatically made available or forwarded to the relevant supply chain members, informing them of the required transaction details (Boyson & Corsi, 2002).

In the case of the Web Printing industry, they do not have the infrastructure in place to support these automated business processes.

6.11 Evaluate Critical Success Factors

The CSF's of the Web Printing industry as well as those emanating from the literature review have been discussed and analysed above under sub-problem c and sub-problem e.

Sub-problem g

Develop a collaborative supply chain model that can be used by the South African Web Printing industry. industry

The model is described in full in Chapter Three of this study. It starts off with a supply chain utility, which includes the technical infrastructure to be implemented. The main purpose of the utility is to support secure data sharing of product definitions, supply chain planning, and supply chain visibility.

The supply chain utility (see Figure 13) must provide an integration framework to allow a set of generic, open standards-based technology applications to interoperate and to provide a collaborative product definition, forecast visibility, planning, scheduling, and execution of orders (Chapman, Lathon & Petersen, 2000:14).

The information made available through the supply chain utility requires each trading partner to provide or make available initial information in the following areas (Chapman, Lathon & Petersen, 2000:15):

- Manufacturing (lead times, process times, and transport times);
- Capacity allocation to the partnership;
- Manufacturing capability (product lines, bill of material for products, product specifications, attributes and boundary constraints) and
- Exception criteria.

The next part of the model is described as the execution of the model and it contains the following main steps:

1). Develop Business Planning Agreements

Organisations access their own strategy and goals in order to make sure that these are incorporated in the partnership agreement.

2). Initialise the Supply Chain Utility

Each member provides data to support the area of collaboration defined in the previous step. This would include product definitions, manufacturing capability and capacity allocations.

3). Define Products

Definitions of which products are available as well as lead-times required to produce the product.

4). Resolve and or Collaborate on Exceptions for Product Definition

Exceptions are generated when specific products or product attributes are not available. This allows for early planning of alternatives.

5). Forecast and Plan Capacity Commitments

According to estimated forecasts, each supply chain member must commit a certain capacity allocation to the product line.

6). Resolve and or Collaborate on Forecast or Capacity to meet Forecast Exceptions

Forecasts may exceed or fall short of the original capacity commitments. In cases such as these, partners must collaborate in order to solve the problem.

7). Schedule Production and Product Delivery

Collaboration between the supply chain members regarding orders for production and the delivery of these orders.

8). Resolve and or Collaborate on Product Ship Date Exceptions

If any problems arise regarding product shipments, these must be collaborated to other members of the supply chain as early on the in the process as possible.

9). Expedite Production and Delivery

Each member provides status updates for the delivery and production status of the product.

10). Execute Delivery

The carrier provides delivery status information which is visible to the rest of the supply chain.

By looking at the above steps, it is evident that a collaborative infrastructure is required to make the model function. This collaborative infrastructure must be supported by a technical infrastructure that allows for the collection and distribution of this information for all the supply chain members.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Summary

The presentation and interpretation of the results were discussed in the previous two sections of this document. This section will highlight the most important points emanating from the analysis done thus far.

7.2 Reviewing Problems and Sub-problems

The aim of the research was to develop a model that indicates collaborative options for the Web Printing industry within its particular supply chain.

7.3 Findings

The supply chain in which the Web Printing industry operates is one that needs a lot of nurturing and attention. Only fifty percent of the respondents indicated that their organisations were considering improvements in the area of supply chain collaboration.

The fact that more than half of these organisations do not have dedicated supply chain management departments in place must definitely have a negative impact on their supply chains.

These organisations must establish departments that can focus on supply chain management. Only then can supply chain strategies and objectives be monitored and properly executed with dedicated personnel to keep these departments in line with overall strategy and objectives.

It is evident from the questionnaire that the Web Printing industry needs to employ better technologies for improved collaboration. The Internet, Intranets and Extranets play a very small role in the collaboration process. For efficient and effective collaboration, these technologies are key for information sharing and distribution. It would be virtually impossible for disparate platforms to be integrated and brought together without making use of web technology.

The use of web technology is likely to lead to visibility deep within the supply chain, which in turn will lower uncertainty and make planning and collaboration more possible. Forecasting and capacity planning are factors that have a huge impact on these organisations. Without the proper tools and collaboration, these factors are ignored. This leads to an inefficient supply chain with organisations or groups of organisations operating in, almost, a vacuum.

The existence of an integrated IT platform for collaboration cannot be over-emphasised. Accurate information is needed from multiple participants. This information must be available on a general “backbone” which is accessible to all relevant members of the supply chain. Understandably, trust and commitment must be established first, as a prerequisite to sharing valuable information. Let this not detract from the fact that efficient collaboration cannot take place without integrated information sources.

Respondents cited inadequate IT systems, unreliable distribution, incorrect forecasting, press room downtime, inaccurate information and lack of trust as major factors that would impede a successful supply chain. To remedy all of these factors requires effective collaboration on the basis of a well integrated IT platform, which can be accessed by all members of the supply chain.

Apart from external factors related to politics and the price of paper, it is interesting to note that two major factors that emerged from the questionnaires were poorly trained staff and demotivated staff. These two factors were highlighted by multiple respondents as major factors that could impede a successful supply chain.

Other major factors that would impede successful communications within the supply chain, were listed by respondents as:

- Poor internal and external IT systems
- Poor or non-existent networks between supply chain members
- Unreliable email infrastructure
- Delayed communication because of inadequate communication infrastructures

- Lack of technology as an enabler for efficient communication
- Insufficient integration regarding information relating to production and delivery schedules
- Duplication of information

Again, the importance of an integrated IT system is highlighted. These factors also point out the importance of collaboration technologies for efficient collaboration between supply chain members.

Poorly trained staff featured once again as a factor that would impede successful communication within the supply chain. Lack of trust was also mentioned as a major factor together with lack of feedback from the supply chain.

When asked what changes they would like to see implemented regarding their supply chains, respondents had the following in mind as far as IT, information or technology is concerned:

- Integrated IT system suited for the industry
- Secure IT systems
- More information relating to inventory and production schedules
- JIT planning systems internal to the organisations as well as across the supply chain
- Barcode tracking of products over the Internet
- Immediate invoicing following delivery of goods

Other changes that were mentioned by respondents were motivation programmes for personnel and in-store merchandising by specialist companies.

7.4 Recommendations

The collaborative supply chain model demands an integrated IT environment. Apart from this, the Web Printing industry must look at their individual and collective IT infrastructure as collaboration without information is not possible. The collaboration process must also be efficient for it to contribute to a successful supply chain.

Planning agreements must be set up that involve all the primary members of a supply chain. These agreements should include strategy and objectives that must be followed by all in order to achieve organisational and supply chain goals. Trust and commitment are cultivated through such agreements. This is in line with the collaborative supply chain model.

Another important issue is that of information-sharing policies. Organisations participating within any supply chain must make information available if effective collaboration is to take place. Members must know what information is required by other members of the supply chain and this information must be made available to those parties. On-line access to critical information is paramount for collaboration and once again the importance of an integrated information system comes to the fore.

Technology evolves almost daily. It is not required that all industries or organisations are leaders. Many organisations are followers as far as technology or SCM is concerned. The Web Printing industry must take cognisance of supply chain and collaboration developments in other industries. Dell Computer Corporation and Cisco Systems are examples of organisations that have highly developed supply chains and the collaborative processes within these supply chains are said state-of-the-art. Web Printing organisations must look at these organisations and investigate the benefits of a collaborative supply chain.

7.5 The Collaborative Supply Chain Model

The Collaborative Supply Chain Model is discussed in Chapter Three with Figure Thirteen indicating the model's Supply Chain Utility while Figure Fourteen discusses the execution of the model.

By analysing the problems and issues that exist within the Web Printing industry's supply chain, it is clear that the collaborative supply chain model in Chapter Three would go a long way toward improving collaboration within the supply chain. The model forces organisations to look at their internal processes first before being able to focus on their supply chain.

By starting off with business planning agreements, organisations must work individually as well as in unison to establish the requirements for their supply chain. This includes looking at company strategy and goals in order to insure that they are in alignment with that of the supply chain as whole. Sharing of risks and rewards as well as common goals is required.

The model also requires each member of the supply chain to make available data concerning product definitions, manufacturing capabilities and capacity allocations. This becomes very important and provides visibility within the supply chain. If, for instance, one of the members have committed to a particular capacity allocation and due to break downs, that member cannot provide the product soon enough, collaboration allows for other downstream members to try and source the product from another supplier who may or may not be part of the supply chain.

The point to be noticed is that the model allows for these exceptions to be collaborated throughout the supply chain early enough and in turn allows for alternative measures to rectify the problem. This minimizes the negative impact that such a situation can have on the rest of the supply chain.

This means that the information must reach other members of the supply chain timeously. With collaboration supported by an integrated information platform,

efficient and effective information sharing becomes a reality for the supply chain. The model does address the technical infrastructure needed in the early phases of the planning agreements.

The Web Printing industry has an advantage in that its industrial vocabulary or ontology is already in place. Product definitions and standards seem to be resolved as far as the industry is concerned.

On the other hand, this is almost meaningless when it is not used to promote collaboration. Disparate information and different data must be consolidated by means of an integrated IT platform to turn this into a benefit for the supply chain.

The collaborative supply chain model allows for the proper planning for a collaborative initiative within a supply chain. Different information means different things to different members of the supply chain. Critical information to one member may not be that critical to another member. However, information sharing is key to the success of a supply chain. Information sharing policies must be agreed upon to make the distribution of information possible and in doing so, create visibility across the supply chain.

Patosalmi (2003) states that increased information visibility is probably the single most often mentioned result of collaboration. He points out that organisations benefit from the reduction of uncertainty and variability in the supply chain.

A company's success depends on the co-ordination of certain activities not only across departments but also with suppliers and manufacturers within the supply chain.

Kotler (2000) makes the important point that competition takes place between entire value-creating networks rather than just individual companies. He writes that one of the key requirements for vigorous SCM is rapid and accurate communication among members of the supply chain so that their activities can be better co-ordinated.

The Collaborative Supply Chain Model in Chapter Three is validated by the fact that the Web Printing has limited supply chain visibility as well as limited collaboration.

Weak communications and poor IT systems make collaboration very difficult while efficient communication and collaboration contributes to a successful supply chain.

It is therefore evident that by examining and implementing the Collaborative Supply Chain Model, the Web Printing industry can largely improve the overall efficiency of their supply chain by focusing on collaboration throughout the supply chain.

Another important aspect of the model is that it highlights the importance of agreements between supply chain members relating to information sharing policies as well as overall and individual goals and objectives. This in itself serves as a vehicle for the supply chain to move in a particular direction which is agreed upon and understood by the entire supply chain.

7.6 Suggestions for Further Research

This project report looked at collaboration within the supply chain. Although attempts were made to investigate the broader supply chain and supply chain management process, that was not the focus of this report. Further research needs to be conducted where the general supply chain is investigated.

In addition, the research is limited mainly to the printing companies that operate within the supply chain. Further research could be conducted with other primary members of the supply chain in order to get a more in-depth picture of the total supply chain.

In terms of issues relating to a successful supply chain, successful communication within the supply chain as well as general issues relating to supply chain management, respondents brought up the topics of demotivated staff and lack of training on multiple occasions. Although these issues fall outside the scope of this research, perhaps they need to be investigated as they seem to have a negative impact on communication within the supply chain.

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APPENDIX A

Questionnaire

1). Identify the supply chain in which you operate. This would be from the raw material supplier to the customer. The supply chain members would be those whom you view as the most important to the success of the supply chain.

2). Are you considering introducing improved means of collaboration within your supply chain?

Yes No Don't Know

☐ ☐ ☐

3). Does your organisation have a dedicated department in place that focuses on supply chain management?

Yes No Don't Know

☐ ☐ ☐

4a). Which of the following tools are utilised for collaboration and / or communication within your supply chain? Please rank these tools in order of importance, 1 being most important and 5 being least important.

	Yes	No	Don't Know	Ranking
Fax	☐	☐	☐	
Email	☐	☐	☐	
Internet	☐	☐	☐	
Intranet	☐	☐	☐	
Extranet	☐	☐	☐	
Electronic Data Interchange (EDI)	☐	☐	☐	
Other (Please specify)				

4b). Which of the following forms of collaboration are utilised within your supply chain?

	Yes	No	Don't Know
Quick Response (QR)	☐	☐	☐
Efficient Consumer Response (ECR)	☐	☐	☐
Vendor Managed Inventory (VMI)	☐	☐	☐
Collaborative Planning, Forecasting and Replenishment (CPFR)	☐	☐	☐

5). What are the major factors that would impede a successful supply chain?

6). What are the major factors that impede successful communication within your supply chain?

7). Please rank the following critical success factors of a supply chain in order of importance. 1 being most important and 5 being least important.

- Integrated Management Environment between supply chain members
- Integrated IT system between supply chain members
- Accurate data and information visible to all relevant sc members
- Trust and commitment between supply chain members
- Joint planning between supply chain members
- Other (please specify)

8a). Do you have business planning agreements in place with key members of your supply chain?

Yes	No	Don't Know
☐	☐	☐

8b). Do all the key members understand each other's strategy and objectives regarding the supply chain?

Yes	No	Don't Know
☐	☐	☐

8c). Is there a strategy as well as objectives in place for the overall supply chain?

Yes	No	Don't Know
☐	☐	☐

9). Do you have any agreements in place with other members of the supply chain such as planning-, supplier- and or risk-sharing agreements?

Yes	No	Don't Know
☐	☐	☐

10). Do you have information sharing policies in place that describe what type of information needs to be shared between relevant members within the supply chain?

Yes	No	Don't Know
☐	☐	☐

11). Do you feel that there is enough trust between the supply chain members to make relevant information available to each other?

Yes	No	Don't Know
☐	☐	☐

12a). Do you have access to information belonging to key members of the supply chain?

Yes	No	Don't Know
☐	☐	☐

12b). If your answer to question 12a is yes, do you have electronic access to this information?

Yes	No	Don't Know
☐	☐	☐

13). Do you make use of a “common unique identifier” that spans the entire process from placing an order, to order fulfilment, across the entire supply chain (an example would be an order number on computer that is available right through the life cycle of an order to all members)?

Yes	No	Don't Know
☐	☐	☐

14). Do you have a set of standards that all members have to abide by for communication throughout the supply chain? An example would be a specific product code (ISO for example) that has one universal meaning to all members. This would then be updated on a regular basis as new products are developed and other products are discontinued.

Yes	No	Don't Know
☐	☐	☐

15a). Is there some infrastructure in place that provides for the integration of all members' information flow throughout the supply chain? This would typically be a system allowing for collaboration in terms of product definitions, forecast visibility, planning, scheduling and execution of orders?

Yes	No	Don't Know
☐	☐	☐

15b). If your answer to question 15a is yes, is this an IT system?

Yes	No	Don't Know
☐	☐	☐

16a). Is there some type of exception reporting in place to warn all relevant members of changes in products, capacity shortfalls, late deliveries and or other problems which might affect delivery performance?

Yes	No	Don't Know
☐	☐	☐

16b). If your answer to question 16a is yes, is the reporting of an automated nature such as an automatic e-mail being sent to the relevant members?

Yes	No	Don't Know
☐	☐	☐

17). Do you collaborate with other members of the supply chain regarding forecasting, demand and capacity planning?

Yes	No	Don't Know
☐	☐	☐

18). Are there any type of automated business processes relating to communication or collaboration within your supply chain? An example would be the automated response of a particular delivery of an important order once the delivery has been executed.

Yes	No	Don't Know
☐	☐	☐

19a). Do you have access to information relating to the production schedules of other members within your supply chain?

Yes	No	Don't Know
☐	☐	☐

19b). If your answer to question 19a is yes, do you have on-line access to this information?

Yes	No	Don't Know
☐	☐	☐

20a). Do you have access to information relating to shipping dates of products flowing throughout the supply chain that might impact production?

Yes	No	Don't Know
☐	☐	☐

20b). If your answer to question 20a is yes, do you have on-line access to this information?

Yes	No	Don't Know
☐	☐	☐

21). Do you have access to on-line information relating to the ongoing production status of a particular product?

Yes	No	Don't Know
☐	☐	☐

22). Do you have access to on-line information relating to the ongoing delivery status as the product moves through the supply chain?

Yes	No	Don't Know
☐	☐	☐

23). Do you or have you considered using a Portal or an Application Service Provider (ASP) model as a collaborative platform for your supply chain due to issues such as cost or technology skills within your company? This would typically be a website that provides a platform for all supply chain members to communicate or alternatively outsourcing the collaborative platform to a third party.

Yes	No	Don't Know
☐	☐	☐

24). Please discuss any changes that you would like to see implemented regarding supply chain management, either internal or external to your organisation.

APPENDIX B

Pitfalls of Supply Chain Inventory Management and Corresponding SC Opportunities According to Lee & Billington (1992)

Problem related To	Pitfalls	Symptoms	SC opportunities
Information and definition and SC Management	1. No SC metrics	- Independent and disconnected individual sites - Incomplete metrics - Performance measures not tracked - No attention to measures tracked	- Define SC objectives - Install and monitor SC performance measures - Metrics must be oriented to customer satisfaction (responsiveness)
	2. Inadequate definition of customer service	- Inadequate line-item fill rate measure - No measures for response times, lateness and/or backorder profile	- Measure delivery performance in terms of completed orders (and not per product line) - Measure total response time and average lateness
	3. Inaccurate delivery status data	- Delays in providing delivery information - Inaccurate delivery information	Provide customers with timely and accurate updates on the status of late orders
	4. Inefficient information systems	- Inadequate linkage among databases at different sites - Proliferation of operation systems for the same functions at different sites - Delays and inaccuracies of data transfer	- Eliminate delays in information retrieval and transmission - Use the same operating systems for the same functional tasks at different sites
Operational problems	5. Ignoring the impact of uncertainties	- No documentation or tracking of key sources of uncertainties - Partial information on sources of uncertainty	- Documentation and tracking of key sources of uncertainties - Tracking of root causes of uncertainties
	6. Simplistic inventory holding policies	- Stocking policies independent of magnitudes of uncertainties - Static stocking policies - Generic and subjective stocking policies	- Making stocking policies independent of magnitudes of uncertainties - Dynamic stocking policies - Make product-specific stocking policies
	7. Discrimination against internal	No service measures of internal customers	Create service measures for internal

	customers	• Low priority for internal orders • Inappropriate incentive systems • Jockeying for priority among different internal divisions	customers • Create appropriate incentive systems
	8. Poor co-ordination between different supplying divisions	• No co-ordination among supplying divisions to complete an order • No system information among multiple divisions • Independent shipment plans	• Co-ordination among supplying divisions to complete an order • Global system information among multiple supplying divisions • Dependent shipment plans
	9. Incomplete shipment methods analysis	• No consideration of inventory and response time effects	• Trade-off inventory and response time effects to mode and cost of transportation
Strategic and design-related problems	10. Incorrect assessment of inventory costs	• Omission of obsolescence and cost of rework • No quantitative basis for inventory holding cost assessments	• Include obsolescence and cost of rework • Use quantitative basis for inventory holding cost assessments
	11. Organisational Barriers	• Independent performance measures and incentive systems at different sites • Barriers between manufacturing and distribution	• Create dependent performance measures and incentive systems at different sites and at different functional units
	12. Product-process design without SC consideration	• No consideration of manufacturing and distribution in product-process design • No consideration in design for customisation and localisation • Organisational barriers between design and the SC	• Consideration of manufacturing and distribution in product-process design • Consideration in design for customisation and localisation
	13. Separation of SC design from operational decisions	• Chain decisions without consideration of inventory and response time efficiencies	• Chain decisions with consideration of inventory and response time efficiencies
	14. Incomplete SC view	• Focus on internal operations only • Inadequate understanding of operational environment and needs of immediate and ultimate customers	• Focus on external operations • Understand operational environment and needs of immediate and ultimate customers • Share status information in the SC

APPENDIX C

Different Varieties of Supply Chain Collaboration Initiatives

Initiative	VMI	CFPR	Scan Based-Trading	Procure to Pay	Item / Product Information	Catalogue Management	Order to Cash	Promotions Management	Third Party Logistics	Transportation Planning	Trade Fund Management	Electronic Bill Presentation	CPC
Area	Replenishment			Buy Side	Sell Side			Fulfilment		Fulfilment		Mfg.	

Collaborative Initiatives	Description
VMI	Supplier manages a customer's inventory levels using either traditional Min/Max/EOQ or forecasting replenishment models
CPFR	Supplier works with the customer to develop a joint sales forecast that is used as the basis for replenishment. Actual sales vs. forecast are compared to alert parties of variances so that proactive action can be taken.
Scan-Based Trading	Suppliers provide manage customer inventory levels and provide goods on consignment. Customers exchange point of sale information with suppliers to drive both replenishment and billing activities from actual sales activities.
Procure to Pay Transactions	Traditional transactions that are used for placing a purchase order, communicating changes, and acknowledging receipt with a supplier.
Item / Product Information	Suppliers and customers share information related to items that they purchase/sell. This initiative is focused on keeping the information in synch across multiple suppliers and customers.
Catalogue Management	Customer centric exchange of supplier catalog information with facility for customers to place orders against new products/items with minimal data entry.
Order to Cash Transactions	Traditional transactions that are used receiving sales orders, communicating changes, sending an advanced ship notification, and invoicing a customer.
Promotions Management	Suppliers provide notification to customers for planned promotions, exchange activity information against a promotion.
Third Party Logistics	Suppliers can outsource the fulfillment of goods to a third party logistics (3PL) provider to service smaller regions, or to handle excess inventory. The 3PL must receive sales order information and send back shipment details.

Source: (adapted from Anthony, 2000)

APPENDIX D

The Evolution of SCM Software

	Phase I (1995 – 2000)	Phase II (2000 – 2005)	Phase III (2005 – 2010)
Leading Software Models	• ERP • Supply Chain Execution (Warehouse Mgt, Transportation Mgt, Etc.)	• Collaborative Planning/Forecasting • Real-time Messaging Systems	• “Smart Networks,” very high bandwidth self-adjusting networks • Point to point delivery of customised Supply Chain applications over smart networks
Characteristics	• Large source code • Bulky applications designed to run on corporate networks • Internal Data Center- Managed applications • Focus on corporate transactions	• Lighter, faster applications designed for Web • Streamlined, automated set of business rules with exception/event reporting to key decision makers across the network • Shift to suites of Supply Chain applications hosted by 3rd party application service providers: (ASPs) • Focus on joint operational agility between companies in a shared supply chain	• Bandwidth & applications bundled together by network providers • Real time total supply chain visualization from assets in the field to key external events • On demand Supply Chain applications customized for individual users • Mergers of ASPs into Telco Network Providers • Virtual Supply Chains, reconfigurable on the fly

Source: (Boyson & Corsi, 2002)

APPENDIX E

Dell's Order Processing Business Model

Dell's process is explained by what happens when customers place an order via the Internet (Kraemer *et al*, 1999:15-16)

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- Customers are aided by configuration management software that enables them to choose from a menu of hardware and software options.
- The configurator ensures that the items chosen are compatible with the rest of the system and prices the system, permitting the customer to iterate through various choices. The customer can also call Customer Service, which can link directly into Dell's inventory to determine whether the required components are available. If not, a sales representative can push available inventory at a lower price, promote newer components at a higher price, or provide them at the same price in order to close the sale. Also, suppliers will be notified to restock those components that are unavailable.
- After Dell receives an order, the configuration details are sent to the manufacturing floor.
- Assembly starts in "kitting" with a chassis and a spec sheet (bill of materials, special instructions, and software to be loaded) for the order that travels with the chassis throughout the process.
- The spec sheet is printed from a computer file that is updated with information about the specific components installed and the employees assembling each machine at each step in the process. This enables quick identification of the relevant components, suppliers or employees when problems develop in assembly or later in system use by the customer. In kitting, parts such as cables, connectors, motherboard, and memory are pulled from the inventory to go with the chassis as it moves down the line.
- In "build and test," other components such as hard drive, floppy drive, CD-ROM or DVD are inserted.

- After all the hardware has been installed, the system is sent to software downloading where the operating system, applications, diagnostics and even customer software are loaded onto the hard drive.
- After the software is loaded, the system is powered and tested, after which it is sent to “boxing”.
- In “boxing”, the completed system is placed in a box, the keyboard, mouse, external cables, manuals, and warranties are loaded, the shipping label is placed on the box, and the box is shipped.
- An electronic message is sent to an outside, independent producer of the monitor for the system to ensure that the monitor is delivered to the customer at the same time as the system.
- Once the system is shipped, customers can log into Dell's web site and track their orders through FedEx.