ELECTRONIC DATA INTERCHANGE :

AN IMPLEMENTATION METHODOLOGY

by

ETTIENNE MEYER

submitted in fulfilment of the requirements
for the degree of

MASTER OF SCIENCE

in the subject

INFORMATION SYSTEMS

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: PROF A L STEENKAMP

JOINT SUPERVISOR: DR W B SMUTS

NOVEMBER 1995

Abstract

The purpose of the research is to propose and evaluate a methodology for implementing EDI to assist organisations in reaping the anticipated benefits. The research involved the systematic analysis of the state of the art of EDI and paradigms of methodologies, to define a model for the EDI implementation methodology, and to define criteria for evaluating such a model. The methodology was developed and modelled utilising the software process model, as adopted by Boehm (1988) and later du Plessis and van der Walt (1992), as a framework. Next a synthesis of the assimilated knowledge and brainstorming of project teams involved in EDI pilot projects, was used to systematically develop an EDI implementation methodology. The methodology was evaluated by utilising it in the implementation of EDI between two organisations, Computer Equipment Brokers (PTY) and Marksec (PTY). It was concluded that the methodology was efficient for implementing EDI.

Keywords: Electronic Data Interchange (EDI), EDI Implementation Methodology, ANSI, EDIFACT, SITPROSA, X.400, X.25, Interchange Agreement, Value Added Network (VAN), Computer Supported Cooperative Work (CSCW), Groupware, Software Development Life Cycle (SDLC), Software Engineering, Methodology, Software Process Model, Spiral Model, Reengineering, BPR.

Preface

Ettienne Meyer, born in Pretoria on 16th of November 1963, studied computer science at the University of South Africa and was awarded a B.Sc (Hons) in 1991. He has been actively involved in the Information Technology (IT) departments of both government institutions and the private sector. After consulting to a number of organisations in the development of Actuarial information systems, he became involved in the management of a Pretoria based IT consulting firm, SA Top Data Consultants, specialising in the development of computer systems across all industries.

He was instrumental in the formation of one of the first Electronic Data Interchange (EDI) organisations in South Africa, namely EDIserv (PTY) Ltd. EDIserv supplies EDI software and has its own *Value Added Network* (VAN).

It was his involvement with EDIserv that prompted his research into the EDI implementation methodologies arena. It is hoped that his work will prove fruitful to industry and researchers in their involvement with EDI in the future.

TABLE OF CONTENTS

Acknowledgements

I wish to express my sincere gratitude to all the following who made this research possible:

Prof. A.L. Steenkamp and Dr. W.B. Smuts, my joint supervisors, for their invaluable guidance and advice. Their contribution to this work was essential to its success.

My wife, Mariette, for without her support I would not have attempted this research.

My parents, for the education, interest and inspiration I received from them.

Dries van Wyk and Andrew Dean, for their time spent on editing.

Hester Mountifield, my subject reference librarian, especially for her assistance during the first trying months.

Computer Equipment Brokers (PTY) Ltd (CEB), EDIserv (PTY) Ltd and CEB Networks (PTY) Ltd for their assistance and for allowing me to utilise their EDI project to implement my case study for this research.

Sandy Kleinhans for her typing assistance.

The staff at the office, whom I often neglected for the sake of my studies.

My fellow project team members, their criticism and assistance was invaluable.

UNISA, whom I have been studying with for the past eleven years.

List of Abbreviations and Acronyms

ANSI	American National Standards Institute.
ANSI ASC X12	ANSI Accredited Standards Committee X12.
ANSI X12	ANSI established US standard for message structures, syntax and data elements.
BEDIG	Banks EDI Group.
BPR	Business Process Reengineering.
CCITT	Comite consultatif international telegraphique et telephonique (International Telegraph and Telephone Consultative Committee).
CEB	Computer Equipment Brokers.
CSCW	Computer-supported Cooperative Work.
CSSA	Computer Society of South Africa.
CTO	Container Terminal Order.
DRO	Delivery Release Order.
E-MAIL	Electronic Mail.
EC	European Community.
EDI	Electronic Data Interchange.
EDICC	Electronic Data Interchange Council of Canada.
EDIFACT	EDI For Administration Commerce and Transport.
EFT	Electronic Funds Transfer.
EICON	Data communications card for personal computers.
FAX	Facsimile.
IBM	International Business Machines.
IETF	Internet Engineering Task Force.
IP	Internet Protocol.
ISO	International Organisation for Standardisation.
IOS	Interorganisational system.
JIT	Just-in-time (manufacturing principle).
LAN	Local Area Network.
MIS	Management Information Systems.
MRP	Material Requirements Planning.

NAAMSA	National Association of Automobile Manufacturers of South Africa.
NDCCC	National Datacomms Consultative Committee.
ODETTE	Organisation for Data Exchange by Tele-Transmission in Europe.
OSI	Open Systems Interconnect.
PAD	Packet assembler/disassembler.
PC	Personal computer.
RAU	Rand Afrikaans University.
SABS	South African Bureau of Standards.
SANA	South African Numbering Association.
SAVA	South African VANS Association.
SDLC	Systems development life cycle.
SITPRO	Organisation for the Simplification of International Trade Procedures.
SITPROSA	Organisation for the Simplification of International Trade Procedures in South Africa. This organisation's responsibilities were taken over by the South African Bureau of Standards in 1995.
TCP/IP	Transmission Control Protocol / Internet Protocol.
TDCC	Transportation Data Coordinating Committee.
UN	United Nations.
UNCID	Uniform Rules of Conduct for the Interchange of Trade Data by Teletransmission.
UN/ECE	United Nations Economic Commission for Europe.
UN/TDID	United Nations Trade Data Interchange Directory.
UNGTDI	United Nations Guidelines for Trade Data Interchange.
VADS	Value Added Data Services.
VAN	Value Added Network.
VANS	Value Added Network Service.
X.Series	X applies either to a committee setting a standard or the standard itself. For example ANSI has the X12 committee for setting EDI standards and CCITT has X.25 for communication

	recommendations and X.400 for message recommendations. The X followed by a dot refers to CCITT recommendations and without a dot implies an ANSI ASC committee prefix.
X.25	Packet switching data communications protocol.
X.400	Describes the services a message handling system (MHS) provides to its users.
X.435	International standard for sending EDI over X.400

List of Figures

List of Tables

Glossary

American National Standards Institute: The body set up to define, maintain and coordinate the setting of standards in the United States.

ANSI Accredited Standards Committee X12: The ANSI standards committee charged with setting standards for EDI documents in the US.

application interface: The component of EDI software that passes electronic transactions to and from the appropriate application system.

Business Process Reengineering: See reengineering.

CCITT: Comite consultatif international telegraphique et telephonique (International Telegraph and Telephone Consultative Committee). Now called the ITU Telecommunication Standardisation Sector(ITU-T), a group responsible for the establishment of international telecommunications standards.

Computer-supported cooperative work (CSCW): The scientific discipline that motivates and validates groupware design. It is the study and theory of how people work together and how the computer and related technologies affect group behaviour.

dial-up line: Access to the network is gained by dialling a telephone line to make the connection.

EDI: Electronic Data Interchange (EDI) is the electronic transmission of standard business documents from a company's business application to its trading partner's business application. The transmission of EDI is done in a standard, predefined format that includes all required and optional data needed to successfully complete a business transaction.

EDI Strategy Committee: (See steering committee).

EDIFACT: EDI For Administration Commerce and Transportation. The ISO standards which will determine a unified international EDI standard, being developed by UN/ECE.

electronic mail (E-mail): The computer-to-computer exchange of messages. E-mail messages are usually written in free-text.

encryption: The encoding and scrambling of data (typically during transmission). Data is encrypted at the sending end and decrypted at the receiving end through use of a predetermined algorithm and a unique key. Encryption is done for reasons of information privacy and security.

functional manager: Manager of a department in a functional area such as data processing, purchasing, sales and marketing.

groupware: Software that supports one or more simultaneous users and provides an interface to a shared environment. Such software is associated with groups of people working in a highly integrated fashion on a common task in real-time.

Header section: the portion of the message which precedes the actual body and trailer of the business transaction, and which contains information which relates to the entire message.

hub: Pivotal centre of a trading network. The EDI server in a one-to-many network.

industry standard: An intra-industry message standard developed cooperatively by companies in a common industry,.

integrate: The process of moving data back and forth between two different computer systems and extracting or entering that data from or to respective business management systems (software applications), without operator/human intervention.

interchange: communication between partners in the form of a structured set of messages and service segments starting with an interchange control header and ending with an interchange control trailer. [ISO 9735]

interchange agreement: document, usually in the form of a user manual, which describes, amongst other issues the syntax level, messages, legal and security requirements.

International Standards Organisation (ISO): A UN organisation to which all national and other standards-setting bodies defer. This includes X.400 and EDIFACT.

interorganisational systems (IOS): IOS are systems that cross organisational boundaries, electronically linking two organisations in an effort to improve organisational efficiency and effectiveness.

IP: (Internet Protocol) The TCP/IP standard protocol that defines the IP datagram as the unit of information passed across an Internet and provides the basis for connectionless, best-effort packet delivery service. IP includes the control and error message protocol as an integral part. The entire suite is often referred to as TCP/IP because TCP and IP are the two most fundamental protocols.

IP address: The 32-bit address assigned to hosts that want to participate in a TCP/IP Internet. IP addresses are the abstraction of physical hardware addresses just as an Internet is an abstraction of physical networks. Actually assigned to the interconnection of a host to a physical network, an IP address consists of a network

portion and a host portion. The partition makes routing efficient.

IP datagram: The basic unit of information passed across a TCP/IP Internet. An IP diagram is to an Internet as a hardware packet is to a physical network. It contains a source and destination address along with data.

ISO 9735: International Standard issued by ISO which reproduces the UN/EDIFACT Syntax Rules as agreed by WP.4.

ISO 2382: ISO Data Processing Vocabulary.

just-in-time (JIT): Manufacturing principle applied to inventory control, whereby only the exact stock required for the next part of the manufacturing chain is delivered at the point of time that it is required, at the place it is required.

LAN: Local area network. A network connecting PC's and/or terminals together in a range generally less than 60 meters.

leased line: A line permanently linking two points (versus a dial-up line).

life cycle: See Software Development Life Cycle.

mailbox: A message repository used by both electronic mail and EDI systems. Allows for security by authenticating messages prior to being deposited in the mailbox.

mapping: Rules by which business data, traditionally found in paper documents, is translated into a computer-readable format for electronic transmission to a trading partner's computer for processing, usually according to a pre-arranged standard format.

message: A message is the collection of data, organised in segments, exchanged to convey business transactions between partners engaged in EDI. Also called a document or transaction set. An ordered series of characters intended to convey information. [ISO 2382/16] UN/EDIFACT: a set of segments in the order specified in a message directory starting with the message header and ending with the message trailer. [ISO 9735] Equivalent to a transaction set.

message code: a unique six character alphabetic reference identifying a message type of a standard document.

message header: the service segment starting and uniquely identifying a message. [ISO 9735]

message standards: Rules by which business data, traditionally found in paper documents, is translated into a computer readable format for electronic transmission to a trading partner's computer for processing.

message trailer: the service segment ending a message. [ISO 9735]

message type: an identified and structured set of data elements covering the requirements for a specified type of transaction, e.g. invoice. [ISO 9735]

method: A definite, orderly way of doing something, and is usually based on an intellectual model of how to accomplish an activity; it is implemented through the use of procedures and tools.

methodology: A collection of methods, techniques, procedures and tools that provides the overall approach to developing and improving software; it is usually based on an underlying intellectual model (the paradigm).

modem: device used for interfacing digital communication equipment to a communications network. An acronym for modulator/demodulator.

multiplexer: A multiplexer accepts lower-speed data streams from terminals and combines them into one high-speed data stream for transmission and vice versa. Effectively improving the efficiency ratio of the path.

MUX: (See multiplexer).

National standards body: an organisation within a country charged with developing national standards and contributing to international standardisation through ISO. [UN/EDIFACT Procedures]

network: A telecommunication structure linking various end-users. Various physical and logical mechanisms exist to implement an actual network, e.g. point-to-point, switched networks and satellite.

ODETTE: Organisation for Data Exchange by Tele-Transmission in Europe. Was formed to implement EDI in the European auto industry.

paradigm: An abstract (conceptual) or intellectual model on which something is based.

point-to-point: A network communication access path where a fixed communication line exists between two access points, forcing the data to take a prescribed path. This fixed line can also be simulated by using for example X.25, thus basically serving the purpose of bypassing the VAN.

project manager: An individual, usually a functional manager, assigned to organise the activities of the project team and plan and implement the EDI project.

project team: A group of individuals responsible for gathering business information and performing implementation tasks for the EDI project, as assigned by the project manager.

proprietary standard: A message standard specifically developed by a single company with the trading partner, to dictate its use by the company's trading partners.

protocol: The set of rules defining the manner in which information can flow within a computer or network of computers. It consists of a syntax set, command set, response set, semantics set (actions and responses), events, event sequences and event timing.

reengineering: Reengineering is the concurrent redesign of processes, organisations, and their support information systems to achieve radical improvement in time, cost, quality, and customer's regard for the company's products and services.

SITPROSA: Organisation for the Simplification of International Trade Procedures in South Africa. Local organisation representing SITPRO to assist in the design of standards for documents not currently represented by the EDIFACT standard. This organisation's responsibilities were taken over by the SABS in 1995.

Software Development Life Cycle (SDLC): A life cycle model to support the breakdown of work during development, implementation and maintenance of a software system.

Software Reengineering: Software Reengineering is the examination and alteration of a subject system to reconstitute it in a new form and the subsequent implementation in a new form.

steering committee: An element of the project team composed of top management executives. Give overall direction and resources to the project with the intent of incorporating the EDI Strategic Plan into the goals of the company's business plan.

strategic plan (EDI): A top management tool that incorporates EDI to enhance the goals of the business plan and provides an overall approach to an EDI implementation.

TCP/IP: (Transmission Control Protocol) The TCP/IP standard transport level protocol that provides full duplex, stream service on which many application protocols depend. TCP allows a process on one machine to send a stream of data to a process on another. It is connection-oriented in the sense that before transmitting data, participants must establish a connection. Software implementing TCP usually resides in the operating system and uses the IP protocol to transmit information across the underlying Internet. It is possible to terminate (shut down) one direction of flow across a TCP connection, leaving a one-way (simplex) connection. The entire protocol suite is often referred to as TCP/IP because TCP and IP are two most fundamental protocols.

technique: An informal method.

third-party network: (see Value Added Network).

Trade Facilitation Organisation: a national body co-ordinating or monitoring trade facilitation developments at national level, providing input to UN/ECE/WP.4 and disseminating information on trade facilitation developments, including UN/EDIFACT. [UN/EDIFACT Procedures]

trading partner: A customer, supplier, or service provider (such as banks and transportation carriers) that actively conducts business with the organisation in question.

transmission: Data that is sent electronically from one trading partner to another trading partner, or from one trading partner to a VAN.

UNCID: Uniform Rules of Conduct for the Interchange of Trade Data by Teletransmission, developed by the International Chamber of Commerce. [UN/EDIFACT Procedures]

UN/ECE: United Nations Economic Commission for Europe. Has extended the work done on standards by SITPRO to Europe.

UN/ECE WP.4: Working Party on Facilitation of International Trade Procedures, a subsidiary body of UN/ECE Committee on the Development of Trade. WP.4 includes national delegations appointed by governments and international organisations having consultative status with UN or invited by the Secretariat. It is comprised of experts on data elements and automatic data interchange and experts on procedures and documentation which are appointed by their governments or by organisations recognised by UN/ECE.

Value Added Data Services(VADS): A network-based data service which adds significant value to the basic function of carriage or message switching provided by the national telecommunication service. An EDI service is considered to be a VADS.

Value Added Network(VAN): A third-party organisation offering telecommunication services through which two or more trading partners can exchange data, i.e. it provides a VADS. It does not provide application processing facilities.

X12: The ANSI standard for inter-industry electronic interchange of business transactions.

X.25: Packet switching data communications protocol.

X.400: International message handling standard for connecting electronic message (e-mail) networks.

X.435: International standard for sending EDI over X.400.

XCOM 6.2: A software package from Legent Corporation that provides for bulk data transfer between mainframes, minis and micros.

WP.4: Working Party 4. See UN/ECE/WP.4.

CHAPTER 1 : INTRODUCTION

This dissertation summarises the results of an investigation into defining and evaluating a methodology for implementing EDI in an organisation.

1.1 BACKGROUND

In the popular press there are many references with regard to EDI and its impact on the way in which organisations will conduct their business. Some of these are:

> *"It would be almost unthinkable nowadays for business not to have a telephone to communicate with customers and suppliers. In the future, it may be almost as unthinkable for a business not to have a computer for the same purpose."* (New York Times July 10th 1986).

> *"By the end of the 90's it will be easier to do business without a telephone than without EDI."* (EDI World June 1992).

> *"Cooperative systems are computer systems that require cooperative system development by at least two groups, perhaps even two or more companies. A prime example is the emerging field of electronic data interchange (EDI) - the electronic transmission of formatted business transactions, such as purchase orders, between companies. In EDI, companies collaborate on system development and day-to-day operation. We see a trend towards cooperative systems, as more business functions are automated, as more people use computers, and as electronic communications become more common."* (McNurlin 1987:35).

Since this statement was penned in 1987, telecommunications within data processing has become common business practice. However, transferring data across company boundaries electronically has only received more recent interest.

EDI is a high growth activity, but not of high public visibility. It involves application of the fastest growing technologies: computing and telecommunication.

EDI is best defined by the following definitions:

Electronic Data Interchange (EDI) is the electronic transmission of standard business documents from a company's business application to its trading partner's business application. The transmission of EDI is done in a standard, predefined format that includes all required and optional data needed to successfully complete a business transaction. (Emmelhainz 1993).

And

"Electronic Data Interchange. A series of standards which provide computer-to-computer exchange of business documents between different companies and computers over phone lines. These standards allow for companies to send each other purchase orders, shipping documents, invoices, invoice payments, etc. EDI software translates fixed field or "flat" files that are extracted from applications into a standard format and hands off the translated data to communications software for transmission. EDI standards are supported (i.e. have been adopted) by virtually every computer company in the country and increasingly, by every packet switched data communications company. For example, you can use IBM VAN -- IBM's Value Added Network for Electronic Data Interchange." (Newton 1992).

EDI is seen as a type of interorganisational system (IOS) such as electronic mail (E-mail), electronic funds transfer (EFT), text document transmission, graphics interchange, image interchange and remote data bases.

Despite the benefits of EDI, very few companies have successfully implemented and

integrated EDI into their business processes. This is due to a number of factors, such as legal issues, auditability, cost, security and the lack of formal implementation road-maps. Many companies spend months trying to get an EDI implementation project off the ground, but not knowing where to start. Of those who actually get going, few do it formally and even less attempt to cost justify it. Given the planning and implementation lead time, estimated at eighteen months, and the fact that the literature (on the state of the art of EDI) is more advanced than the practical implementation of EDI, (due to the limited number of documented case studies) this dissertation intends to present the practical issues involved in planning for EDI implementation.

1.2 PROBLEM STATEMENT

Much of the literature on EDI describes the implications for an organisation implementing EDI in terms of costs and benefits as well as on EDI in general (Preston 1988; Davis 1989; Feldman 1987; Kimberley 1991). However not much documentation is given in terms of the practical implementation of EDI. It has been discovered that many companies are implementing EDI on a trial and error basis without following a proper implementation methodology. This not only resulted in time and money being wasted by frustrated efforts, but even more important, it led to a lack of faith and trust in the process of EDI. A need therefore existed to identify and define a more methodical approach to understanding and implementing EDI, at a detailed enough level to be of practical use to organisations in South Africa.

1.3 OBJECTIVES OF THE RESEARCH

In order to define an EDI implementation methodology a number of objectives were defined. The first being to gain a thorough understanding of the state of the art of EDI, the objective is thus to provide a solid foundation of knowledge about EDI by bringing together explanations of EDI terminology, examples of EDI usage, benefits and problems in implementing EDI.

The second objective is to gain an understanding of software process models to enable the use of the model to provide a framework for defining an EDI implementation methodology.

The third objective is the definition of the EDI implementation methodology utilising the EDI knowledge base, software process models and practical experience.

Fourthly the methodology is to be tested by means of a case study and evaluated against criteria defined.

1.4 SCOPE OF THE INVESTIGATION

The research is concerned with developing a methodology for implementing EDI in an organisation. To achieve this, existing software development methodologies were utilised to assist in developing a model to represent the methodology. The scope of the research is thus defined by the following hypothesis, delimitations and assumptions.

1.4.1 Hypothesis

This investigation is based on the hypothesis that the spiral model can be adopted to define an implementation methodology for the EDI application domain, that will (i) facilitate the integration of EDI into the organisation, and (ii) optimise the benefits accruable from EDI utilisation.

1.4.2 Delimitations

Various delimitations exist with regards to a study of EDI implementation methodologies and these are addressed below.

Related Issues

This study is not an attempt to solve related issues which may hinder an organisation in its attempt to implement EDI. The most significant issues already identified are legal, audit and security problems w.r.t. implementing EDI in South Africa. The possible impacts of these problems in the proposed implementation methodology are, however, addressed in the methodology.

Existing methods and techniques

Various methods and techniques exist for performing some of the activities within the various steps of the proposed methodology for implementing EDI. It is not the intention of this study to address or recommend these, with specific reference to reengineering methods, cost-benefit analysis techniques and hardware/software evaluation and selection procedures.

Time Constraints

It is unlikely that a medium to large size organisation will fully implement EDI within a period of four years, making complete testing of the methodology with all trading partners and for all documents identified, unrealistic for the purposes of this research.

Technical Aspects of EDI not Studied

The finer technical aspects of EDI are not addressed as this study is not meant to be a detailed study of EDI itself.

1.4.3 Assumptions

Due to the enormous time constraints with regards to implementing EDI, and the resulting inability to test the methodology across different industries, it is assumed that the two organisations used for the case study are representative enough to prove fruitful.

1.5 RELEVANCE OF THE RESEARCH

"During the 1990's, globalisation will mature from a buzzword to a pervasive reality. The emerging economic prowess of the Pacific rim countries and the opportunities and upheavals triggered by Europe 1992 means that companies will have to meet global standards for quality, design, pricing, and service....Markets will expand and shrink overnight, driven by the technologies that constantly change."
(Dumaine 1989:48).

This statement epitomises the type of changes organisations will have to contend with in the future. Competition will thus not be confined locally, but to a far wider and more sophisticated group of companies.

As discussed above, the nature and the size of the competitive market arena (for just about everything) is changing at such an accelerated speed, that it is conceivable to think that IT could be used to enhance a company's market share. McFarlan (1986:91) believes that *"the new technologies of communications have the power to change the competitive game for almost all companies, of all sizes"*.

Everyone who has tried to market anything knows that the closer one gets to the customer, the better one's information is about the customer's likes and dislikes. Wriston (1989:679) says that once goods are on the shelf, electronic technology can move directly into the marketing process. Firstly, information on human purchasing behaviour may be collected and used for marketing purposes. He indicates that the next logical step in the process would be to tie the customer to the supplier electronically in order to increase market share and profits. This is precisely how EDI can provide companies with the opportunity of gaining competitive advantage in an ever changing market. It should be noted that many companies have already automated their internal systems and use computers on a daily basis. Interfacing between computer systems, of the same company, (intra-company) is now being done extensively. It is across the company boundaries (inter-company) that systems will have to be interfaced on a much larger scale. EDI refers specifically to inter-company interfacing, involving the passing of data from one company's computer to that of another.

Sokol (1989:6) states that *"unless faced with a specific business reason for implementing EDI, very few companies did"*. However the EDI climate has been changing and electronic trade is fast becoming the "wave of the future". EDI will soon become a necessity for trading in certain industries and unless companies are doing EDI, these companies will be at a marked competitive disadvantage. Given the planning and implementation lead time, estimated at eighteen months, and the fact that the literature is more advanced than the practical implementation of EDI, this dissertation intends to present the practical issues involved in planning for EDI implementation.

EDI must be seen as a new technology that supports existing application domains and its implementation may affect adaptive maintenance to these existing applications. This is one of the reasons that a methodology for EDI implementation is required.

Automation by technology alone has, in the UK and USA experiences, led to higher prices and of itself failed to stem the cost differential in favour of the Japanese. It is through reorganisation (business process reengineering) in association with technology that the tide may be turned.

To achieve this, senior management must champion the organisational change which accompanies automation and which is essential for the successful exploitation of EDI. This entails changes to business procedures, job roles, working practices, organisational structures, manning levels, and the flow and ownership of information.

The most important reason for implementing EDI is thus to avoid what might happen if an organisation ignores implementing EDI. Organisations may argue that EDI is not yet a requirement for their organisation, however, it is likely to become one in the future. Thus implementing EDI now, can provide a significant competitive advantage, whereas not implementing it can leave the organisation behind the rest of the industry. Table 1.1 details the reasons cited by respondents for implementing EDI, in a recent local survey (Harrington 1994).

Reasons for Implementing EDI	%
1. Business survival	23,7
2. Reduce errors	15,2
3. Improve customer satisfaction	13,5
4. Reduce costs	11,9
5. Reduce inventory holdings	10,2
6. Reduce payment delays	6,8
7. Improve trading partner relations	5,1
8. Achieve competitive advantage	5,1
9. Improve data integrity	5,1
10. Improve internal options	3,4
	100 %

Table 1.1 EDI implementation reasons

According to the survey a number of respondents did not give their reasons for EDI

implementation, but of particular interest is the percentage citing business survival. It is as a result of this uncertainty that a formal methodology is required to ensure management control with a risk-driven approach.

1.6 METHOD OF INVESTIGATION

The research can be viewed as a triangle of three equally important, dependent thrusts, as shown in Figure 1.1. The top node focuses on theories and models of EDI and implementation life cycles in general. It involves the systematic analysis of the state of the art of EDI on the one hand and paradigms of methodologies on the other hand. This phase is an intensive literature assimilation and interpretation process to gain an understanding of software development models in order to define the relevant corner stones of a methodology for EDI implementation and to enable the definition of criteria for evaluating such a methodology.

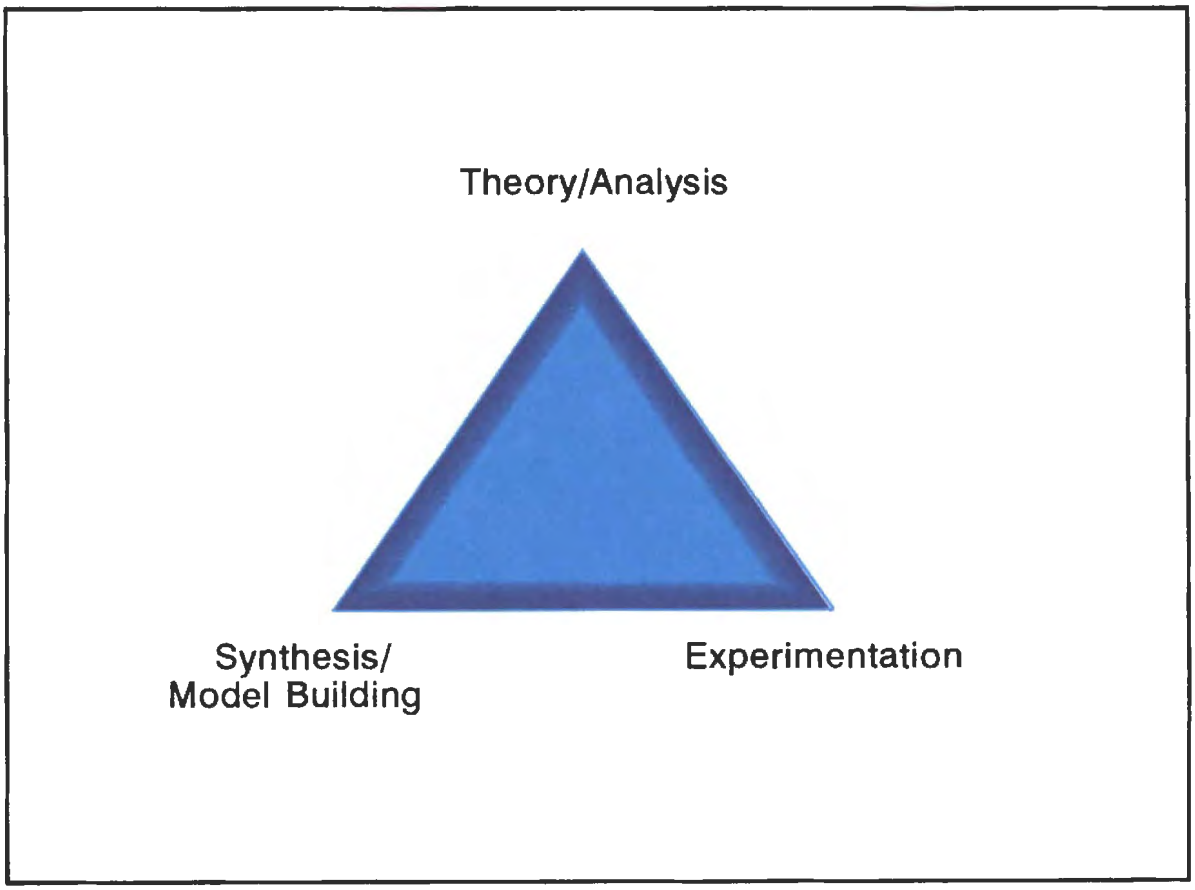

Figure 1.1 Research thrusts

Next a synthesis of the assimilated knowledge and brainstorming of project teams involved in EDI pilot projects led to the conceptualisation of a solution to the hypothesis of the investigation in the form of a systematic development of an EDI implementation model.

The third node involves the experimentation of the model in a case study environment in order to demonstrate the concept and to evaluate and refine the model. An EDI implementation project will be undertaken between two organisations, viz. CEB Networks (PTY) and Marksec (PTY), to demonstrate the application of the proposed methodology.

1.7 STRUCTURE OF THE DISSERTATION

The remainder of the dissertation is divided into five more chapters. Chapter 2 gives an overview of the background to EDI, defines EDI, and examines the key concepts behind EDI. Basic EDI components, such as standards, software and networks, are introduced and explained. Current research areas are reviewed, as are examples of EDI implementations world-wide. The concept of groupware and Computer Supported Cooperative Work (CSCW) is introduced and related to EDI.

Chapter 3 reviews software engineering and the software development process with specific emphasis on the spiral model. This is to enable its adaptation into a model for defining an EDI implementation methodology.

Chapter 4 defines the proposed EDI implementation methodology using the spiral model defined in Chapter 3 as a basis. The methodology is discussed in detail with regards its deliverables and techniques. Criteria for evaluating EDI implementation methodologies are also presented at the end of the chapter.

Chapter 5 summarises the results of the case study of an EDI implementation between two organisations, utilising the proposed methodology for implementing EDI. The chapter ends with an evaluation of the project and of the proposed methodology.

Chapter 6 summarises the dissertation and its results, and provides a conclusion on the findings as well as recommendations based on the findings.

CHAPTER 2 : REVIEW OF THE RELATED LITERATURE: EDI

2.1 INTRODUCTION

In this chapter an explanation of Electronic Data Interchange (EDI) is given. A brief background on the emergence of EDI is discussed, followed by an analysis of a definition of EDI and a discussion of key concepts behind EDI. A brief look is taken at the perceived benefits of utilizing EDI and current research issues are addressed. Next EDI implementations and successes achieved both locally and abroad are briefly summarised. The chapter ends with an introduction into groupware and computer supported cooperative work.

2.2 BACKGROUND TO ELECTRONIC DATA INTERCHANGE (EDI)

The concept of EDI was initiated by Edward Guilbert, who, as director of Traffic for the 1948 Berlin Airlift, found it terribly frustrating to cope with business transactions on paper. In 1968 he and a few colleagues formed the Transportation Data Coordinating Committee (TDCC), to support the standardisation of tariffs for overseas shipments. It had a mission

of convincing business managers that it was far better to do business via a computer than on paper. They established the following four ground rules, still valid, for Electronic Data Interchange:

- Generalised interface data standards and formats, must be responsive to user needs for intercompany computer to computer transactions.
- The interface capability must be insensitive to internal computer equipment and the programs of the interchange party.
- Users should have a choice with regard to communication speeds and services. Thus an EDI implementation should support the open systems concepts.
- It should have the capability of providing documents, when required, as a by-product of Integrated Database transactions. (Thierauf 1990).

In 1975 they released the first EDI documentation: Rail Transportation Industry Applications (Thierauf 1990). That document became the first of ten current volumes of US EDI Standards.

Electronic data interchange has been used more extensively by large manufacturers since the early 1980s, but until recently its use was limited primarily to large companies that saw it as a strategic means of doing business. Companies supplying parts and raw materials used EDI only after customers demanded that they send and receive orders electronically; they worked initially with the code supplied by their large clients, where each client required a different customised solution.

Translation software packages became available more recently, enabling EDI active companies to respond to multiple clients, but this required manual rekeying in both directions. Companies are now looking for comprehensive EDI systems that integrate information sent and received with their central computer system. However, the mapping involved in connecting company databases and EDI transaction sets is complicated and costly.

To most organisations it's not a matter of committing to EDI, but one of when and how. It is of vital strategic importance to any organisation.

2.3 STATE OF THE ART IN EDI

The objective of this section is to define what EDI is (by also looking at what EDI is not!). The EDI environment (communication software and hardware, standards, translation, business applications, organisation maturity level and syntax rules), are placed in perspective to one another and each element of the environment is briefly explained. This is followed by a brief discussion on the perceived benefits of an EDI implementation. An overview of the importance of business process reengineering is presented, followed by a discussion of current EDI research and existing EDI implementations. The chapter ends with an overview of groupware and computer supported cooperative work.

2.3.1 What is EDI?

Electronic Data Interchange is the automated flow of business information between organisations. This information is integrated with, and flows into and out of, their respective business management systems. To accomplish this, documents in **standard data formats** move between the organisation's computerised business management systems and a trading partner's system.

Based on the above definition, it is a common misunderstanding of EDI that trading partners or competitors could have direct access to a company's business files and thereby extract information. This conception is totally false. EDI only allows data that is **SENT** by one trading partner to be **RECEIVED** by another trading partner. EDI does not permit anyone to extract data from a trading partner's business management systems.

It is important to understand business technologies that are similar to EDI and may even appear to be as effective as EDI, **but are not EDI** and are certainly not as effective:

- **Facsimile (FAX)** transmission of documents to a trading partner is not EDI. It still requires someone to **interpret** the data (retaining the human element of data misinterpretation) and **rekey the data** into the business management system (retaining rekeying errors and time delays). The only advantage to FAX transmission is the speed with which it replaces the postal system.

- **Electronic mail (E-mail)** eliminates the paper associated with FAX but is still not EDI. The information moves directly from one computer to another, but is unstructured and requires a person to **interpret the information and rekey the data** into the internal business system.

- Some companies would install a workstation at another organisation's premises, to allow that organisation access to its computer systems. The existence of such a **dedicated computer terminal** linked between two trading partners is not EDI. It allows a trading partner access to one or more application systems of the other trading partner, but does not actually integrate the different computer installations of the two partners. Thus it merely serves the purpose of allowing access to the other's data and most often only as an enquiry feature. There is no transfer of data between trading partners. A person is still required to manually **rekey** the data into the internal systems, again subject to **misinterpretation, rekeying errors and processing time delays**.

- Exchanging data electronically with a single trading partner using non-standard data formats is called **proprietary EDI**. This technology yields some of the benefits of EDI and may satisfy a small number of trading partners, but the benefits of proprietary EDI cannot easily be extended to business transactions with other customers, and potential trading partners who are already successfully operating with standard EDI will almost certainly not trade with another's proprietary EDI formats.

Some organisations may use EDI standard formats to send and receive information, but they **rekey information to be transmitted to a PC or print the information that is received (as if it had been received by post)**. This is a better approach than "proprietary EDI' in that it can easily be used with many trading partners. However, even though it may serve the needs of those trading partners, it provides very few benefits for the organisation because redundancy of clerical tasks, processing time delays and rekeying errors are not eliminated.

This approach should only be regarded as an interim solution to an EDI implementation strategy.

Used most effectively, EDI communicates common business document data, such as an invoice and a remittance advice, **between two different business management systems** using standard data formats.

The key phrase is **between two different business management systems**. This implies two things:

- Firstly, it requires that each trading partner has a **computerised business management system** in place, in order that data received and sent can be integrated directly with the appropriate business management systems;

- Secondly, **EDI must be integrated with the existing computerised business management system.** This eliminates redundancy of clerical effort (reading, interpreting, routing and filing), processing time delays and errors from the movement of information between business management systems.

Real-time electronic data interchange technology can deliver data faster than traditional EDI, but it may be years before a standard for real-time EDI is established. Major EDI users are encouraging the development of fast data exchange methods, but most users are still using EDI as a store-and-forward process in which data is sent as a batch in a predetermined cycle. With real-time EDI, a link over a *Value Added Network* (VAN) is maintained until all EDI data is exchanged between partners. Interactive or conversational EDI is a step beyond real-time EDI. It allows systems to communicate interactively over standard digital transmission lines so that the data recipient can respond to the data during the same transmission. For real-time EDI or interactive EDI to become a reality, current EDI standards must be rewritten to accommodate a change in architecture from store-and-forward to interactive systems. The ANSI X12 workgroup is working on a draft proposal of a real-time and interactive EDI architecture.

In Figure 2.1 the implementation of EDI is illustrated where the process is not integrated into existing application systems. In step 1 a document is produced or obtained from a trading partner and captured onto the computer for processing in step 2 by the EDI translation software. In step 3 the document is translated into a standard format and passed

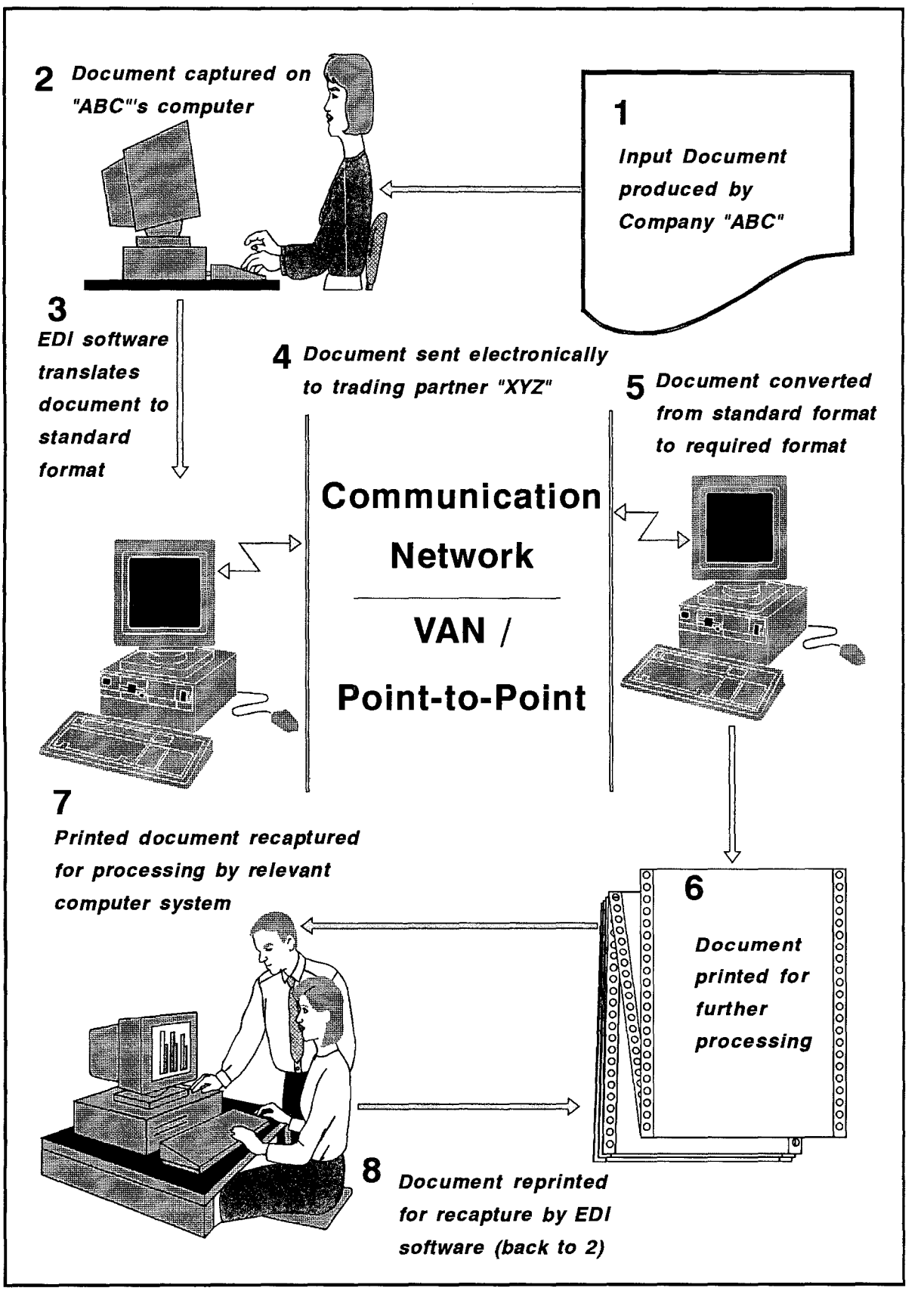

Figure 2.1 "Non-integrated" EDI

to the communications software for transmission to the trading partner (step 4). In step 5 the communications software produces the document in the standard format required by the trading partner for processing. The EDI software translates the document into the format required (specified) by the trading partner. The trading partner prints the document (step 6) for processing as the application systems are not integrated with the EDI software. The document is now captured manually into the relevant application system for processing (step 7) and the process may in fact repeat itself if a new document is to be transmitted to the original transmitter (step 8).

Figure 2.2 illustrates multiple EDI participants in an integrated implementation of EDI with different communications strategies involved. The emphasis is on technology independence (LANs, WANs, mainframes, notebooks, VANs, point-to-point) as well as independence from human intervention. Data is not re-entered into a computer system when organisational or national boundaries are crossed, but only at an initiation stage. Also of importance is that no organisation has access to the data and information of another, except that which is given to the other by choice.

Integrated EDI eliminates the problems that can be experienced by elimination of human intervention, unless appropriate. The packet assembly/disassembly (PAD) function in Figure 2.2 provides for asynchronous access into X.25. It has various other functions such as protocol conversion, character assembly and packet disassembly.

Integration is essential if interactive query-response data interchange between two different organisations is to be implemented, as in reservation systems. The use of interactive EDI is increasing, but there are still relatively few users. A VAN will not facilitate interactive EDI as it make use of a mailbox concept. Thus the intended use of EDI must be well defined before decisions on the communications route are made, especially with regards to a VAN or point-to-point implementation.

2.3.2 The EDI Environment

EDI may be seen as a cooperative system, requiring the collaboration of at least two parties, usually with different business objectives, to form a joint computer-based trading

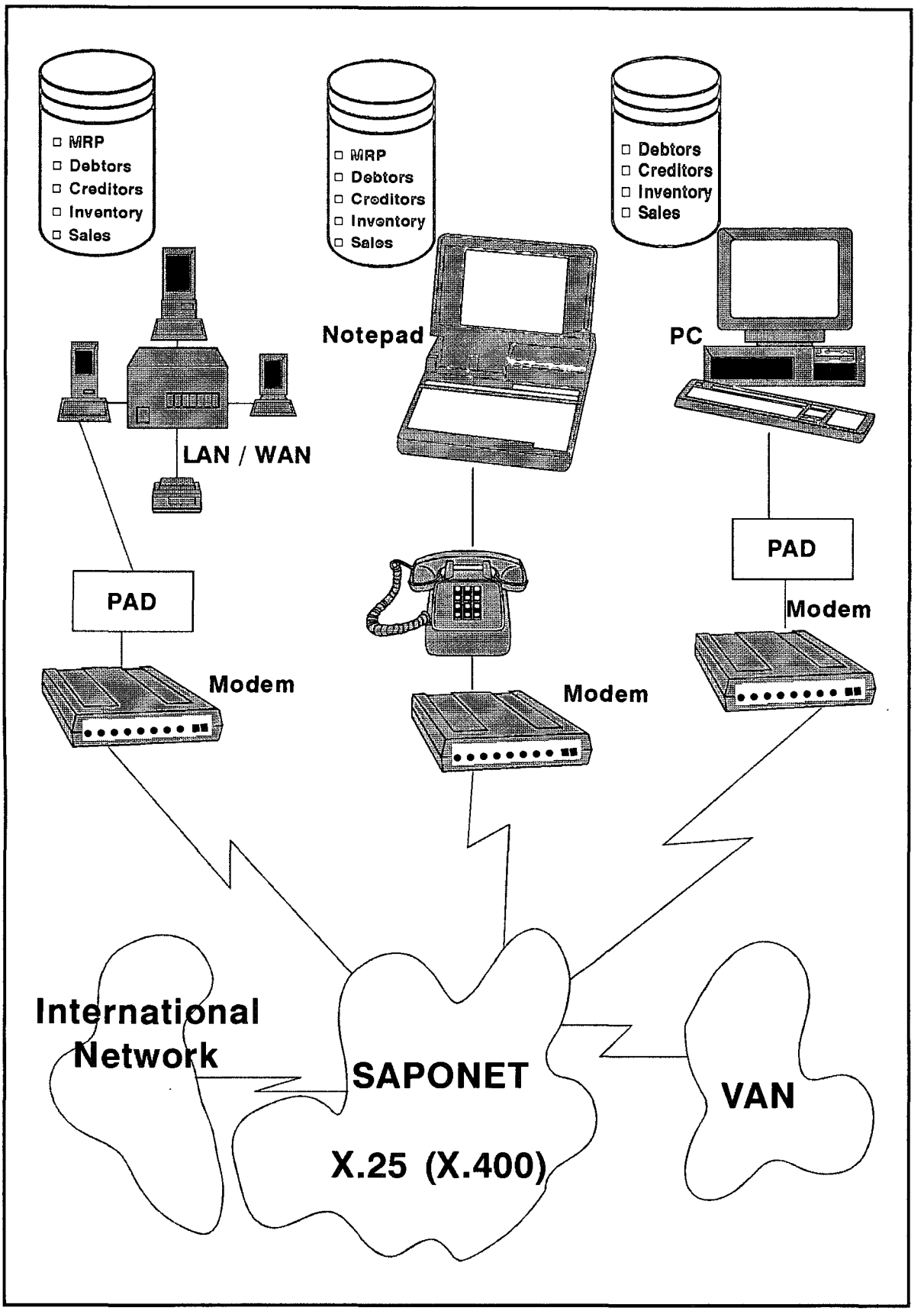

Figure 2.2 Integrated multi-user EDI implementation

system. These cooperative systems may involve corporations and their suppliers and customers, corporations and their banks, companies in joint ventures with each other, or even competitors. This complexity can be in terms of the following key elements of an EDI environment:

- Syntax rules;
- Message Standards;
- Communication medium;
- Communications software;
- Translation software;
- Applications link software;
- Business applications;
- Level of maturity of the relevant organisations;
- Computer hardware.

All these elements are needed to ensure proper data flow when utilising EDI between trading partners.

2.3.2.1 Syntax rules

Syntax rules define the way data is represented within a message, i.e. the grammar of a language. An example of such a syntax is the EDIFACT syntax for message construction.

2.3.2.2 Message Standards

Message standards enable trading partners to trade with documents in such a way that no matter who is received from or communicated to, the end product always looks the same after translation.

To understand the complexities involved in inter-organisation communications one can start by looking at potential participants in an EDI participation network (Figure 2.3). The potentially vast number of players, from different industries, that can form part of an EDI implementation clearly illustrates the importance of having and using standards. It shows

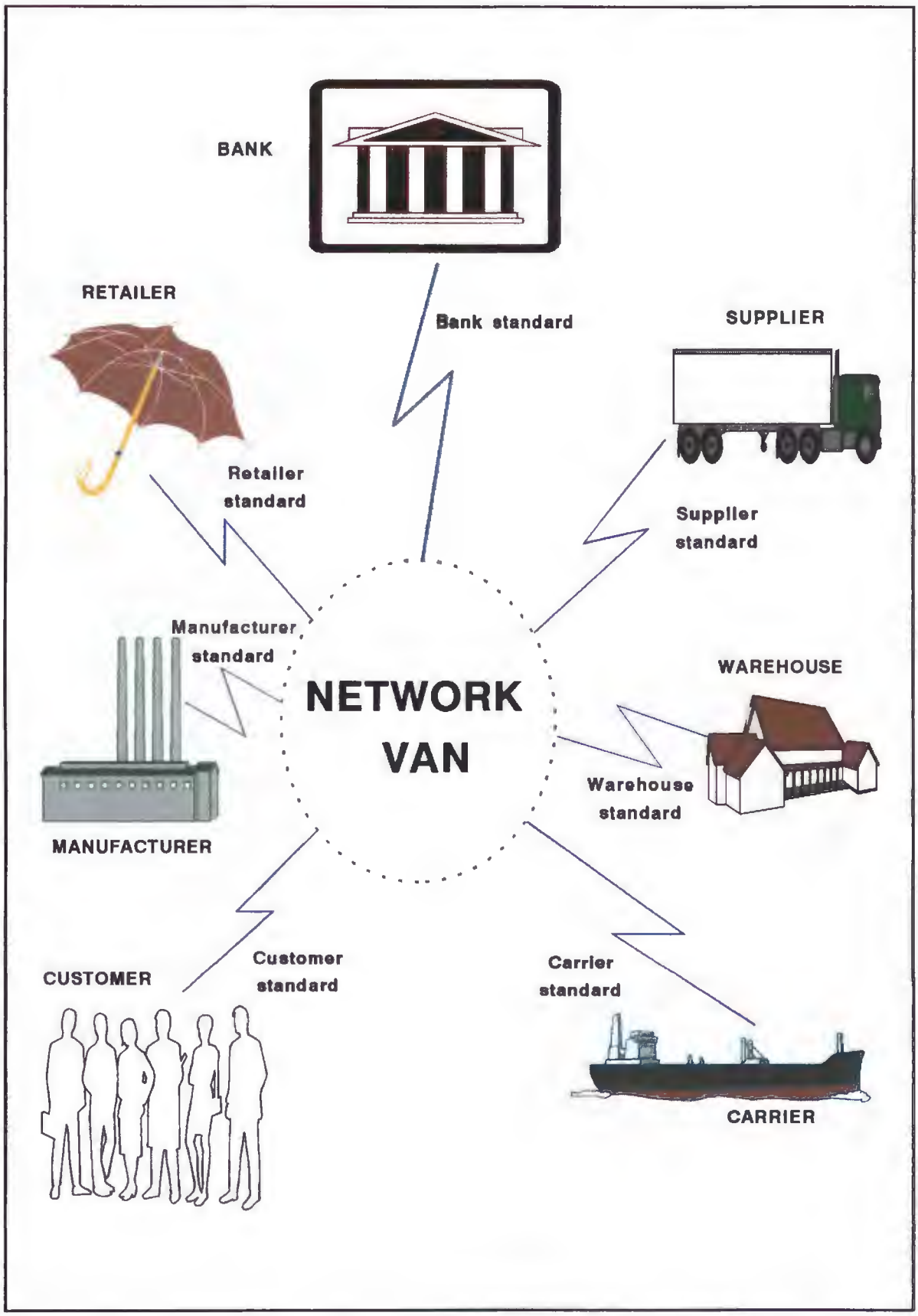

Figure 2.3 Network of EDI participants

the problems that can arise even if an industry should adhere to its own standard as EDI communication occurs across industry boundaries. Imagine the chaos if various institutions in the same industry would have their own standard. Thus even industry standards should be avoided in favour of a single international standard as EDI implementation will occur not only across company boundaries, but across industry and national boundaries.

Without message standards, EDI could not happen. Message standards in EDI **are rules by which business data, traditionally found in paper documents, are translated into a computer readable format for electronic transmission to a trading partner's computer for processing.**

The use of message standards is critical for the interpretation of business data in a variety of internal formats. If one thinks about the number of different computer systems used throughout organisations, and the number of different business management systems and programs in use, standards are the only way of ensuring that trading partners understand one another and that diverse computer systems can exchange information.

EDI message standards define the syntax, sequence and structure of the data sent and received. Subsequently, with the appropriate applications-link software, the computer can integrate the information that is received, into the correct internal business applications or system.

Proprietary Standards

A proprietary standard is developed by a single company with the trading power to dictate its use by its trading partners. This type of standard is too limited in its scope and should be avoided. Proprietary standards were used by the pioneers of EDI to link to their larger suppliers, resulting in major inconsistencies when a supplier wished to link to different manufacturers.

They are generally easy to design as only two corporations are involved, but requires a maintenance overload when multiple proprietary standards are introduced in a single organisation.

Industry-specific Standards

This type of standard is developed through the cooperation of companies in a similar industry, e.g. the motor industry, the retail industry and banking. This broader approach is widely used but the need to communicate across different industries remains. It serves the purpose of consolidating multiple proprietary standards and serves as a catalyst for EDI within an industry. As most companies have trading partners across multiple industries it still leads to multiple sets of standards.

National Standards

South Africa, being a newcomer to EDI, has not set up a national standard, but in 1979, the X12 Accredited Standards Committee was chartered by the American National Standards Institute to develop national EDI standards, by consolidating all industry specific standards. Its primary advantage being a single national standard, but due to its incorporation of numerous industry standards it is time consuming to implement and is perhaps to general.

EDIFACT International Standard

International EDI business transactions are being supported by the development of a standard called EDIFACT (**EDI** For Administration, Commerce and Trade), which is accepted as the standard that all industry-specific groups are moving towards. As EDIFACT stemmed from a United Nations Economic Commission for Europe (UNECE), it should be called UN/EDIFACT or UNEDIFACT, however the abbreviation EDIFACT has been accepted. The EDIFACT syntax was agreed on as an international standard (ISO 9735) in September 1987 and evolved from a fusion of the standards developed by the ANSI X12 committee and the Guidelines for Trade Data Interchange (GTDI) developed by the United Nations Trade Facilitation Committee, WP4, on the initiative of UNECE. The EDIFACT standard and X12 standard are dissimilar, although work towards their integration has begun. Its strength lies in its potential worldwide application, but it is still not complete and will contain requirements that are often not applicable to a specific industry.

The ODETTE Standard

During 1990 the National Association for Automobile Manufacturers of South Africa (NAAMSA) initiated investigations into EDI within the local motor industry. The purpose was to ensure that a recognised standard was used. A number of industry standards that are accepted world-wide were evaluated and the ODETTE (**O**rganisation for **D**ata **E**xchange by **T**ele **T**ransmission in **E**urope) standard was found to be best suited locally.

This standard has been in use throughout Europe within the motor industry since 1985. An additional reason for adopting the ODETTE standard is that it uses the EDIFACT **syntax** rules (mentioned above), which means that future migration to the EDIFACT **message** standard can easily be implemented.

2.3.2.3 Communications Media

There are a number of different media for EDI communication, the most popular (and cheapest) being a point-to-point implementation over the Telkom X.25 network. Either a modem using a *dial-up* link to access the network is required, or a leased link into the network can be installed. The modem link is the cheapest but means that all communication must be initiated by the trading partner with the modem, and in all cases at least one trading partner must have a leased line installed.

In the local motor industry, all the manufacturers have leased lines, so in most cases a *dial-up* link is sufficient. Figure 2.4(a) demonstrates a point-to-point implementation utilising a modem and a dial-up link, whereas Figure 2.4(b) demonstrates the translation process utilised in a point-to-point link.

In this architecture outside users are connected to a central host computer system. This has now commonly become known as the 'single hub' or 'one-to-many system'. The host computer system can receive data from any of the outside users. In many instances the individual outside users cannot receive data directly from one another - as they are usually not connected.

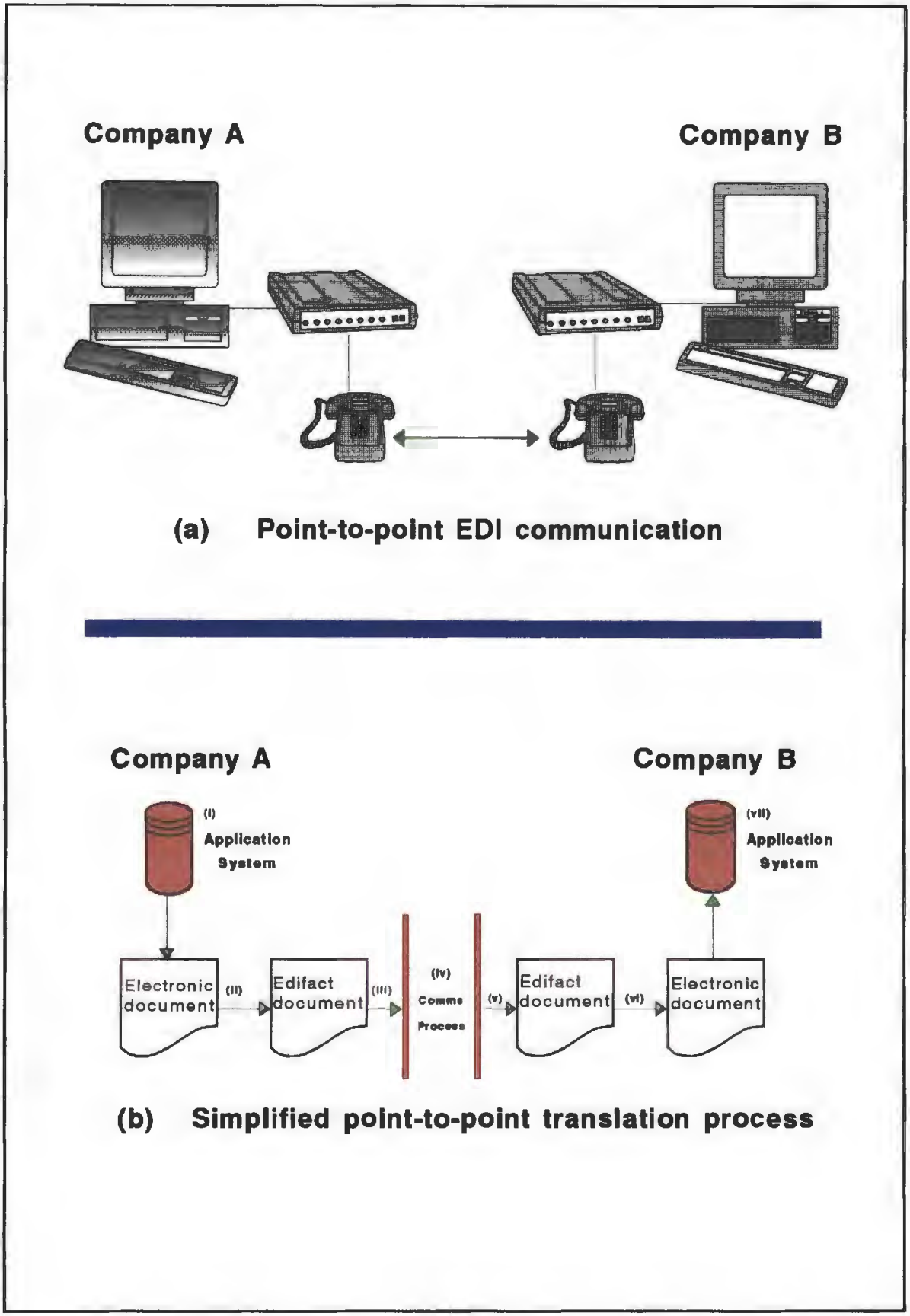

Figure 2.4 Point-to-point communication and translation

In Figure 2.5 an example of a 'point-to-point EDI network' is given. It should be noted that suppliers A, B and C are linked to the JIT manufacturer. The bank and the transport company are also linked to the JIT manufacturer. The suppliers, the bank and the transportation company are not necessarily linked and therefore cannot communicate directly with one another by using this type of network.

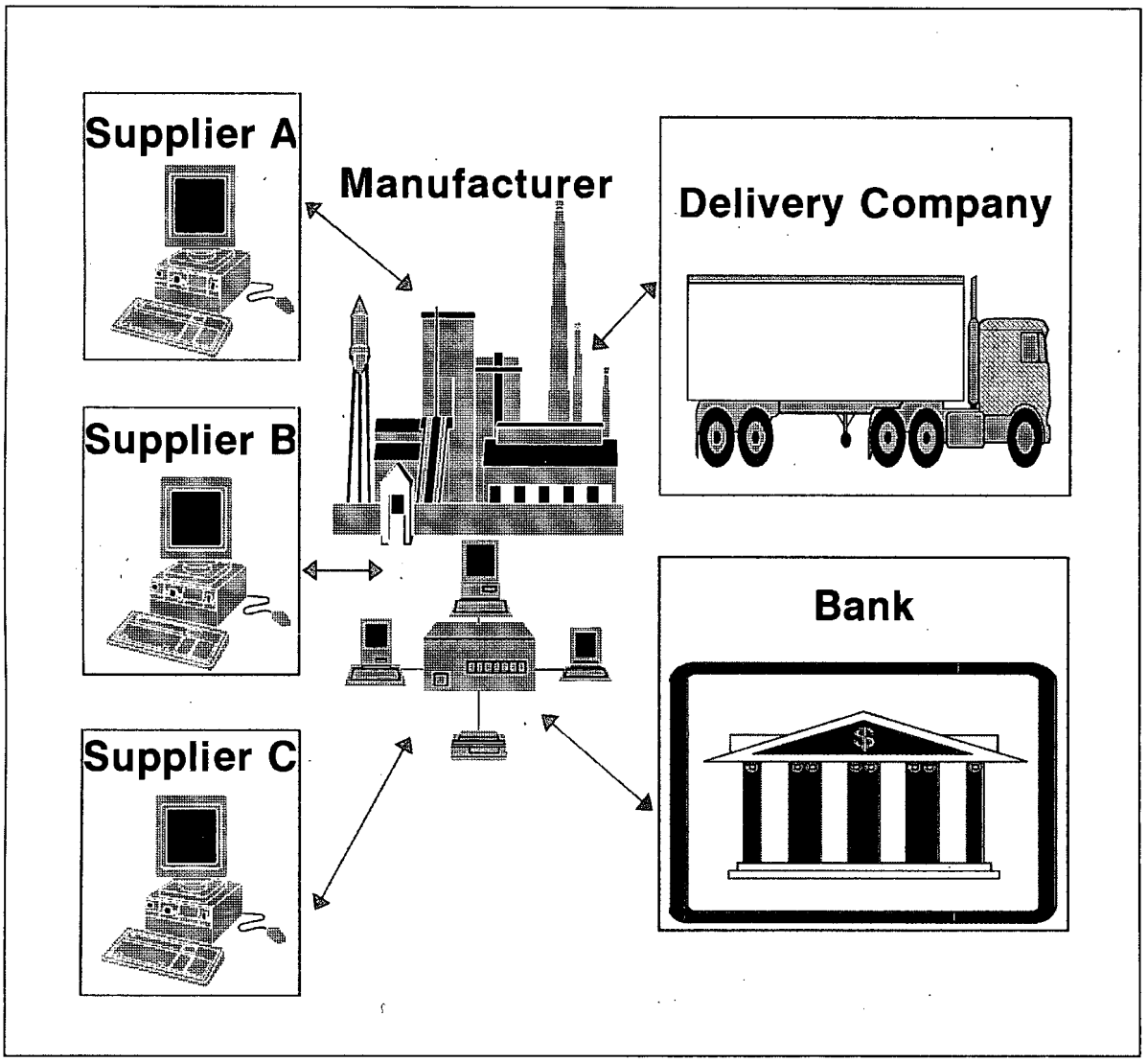

Figure 2.5 Point-to-point EDI Network

Another means of communication is to use *Value Added Networks* that offer a mail-box-type facility, which means an electronic 'mail-box' can be rented, and data is stored and retrieved from there without the need to link to the trading partner. This is a convenient facility, but costs somewhere in the region of ten times as much as the X.25 option. Figure

2.6(a) illustrates a simplified VAN implementation and Figure 2.6(b) the translation process utilised in a VAN implementation.

The VAN has the advantage that the user retrieves data from the mailbox when it is convenient to load the documents into the user's application systems. Thus the electronic mailbox eliminates document exchange timing constraints and simplifies the problem of multiple communication media between trading partners. This is due to the fact that the user communicates with a standard VAN interface rather than with a host of different platforms and interfaces. The administration of the network is handled by the network provider which ensures hardware compatibility with the network itself, data access, security, storage and confidentiality of data. When using a VAN the service bureaux can generate reports for their customers, such as listing accesses made to the data they handle. The listings could also include the data type, the data and time accessed, the access level (i.e. READ or UPDATE) and the identifier of the party accessing the data. The bureau can also provide editing capabilities where errors can be identified before the exchange of data with trading partners. One of the advantages of using EDI third-party networks is that transmissions can be sent and received during off-peak hours as the transmission hours and receiving facilities are normally available twenty four hours per day. As rates are normally less expensive during off-peak hours, the associated transmission costs could be reduced.

2.3.2.4 Communications Software

The objectives of communications software are:

- to ensure that data integrity and security is maintained;
- to send an acknowledgement of receipt (known as an end-to-end response);
- and to facilitate direct communications (over X.25) as well as VAN services.

The communications software must be able to route groups of similar or dissimilar messages to multiple destinations automatically, and will retry any unsuccessful links, or restart any transmission that dropped during execution. Audit trails of all transmissions are produced, and a successfully received end-to-end response will stand in a court of law as proof of delivery.

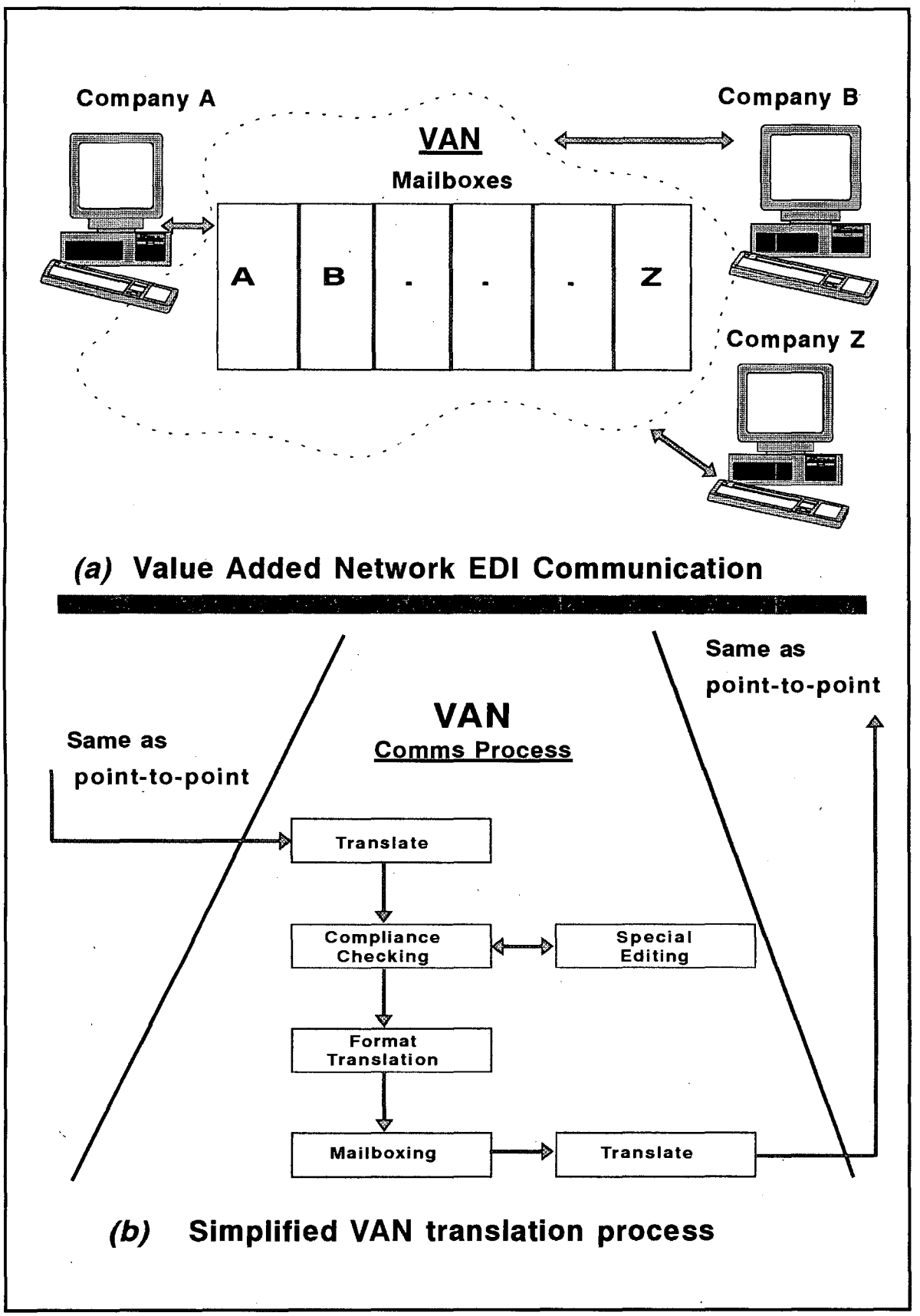

Figure 2.6 VAN EDI communication and translation

2.3.2.5 Translation Software

Translation software is required to construct a standard EDI message from an organisation's data, e.g. a material release, and ensures that the material release message to a supplier is translated upon receipt, to the required format, regardless of the sender. The translator should be able to translate messages written in different syntax standards, namely, EDIFACT, ANSI X12 and UNGTDI. All recognised EDI standards use one of these three syntax standards, so no matter what an organisation receives, it will be able to translate it. For a simplified description of the EDI translation process in a point-to-point implementation refer back to Figure 2.4(b) and for the process in a VAN implementation see Figure 2.6(b). Conversely, the translation software should be able to convert standard file formats into proprietary company file formats as well.

In Figure 2.4(b) an application system will generate an electronic document, e.g. an invoice. This invoice will be translated by the EDI translation software into the recognised EDIFACT document representing an invoice. This EDIFACT document will be communicated to the recipient's hardware by the communications software and hardware links. The recipient will receive the EDIFACT invoice, which will be translated by his EDI translation software into an electronic invoice in a format recognisable by his application systems for processing.

In Figure 2.6(b) the EDI software translation process is the same as for point-to-point. It is the communication process that differs. Instead of being communicated directly to the recipient, the EDIFACT document is communicated to a VAN. The VAN translates the received document in order to do the necessary compliance checking and recipient identification. More recent VAN implementations are no longer doing any translation and acting purely as a mailbox facility. The EDIFACT document is stored in a mailbox where it is retrieved by the recipient when convenient. Thus ensuring that documents may be transmitted irrespective of the availability of the recipient's computer.

Conceptually the design concept of a translator is relatively simple. Just convert from one file format to another. However, the complexity of implementing this design should not be underestimated. In addition to converting file formats, the system must direct transmission

flow, ensure transmission accuracy and completeness, know what standards a trading partner is using, and handle problems.

For example, a company could transmit different transaction sets (i.e., invoice, purchase order, delivery instructions and statements) to multiple trading partners, using different value-added networks.

In addition, each transaction set could use a different standard (such as X12) or a different version of the same standard. Ensuring that each trading partner automatically receives the correct version of the correct standard over the appropriate network is not easy. Also, if there are transmission or translation problems, the system must identify the problems and take appropriate corrective action. Translation software is complex. It requires substantial setup time, the interaction of many different components, and the processing of data through a series of intermediatory steps, while maintaining control at all times. Should a company purchase or develop a translator? When making such a decision, it is important to consider the scope and complexities of translator systems and evaluate whether the technical skills to successfully complete the job are available. The primary issue here is the age-old question, "Is it better to develop the system in-house or purchase a package from a third-party software vendor?"

In answering this question, many things must be considered: price, performance, reliability and durability. Nevertheless, based on experience, the prudent choice is to purchase a translator package. The reasoning is simple. First, it is a commodity price application. Most packages are fairly standard in their implementation and are priced competitively. In addition, there will always be new versions and new releases of standards that must be updated. Updating these standards is a time-consuming and costly maintenance project. However, by maintaining a relatively inexpensive maintenance contract provided with a purchased package, the software vendor becomes responsible for updating the standards.

2.3.2.6 Application Link Software

This is the area where in-house programs must be written to integrate applications software with the EDI software. For example, when sending invoices, a file must be written that

contains all data specific to the invoice, with specific information identifying elements such as network addresses and user identifications, as well as segment identifiers which enable the translation software to construct the standard EDI message. The segment identifiers break the data into segments indicating document data (e.g. data pertaining to the invoice) and header and trailer information that identifies the recipient, sender and audit requirements.

The same holds true for the reverse: in order to automatically input a received file, a program must take the data and move it into the correct files/fields within the application system. This software is unique to each environment if the business applications have been written in-house, or will be unique to a specific manufacturing package or financial package that an organisation uses.

2.3.2.7 Business Applications

This refers to the business systems running in an organisation, such as Material Requirements Planning (MRP), purchasing, debtors and creditors systems, and it is with these systems that the application link software must interface. Once properly integrated, tasks such as re-keying data should no longer be required, and many checks that would normally have been done by people can be done by the computer, thus making the processing of documents far more accurate and efficient.

2.3.2.8 Level of Maturity of the Organisation

The level of maturity of the organisation has an impact on the way in which it will embark on the EDI route. The larger corporations are more advanced electronically and will perceive it to be just another technology issue, the less computer literate the organisation the greater the learning curve, however.

Many small suppliers to the large manufacturers in South Africa face a major dilemma. These suppliers supply a few parts to a manufacturer and a minimum document flow occurs between the organisations. Such a supplier often uses manual systems only and may not even have a personal computer. The manufacturer is now placing pressure on all its

suppliers to trade electronically as it does not wish to maintain manual systems for a few suppliers. For this supplier it is very difficult to cost justify EDI, never mind actually implementing it, however he may not have a choice. These suppliers will rely heavily on the support of the manufacturer during this process.

2.3.2.9 Computer Hardware

EDI communications and translation software must run on some form of computer hardware. In most environments, even those utilising large mainframe computers, the PC is chosen as this platform. The reason for this is that not only is it the cheapest solution, but only in cases where the volume of data being transmitted is very large and transmissions are of an almost continuous nature, will it be necessary to run on a larger machine. For example, installations in the local motor industry make use of PC's.

In mainframe environments (such as the manufacturers) data is up- or downloaded from and to the PC for the communication and translation process. As more and more trading partners are converted onto an EDI communication mechanism, these organisations are doing the translation at mainframe level, but still leaving the communication at PC level.

In addition to a PC, if a *dial-up* link is to be used, a modem must acquired, either a simple modem card for the PC or a larger, more sophisticated (and expensive) external modem.

For linking to an X.25 leased line, no modem is required, but an X.25 communication card must be installed on the PC. The recommended product is the EICON card, but it is expensive. For initial EDI trading, because most large corporations have mainframes with an X.25 leased line and therefore a permanent address, a *dial-up* link is sufficient.

2.3.3 EDI vs E-Mail

It is of the utmost importance that EDI users and potential users clearly understand the difference between EDI and E-Mail. The essential differences between these two technologies are itemised here:

- **Interchange agreement**. EDI trading commonly involves an agreement between trading partners concerning the types of information to be transmitted, and provides legal status to the electronic documents. Even where no formal agreement exists, the EDI partners have a much higher level of expectation of what will appear in the electronic mailbox and when, than do the electronic mail users.

- **Structured data**. As previously stated, EDI is concerned with specific presentations of trade data, according to specific standards. Although data may be structured for electronic mail, for example in telex systems, this is not a cornerstone of the E-Mail technology as it is in EDI.

- **Personal/company mailbox**. EDI systems are likely to have company or functional electronic mailboxes (e.g. invoicing, order processing) as opposed to the personal mailboxes prevalent in electronic mail systems. This distinction is associated with the necessity for user intervention when processing electronic mail, whereas the basis of EDI is that the mail may be processed automatically by computer systems, i.e. the rules for processing documents such as invoices and purchase orders, are fixed and programmable.

Thus an EDI communications environment is not a special case or subset of an E-Mail implementation.

2.3.4 Benefits of EDI

The benefits that EDI brings to an organisation are both tangible and intangible, as well as of a short and long term nature. The most obvious benefits are reaped by a reduction in the typical inadequacies of the "paper-intensive" environment: administrative overheads, poor forecasting based on outdated data, outdated inventory access and late or incorrect supplier shipments.

Eliminating this results in vastly reduced processing time, improved service quality, accurate forecasting and inventory control, enhanced employee productivity, and effective asset management.

A trend is being set in Europe and the US where EDI is fast becoming a prerequisite for doing business. Thus EDI becomes strategically necessary. An example is the international banking network, where it is a prerequisite for electronic fund trading. EDI improves trading relationships and it is changing the manner in which companies do business.

Tyndall (1988:10) cites that many leading companies are starting to discover that "supply-chain management" is one approach that is made feasible by EDI, as well as "Just-in-Time" (JIT) strategies, which hold promise.

Prof Hill (at the EDI 92 conference) stated that some important aspects improved by EDI are document handling, effective buying at lower prices, reduced buyer and seller inventories and reduced selling prices. He further comments that EDI is a strategic issue as it deals with long-range competitive issues, crosses organisational barriers and enables "total quality management" (customer priority, key information, error reduction and reduced cycle times). It facilitates quicker response (faster reorder, accurate inventory information, lower inventory, demand driven, low stock-out levels) and allows introduction of Just-in-Time manufacturing principles.

Globalisation has become more paramount resulting in borders dissolving and international trading partners becoming more commonplace, with communication being the key. Thus EDI facilitates free trade.

Another strategic issue is concern over increased labour and paper costs versus decreases in telecommunication and computer costs.

EDI allows a buyer and a supplier to work together in a real-time environment, resulting in the potential to reduce costly incoming material delays by shortening procurement lead time. Communication becomes more timely and efficient. This, in turn, allows both the buyer and supplier to become more market reactive, thereby strengthening their competitive position.

EDI essentially creates a paperless purchasing environment, minimizes administrative and clerical needs, reduces inventory levels, and improves data accuracy.

Although there are many benefits, EDI has only recently started to grow in popularity. This is largely due to:

- the emergence of a broadly accepted standard (EDIFACT);
- the development of relatively inexpensive computer hardware;
- the growing proliferation of EDI software; and
- an increasingly competitive environment.

EDI will impact the corporation's survival. The typical benefits to be derived from the utilisation of EDI include:

- reduction of communication delays by replacing document flow electronically and thus also reduced processing costs;
- reduced delays between ordering and shipping, thus improving customer relations and strengthening competitiveness;
- reduction in clerical staff handling document flow, which enhances productivity;
- reduction in warehouse space due to more precise movement information facilitates just-in-time inventory management, thus reducing inventory costs;
- reduced outstanding receivables;
- reduced errors (no need to retype data);
- reduced storage space for used documents.

Thus EDI facilitates up to date and correct data, and eliminates the delays incurred when documents need to be recaptured for processing, misplacement of documents and the problems incurred with incorrect data capture.

Thus EDI facilitates reengineering of business processes, enables easier evaluation of suppliers and it provides significant cost savings. Its main benefit is enhanced productivity resulting in improved competitiveness.

Figure 2.7 illustrates the time delays experienced when not using EDI versus the savings when using EDI. It is clear that there can be large delays due to postal delays, re-input delays and input processing.

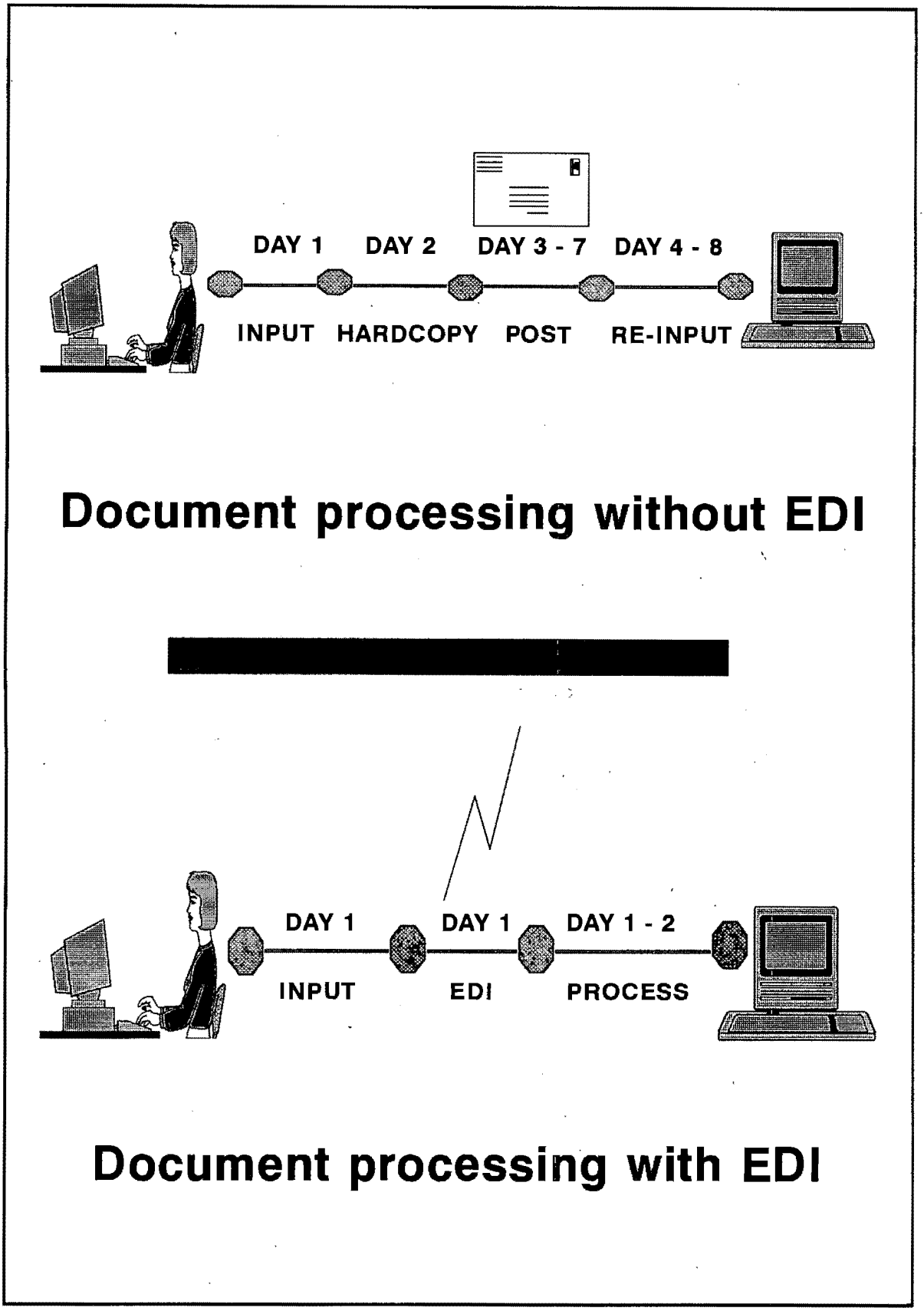

Figure 2.7 Document processing without and with EDI

The benefits of EDI may be conveniently summarised into strategic, operational, and opportunity benefits, (Preston 1988):

Strategic benefits: Of crucial, long-term significance to the functioning of the organisation. These benefits will affect the very business the company is undertaking, i.e. its central operating function. Examples are:

- Faster Trading Cycle;
- Just-in-time Manufacturing;
- Terms of Trade Dictated by Bargaining Power;
- Need to Respond to Highly Competitive Market Entrants.

Operational benefits: Of crucial significance to the daily operations of the company, usually only impacting on certain departments within the organisation. Examples are:

- Reduced costs:
  - Paper and postage bills cut
  - Reduced stock holding costs
  - Manual processing costs;
- Improved cash flow;
- Security and error reduction;
- Acknowledged receipt.

Opportunity benefits: Not necessarily crucial to the current operations of the company, but seen as offering potential future benefits. The list of opportunity benefits will include such factors as enhanced image and competitive edge which, although perceived as beneficial, are difficult to quantify. Benefits which may be classified as operational for one company are of such major importance to another company that they must be termed strategic. In this respect the categories are not clear cut.

2.4 BUSINESS PROCESS REENGINEERING

One of the catch-phrases for the Nineties is business process reengineering (BPR). It

involves the reassessment of people and their roles in the organisation, the procedures and tasks that they perform, the organisational structure and appropriate supporting technology. (Although a detailed discussion on BPR is beyond the scope of the research a brief overview will be presented here.) The concept is not new, but suitable technology to enable BPR has only recently become available. EDI is one of these technologies and it often acts as the catalyst to bring about a BPR exercise. Other technologies are imaging and E-mail.

BPR may be defined as the radical design of business processes to achieve significant improvements by taking advantage of information technology. It is essentially a cooperative process between Information Systems professionals with the required IT knowledge and business management. Another definition of reengineering is as follows (Petrozzo, 1994):

> ***Reengineering is the concurrent redesign of processes, organisations, and their support information systems to achieve radical improvement in time, cost, quality, and customer's regard for the company's products and services.***

BPR should not be confused with Software Reengineering, which involves concepts such as reverse engineering, forward engineering and restructuring of existing software. Software Reengineering may be utilised within the overall BPR process to further the aims of the BPR. Software Reengineering may be defined as the examination and alteration of a subject system to reconstitute it in a new form and the subsequent implementation in a new form (Blum 1992).

The possibilities offered by EDI have made organisations think about accepted processes for trading with suppliers and customers and has also made them question why such processes take place, what the alternatives are and how both internal and external trading processes can be improved. The success of BPR in the manufacturing environment can be applied to the office as follows, (Arnold 1993; Petrozo 1994) by:

- the removal of non-value-adding tasks;
- organising business processes around outcomes rather than tasks;
- the reduction of work-in-progress inventories and automation of processes;

- improving responsiveness and enabling better access to information;
- integrating information processing into the work that produces the information;
- creating a virtual enterprise by treating geographical distributed resources as though they were centralised;
- linking parallel activities instead of integrating their results;
- replacing sequential processes with parallel processes;
- providing a working environment which encourages change and new ideas;
- assigning those who use the output of a process, to perform the process;
- creating self-managing teams and staff responsibility.

A number of important trends occurring in today's business environment regarding reengineering have been identified (Manganelli 1994):

- Reengineering is the number one initiative taken by senior executives to achieve their strategic goals;
- Competition, profitability, and market share are the issues cited most frequently by senior executives for turning to business process reengineering.

Manganelli also establishes a number of reasons for the failure of BPR. These are:

- Unclear Definitions;
- Unrealistic Expectations;
- Inadequate Resources;
- Taking Too Long;
- Lack of Sponsorship;
- Wrong Scope;
- Technocentricism;
- Mysticism;
- Lack of Effective Methodology.

2.4.1 IT in Business Process Reengineering

The importance of both information technology and business process reengineering is well

known to industrial engineers (IE), albeit as largely separate approaches in specific limited environments. IT is used in industrial engineering as an analysis and modelling tool, and IEs have often taken the lead in applying information technology to manufacturing environments. Well-known uses of IT in manufacturing include process modelling, production scheduling and control, materials management information systems, and logistics. In most cases where IT has been used to redesign work, the redesign has most likely been in the manufacturing function, and industrial engineers are the most likely individuals to have carried it out.

Research suggests that IT can be more than a useful tool in business process redesign (Arnold 1993). In leading edge practice, information technology and BPR have a recursive relationship, as Arnold illustrates in Figure 2.8. Each is the key to thinking about the other. Thinking about information technology should be in terms of how it supports new or redesigned business processes, rather than business functions or other organisational entities. And business processes and process improvements should be considered in terms of the capabilities information technology can provide. *We refer to this broadened, recursive view of IT and BPR as the new industrial engineering* (Arnold 1993).

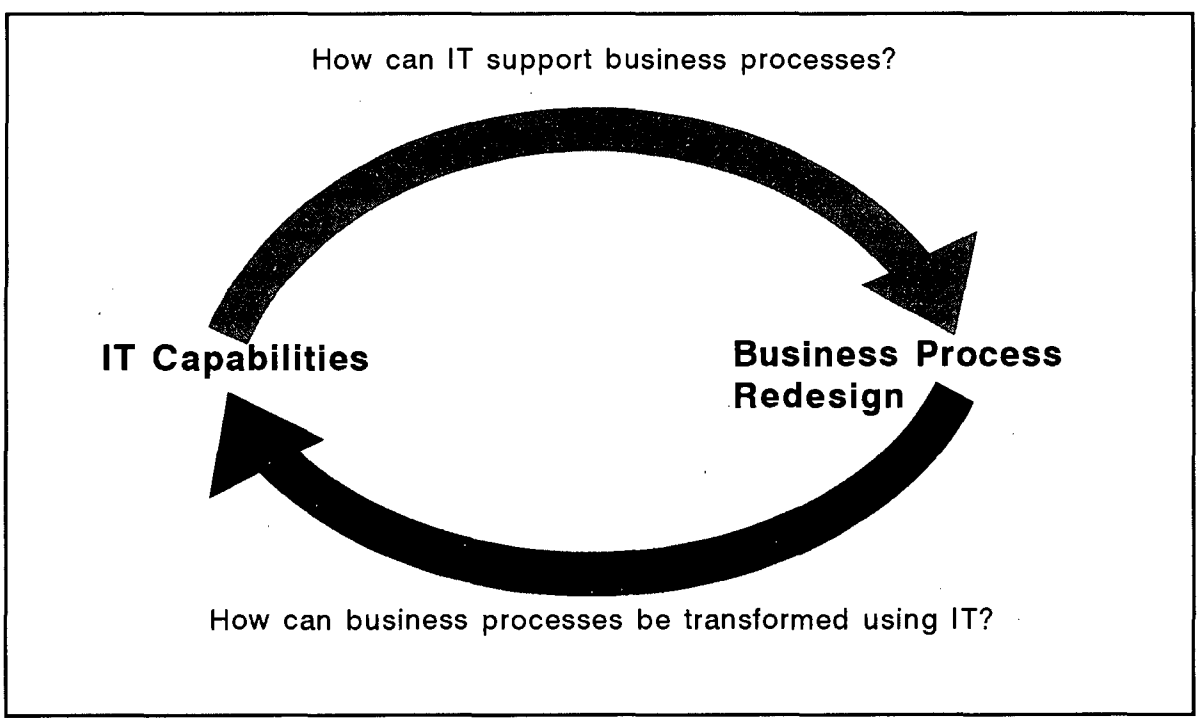

Figure 2.8 Recursive relationship between IT and BPR (Arnold 1993)

2.4.2 What Are Business Processes?

Arnold (1993) defines business processes as a set of logically related tasks performed to achieve a defined business outcome. A set of processes forms a business system i.e. the way in which a business unit, or a collection of units, carries out its business. These processes have two important characteristics:

- They have customers; that is, processes have defined business outcomes, and there are recipients of the outcomes. Customers may be either internal or external to the firm.
- They cross organisational boundaries; that is, they normally occur across or between organisational subunits. Processes are generally independent of formal organisational structure.

Common examples of processes meeting these criteria include:

- developing a new product;
- ordering goods from a supplier;
- creating a marketing plan;
- processing and paying an insurance claim; and
- writing a proposal for a government contract.

These are the processes that one would consider for reengineering purposes.

2.4.3 Redesigning Business Processes with IT: Five Steps

Assuming that a company has decided that its processes are inefficient or ineffective, and therefore in need of redesign, how should it proceed? This is a straightforward activity, but five major steps are involved: develop the business vision and process objectives, identify the processes to be redesigned, understand and measure the existing process, identify IT levers, and design and build a prototype of the new process (see Figure 2.9 for a summary of these steps).

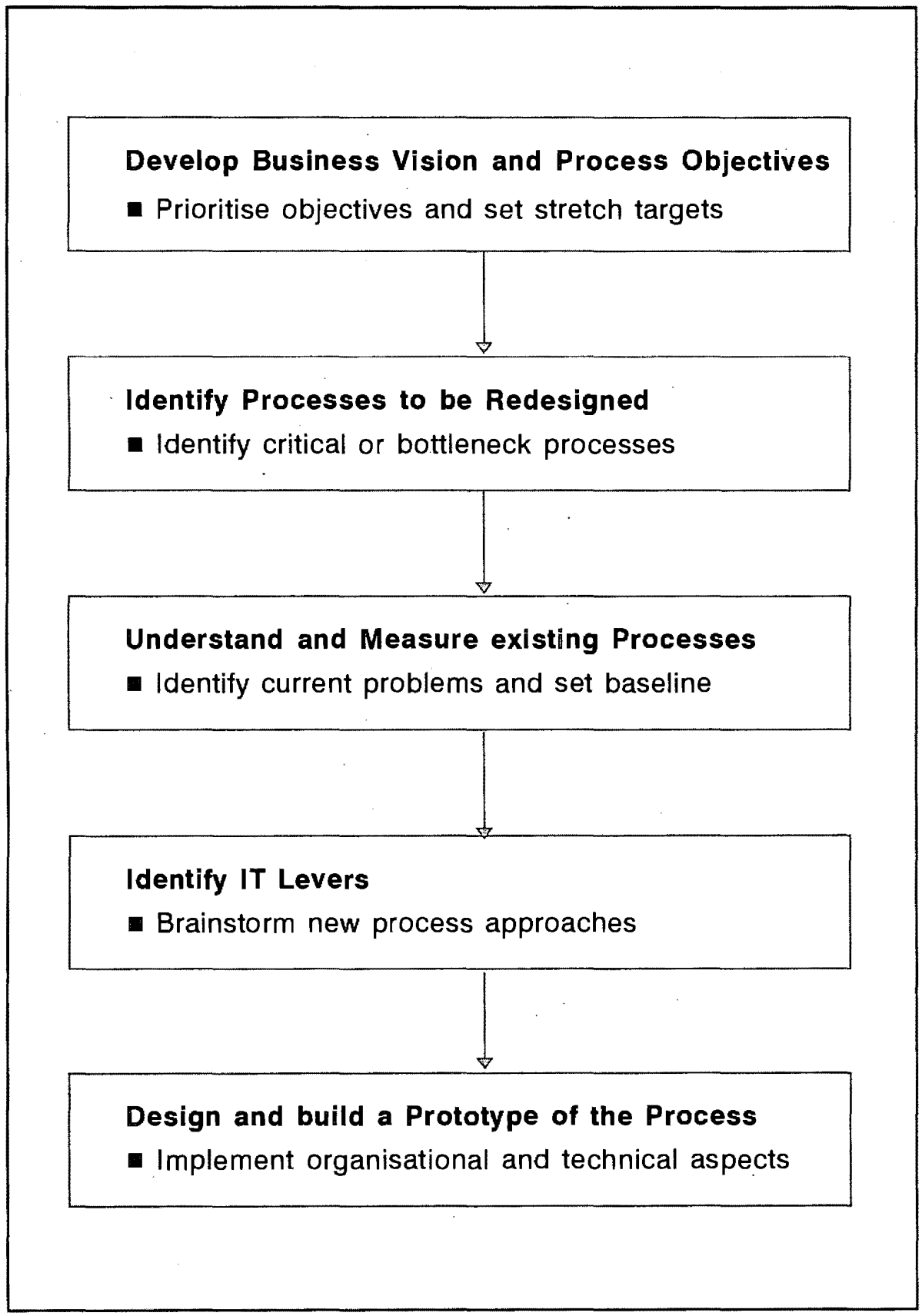

Figure 2.9 Five steps in process redesign (Arnold 1993)

A number of methodologies for implementing a business process reengineering project exists and it is not the intent of this research to elaborate on all of these, thus only the one proposed by Arnold will be examined.

Develop Business Vision and Process Objectives

An example of the rationalisation approach appears in a 1961 "Reference Note on Work Simplification " from the Harvard Business School:

> A good manager asks himself why things are done as they are, extending his inquiry to every aspect of the job and the surroundings in which it is performed, from the flow of paper work to the daily functioning of his subordinates... He is expected to supply the stimulus and show that job improvement or simplification of work is not only important but also is based on commonsense questioning aimed at uncovering the easiest, most economical way of performing a job.

The most likely objectives for process redesign are the following (Arnold 1993):

- **Cost Reduction**. Cost is an important redesign objective in combination with others, but insufficient in itself.
- **Time Reduction.** Time reduction has been only a secondary objective of traditional industrial engineering. Increasing numbers of companies, however, are beginning to compete on the basis of time.
- **Output Quality.** All processes have outputs, be they physical - such as in manufacturing a tangible product - or informational - such as in adding data to a customer file. The specific measure of output quality may be uniformity, variability, or freedom from defects; this should be defined by the customer of the process.
- **Quality of Worklife (QWL)/Learning/Empowerment.** IT can lead either to greater empowerment of individuals, or to greater control over their output.

Identify Processes to Be Redesigned

Most organisations could benefit from IT-enabled redesign of critical (if not all) business

processes. The means by which processes to be redesigned are identified and prioritised is a key issue. This is often difficult because most managers do not think about their business operations in terms of processes. There are two major approaches (Arnold 1993). The *exhaustive* approach attempts to identify all processes within an organisation and then prioritise them in order of redesign urgency. The *high-impact* approach attempts to identify only the most important processes or those most in conflict with the business vision and process objectives.

The kinds of process classifications in an organisation are shown in Figure 2.10 (Manganelli 1994). Strategic processes are those that are of essential importance to a company's business objectives, goals, positioning, and stated strategy; strategic processes are integral to how a company defines itself.

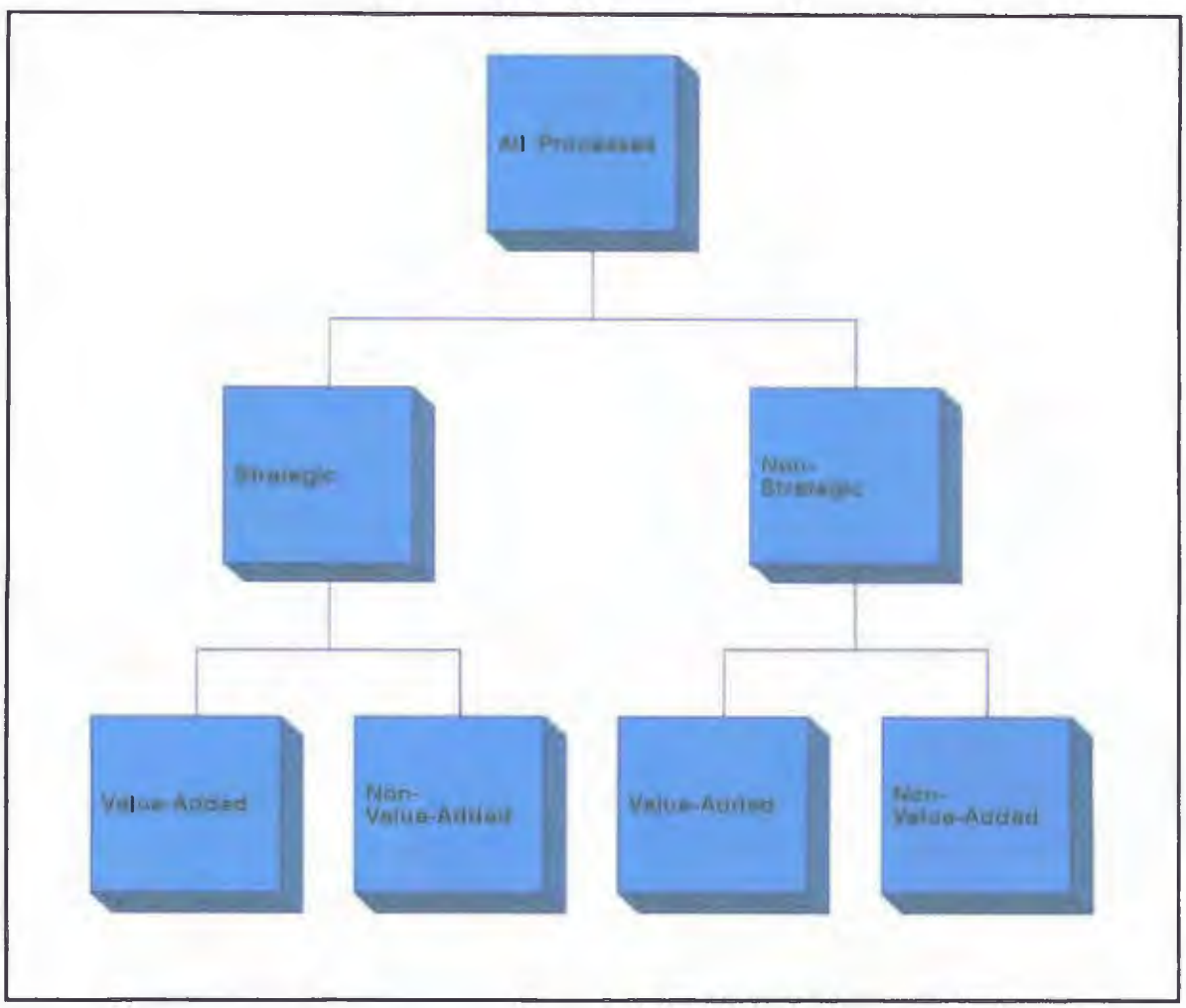

Figure 2.10 Importance of processes in the organisation

Value added processes are processes that are essential to a customer's wants and needs and that a customer is willing to pay for; they deliver or produce something that he or she cares about as part of the product or service offered. Figure 2.11 shows where we look to identify processes to reengineer. The primary targets of business process reengineering (BPR) are processes that are both strategic and value-added. (Manganelli 1994).

Understand and Measure Existing Processes

There are two primary reasons for understanding and measuring processes before redesigning them. First, problems must be understood so that they are not repeated. Second, accurate measurement can serve as a baseline for future improvements. If the objective is to cut time and cost, the time and cost consumed by the untouched process must be measured accurately.

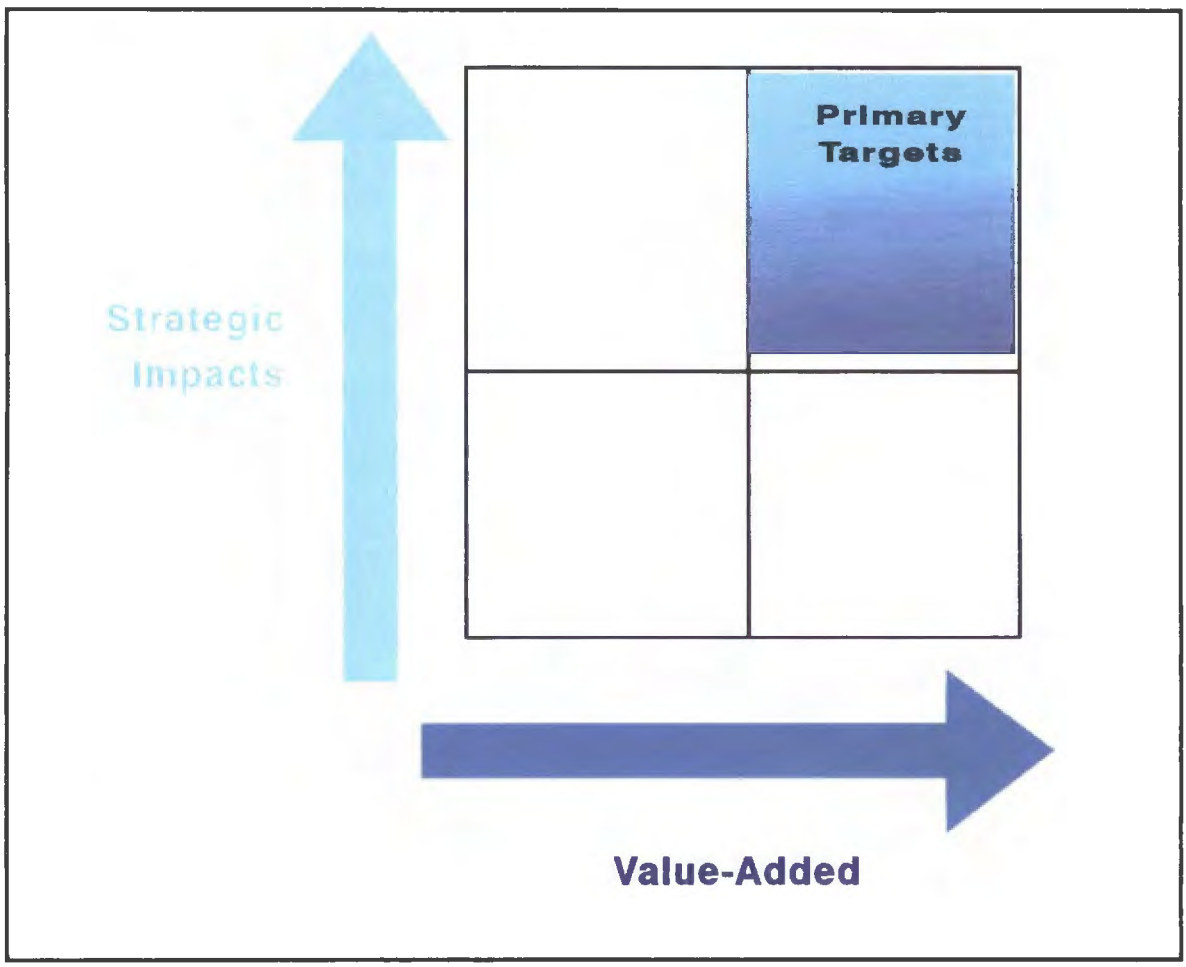

Figure 2.11 Process Selection

Identify IT Levers

Until recently, even the most sophisticated industrial engineering approaches did not consider IT capabilities until after a process had been designed. The conventional wisdom in IT usage has always been to first determine the business requirements of a function, process, or other business entity, and then to develop a system. The problem is that an awareness of IT capabilities can-and-should-influence process design.

Design and Build a Prototype of the Process

For most firms, the final step is to design the process. This is usually done by the same team that performed the previous steps, getting input from constituencies and using brainstorming workshops. A key point is that the actual design is not the end of the process. Rather, it should be viewed as a prototype, with successive iterations expected and managed.

Key factors and tactics to consider in process design and prototype creation include using IT as a design tool, understanding generic design criteria, and creating organisational prototypes.

2.4.4 Management Issues in IT-Enable Redesign

Companies have found that once a process has been redesigned, several key issues remain. These include the management role in redesigned activity, implications for organisation structure, new skills requirements, creating a function to perform IT-enabled BPR, the proper direction for the IT infrastructure, and the need for continuous process improvement. Many companies that have used IT to redesign particular business processes have done so without any conscious approach or philosophy.

The individuals and companies that can master redesigning processes around IT will be well equipped to succeed in the new decade - and the new century. EDI is without doubt the major IT catalyst to facilitate this reengineering process.

2.5 CURRENT RESEARCH IN EDI

This section addresses the areas of EDI being researched. Legal and audit issues are receiving the greatest attention due to the fact that unless the legal and audit professions find EDI acceptable, this technology will not be generally adopted. Research into EDI and its use is increasing all over the world, with much of the focus on the state of the art of EDI, communication issues and benefits that may be reaped from EDI implementation.

There are seven major aspects of EDI implementation being researched currently:

- Legal issues;
- Security and audit issues;
- Implementation strategies;
- Application system integration issues;
- Standards;
- Communication issues;
- EDI utilisation.

2.5.1 Legal Issues

In a letter to SITPROSA (21/03/91) the Secretary for the United Nations Commission on Internal Trade Law, Prof Eric Bergsten had the following to say about EDI and the Law:

> *"It seems that until quite recently, there was a general feeling in the international EDI community that EDI was not a legal subject but merely a new means of communicating that would provide an opportunity to rethink existing legal rules and legal analysis and see to what extent they should be changed - or affirmed - in the light of the new ways of communicating. It is now envisaged that the future developments of EDI may involve more than simple adjustments to the existing legal system. In fact the whole of contract law is likely to be affected because the whole structure of the commercial transaction may well be altered."*

Although initial reports clearly indicated that some areas in South African Law, like the

Law of Evidence, needed a fundamental rethink, it has come to light that other areas, particularly, the Law of Contract, would not remain untouched. It now seems that the hypothesis that a well structured Interchange Agreement would be sufficient to deal with contractual problems may not quite hold in the light of the changes EDI is likely to bring about. There is therefore an urgent need for research in this area.

The change-over to EDI creates uncertainty for businessmen who are familiar with paper transactions. Questions that arise include: Can existing legal requirements like writing and signatures be satisfied in the new medium?; Is data transmitted in this way legally acceptable?; Can it be used in court and how should it be proved?; Who bears the responsibility if something goes wrong?; and, How reliable and secure is the system?

From an informational point of view EDI presents no real problems. Given the fact that different computer systems can efficiently communicate by way of a suitable network, all data that is sent is easily accessible and interpretable. However, the closely related evidentiary function is one of the main areas of concern in EDI implementation. Traditional rules of evidence and procedure have been unable to adequately contend with the problems created by computer evidence. Finally, whether the symbolic function of the paper document can be preserved depends on the conceptual approach towards EDI that is used.

To come to a proper agreement, it is necessary that all parties involved know what the risks are of communicating by EDI. Most problem areas could be sorted out contractually. Much legal uncertainty can also be avoided. Thus all parties participating in EDI should enter into an umbrella or interchange agreement which then regulates their EDI relationship. This agreement should regulate:

- the standards for messages;
- the consequences of not complying with these standards;
- the responsibility for faulty messages;
- evidential and jurisdictional matters; and
- in international contracts, a conflicts-of-law provision and arbitration in cases of conflict.

The use of EDI raises some specific legal issues. The major issues relate to the legal effect of EDI messages, the validity and enforceability of such messages, the proof, the contract formation, the security and authentication services and procedures, the preservation of EDI messages, the involvement of third party service providers. Other issues arise as a result of the application of specific legal requirements in a country or a region. An example is the case of personal data protection legislation in most of the European Union Member States. Although at some stage, modifications of both commercial and administrative laws will be needed to fully accommodate electronic commercial practices, most of the issues mentioned above can be adequately addressed in a contractual framework, the enforceability of which will be recognised under most legal systems. The adoption of an Interchange Agreement provides that contractual framework, which will, in turn, reduce the legal uncertainty associated with the use of EDI and enhance the confidence with which the technology's use is expanded.

Potchefstroom University for CHE is doing research into the legal aspects of EDI and Professor Eiselen has spoken at a number of EDI conferences on his views and findings (Eiselen 1988).

2.5.2 Security and Audit Issues

A major predicament being faced by EDI users is the fact that paper plays a major role in the legal and security environments. We cannot yet perceive auditors, lawyers, security organisations and bureaucrats functioning without paper. Systems of business conducted in the EDI era have specified characteristics, which require different audit knowledge and skills levels. One important characteristic is the fact that EDI is solely computer-based, which means that the auditor has to have the required knowledge and skills levels to audit in a computer environment.

Consider the auditor, who relies on authentic, original documents as a starting point for reviewing the accurate and reliable handling of financial information within a company.

Security and audit issues are not normally popular with pioneers. The reasons are not hard to see. The pioneer wants to get on and do new things, and introducing controls tends to

slow things down. The ideal control situation would be where nothing moved. However, because EDI systems deal with transactions between different, external arms-length parties, and because by their very nature these transactions involve money elements, there have to be controls over these elements in the new technology.

The auditor is looking for controls to ensure that his objectives are met -

- all relevant data must be input;
- no additional data must be input;
- no data must be duplicated;
- all data must be valid;
- internal processing must be correct;
- all the data must come out;
- it should match what went in;
- it should go to the right people;
- it should be on time;
- the system must be able to recover from failures;
- confidential data must remain confidential.

For an EDI environment to be operating successfully, certain security requirements exist:

- Message Origin Authentication

  Message origin authentication indicates uniquely who initiated the message. Establishing the identity of the initiator must be indisputable, so that this identity can be used in a court case.

- Message Integrity

  The integrity of a message is threatened when the contents of the message are changed in any way during transmission. The changes could be deliberate or accidental. There are methods available to ensure that any changes to the message will be discovered.

- Message Privacy

  The privacy of a message depends on the methods used to ensure that the contents of the message stay private and confidential.

- Message Replay

  If a message is sent via a cable, then an unauthorised user could tap the line and isolate the message. The unauthorised user could repeat the message at any time.

- System Availability

  System availability is one of the user's greatest requirements, seeing that if the user has no access to the system, he will be stranded. The user requires the service to be available 24 hours a day, every day.

- Message Receival Acknowledgement

  When a user sends an EDI message, the user expects acknowledgement from the receiver, in order to place himself in a position to re-order from another source if necessary.

Currently most VANs only cater for the two basic requirements, namely System Availability and Message Receival Acknowledgement. The key issue is to start recognising and doing something about the EDI risks earlier, not later. Professor S.H. von Solms at Rand Afrikaans University has researched the audit and security issues w.r.t. EDI implementation and has presented his views and findings at a number of EDI conferences.

2.5.3 Implementation strategies

Very few strategies exist for implementing EDI and it is this issue which prompted this dissertation. Most organisations are convinced they have to implement sooner or later and start off with a pilot project to implement EDI to transmit one or two documents to one or

two suppliers. Few get much further. An EDI implementation methodology is presented in Chapter 4 and the results of a case study using the methodology in Chapter 5.

2.5.4 Application system integration issues

In the current scenario a document is received by one trading partner from another and is "integrated" into the existing automated business systems by human intervention. Thus the initial validation and authorisation process is done by humans. In the ideal EDI environment it is this process that must be automated. Of all the organisations that have embarked on the EDI route, few have overcome this hurdle of successfully integrating the EDI software with existing business systems. This is robbing industry of reaping the benefits promised by EDI implementation. The problem seems to lie in the removal of human judgement, implying the possible need for expert systems. What is required is an implementation methodology with the necessary guidelines for integration without human intervention to assist organisations in successfully implementing their EDI strategies.

EDI integration into existing application systems implies maintenance to this systems. There are three main types of maintenance: corrective (20% of resources), adaptive (25%) and perfective (55%) (Blum 1992). Perfective maintenance consists of user enhancements, documentation changes and efficiency improvements. It has also been accepted in the IT industry that maintenance costs far exceed development costs during the life span of an application. EDI integration relates to perfective maintenance, as it aims at perfecting the procedures within an organisation.

2.5.5 Standards

The organisation for Simplification of International Trade Procedures in South Africa (SITPROSA) was formed with the mission of simplifying the procedures and documentation needs in South Africa's trade with specific reference to the foreign trade scenario.

As such they are the national trade facilitation body in South Africa, whose main purpose is to make foreign trading easier and not to promote foreign trade as such. Through their efforts nationally and internationally there is always some degree of promotion in so far as

the international community prefers to trade electronically rather than with paper-based systems.

SITPROSA is the national standards body for EDIFACT in South Africa. SITPROSA is also involved in several mini pilot projects, independently launched by prospective private and public sectors using EDI. SITPROSA also has an application level software package available, called EDI Messaging Software (MSGSOFT).

They are responsible for the spreading of the EDIFACT gospel and for the training of users in EDIFACT. This is achieved with the cooperation of the South African Bureau of Standards (SABS), who has also been involved with SAVA. In 1995 the SABS has taken over the responsibilities handled by SITPROSA.

2.5.6 Communication Issues

The South African VANS Association (SAVA) (originally the S.A. Videotext Association) was formed with the goal of promoting awareness of VANS and their benefits. They are also represented on the board of the National Datacomms Consultative Committee (NDCCC), who are recognised by Telkom as the federal body representing all sectors of computer and telecommunications users. They coordinate numerous EDI related seminars to enhance the EDI image locally.

In South Africa the VANGUARD steering Committee was initiated by, and drawn from, an "ad-hoc" group of concerned business representatives, following their attendance of Dr Peter Keen's "Strategic Business Connections" seminar in early April, 1992. The committee was charged with defining the requirements of:

- undertaking an analysis of the likely economic effects of *Value Added and Data Services* (VADS) on South Africa, and,

- the work that would be necessary to promote and expedite its development and adoption in the country.

2.5.7 EDI and the Internet

A number of organisations in the United States, including Cisco Systems and Nasa, are using the Internet, instead of a value-added network (VAN), to exchange EDI documents with trading partners. EDI in the Internet is still limited. For one, it lacks the kind of security EDI users have come to depend on. Customer service is practically non-existent, limiting EDI on the Internet to pioneers. If a user sends a business document over the Internet and it doesn't arrive, who can they call for help?

Many organisations already have an Internet connection, be it a dial-up E-mail account or dedicated leased lines and a World Wide Web server. Far fewer have accounts with an EDI VAN service.

EDI on the Internet can ease the way for smaller businesses that previously could not afford the fees of VANs. For the same reason, the EDI-Internet combination should also help large companies send documents to small partners and customers.

Already, the Internet Engineering Task Force (IETF), the governing body for Internet standards, has devised a common method for sending EDI documents over the Internet. Although Internet access is a lot cheaper, there are some hidden costs for EDI over the Internet. It still entails the requisite EDI translator software on each end of the transaction.

Traditional VAN providers could be forced to offer Internet access to their own networks, or to use it as an alternative transport. That means VAN providers would offer many of their custom services - including integration and support - on top of the Internet.

2.5.8 EDI Utilisation

The EDI supplier market is continuously publishing surveys regarding EDI implementation and savings.

A survey conducted by Computer Sciences Corp (Eckerson 1992) shows that information system (IS) executives believe speed is the top priority when it comes to building computer

and network systems for end users. The executives stated that responsiveness to user requests is particularly important in competitive environments, where compression cycle times and a fast time to market can provide a company with a competitive edge. The survey also shows that companies are implementing electronic data interchange (EDI) more aggressively than any other new technology. Other issues believed to be of great importance to IS directors are increasing developer productivity, identifying and developing strategic information systems and developing an information architecture.

EDI is becoming more widely used, helping businesses to, automate procedures such as ordering and invoicing, reducing costs, linking customers and suppliers, linking companies, and incorporating new features such as Electronic Funds Transfer (EFT). Some estimates show electronic commerce producing almost $1 billion in revenues in 1992 and $3.8 billion in 1993 (Thierauf 1990). Automating ordering often involves not only eliminating paperwork but linking ordering more closely with actual purchases and even automating authorisation of funds, so that businesses are keeping inventories that meet customers needs more closely and more quickly. This process also links businesses more closely with suppliers. Integrating EFT with EDI increases efficiency. Businesses hope to achieve real-time management of these processes. Contrary to current business trends, EDI is migrating from the desktop to the mainframe.

2.5.8.1 Trade Sector Research

Information for this section was obtained from SITPROSA and speakers at various EDI seminars and conferences. Bodies representing various industry and trade sectors have formed sub-committees looking into the effects and benefits of EDI on their sectors, e.g. National Association of Automobile Manufacturers of South Africa (NAAMSA).

The Computer Society of South Africa (CSSA) has a Data Communications Special Interest Group looking into EDI aspects. The South African Numbering Association (SANA) has been involved in EDI standards for a number of years.

The South African Bureau of Standards (SABS) formed an Information Technology Committee, who in turn formed an EDI Sub-committee which is currently involved in EDI

standards in conjunction with SITPROSA and aims at taking over SITPROSA's responsibilities during 1995.

EDI being a relatively new concept has not yet become a major research topic at South African universities, although it has a large following at American and European academic institutions. Local interest is mostly at legal and commercial levels.

RAU is doing extensive work in the security aspects of EDI as well as EFT, Open Systems implications and EDI communications. Potchefstroom University is doing research into the legal aspects of EDI. Little work on EDI is being done at any of the other universities.

2.5.8.2 International Research

European and US industry is approaching EDI on a cooperative basis, concentrating on standards for particular industry sectors. Successful economic integration will be partly dependent on the effective use and research of EDI.

Turnbull (1988:16) states that *"...competitive best practices, expose any comparative weakness in internal procedures and highlights the need for significant changes in business practices to operate more effectively and reap the benefits".*

Other writers, for example, (Robinson 1990) say that EDI means change, major change to the organisation and its people. He states further that it is a new way of doing business, and new methods affect people. Unfortunately, as stated by Turnbull (1988:16) *"... managing this degree of change is something of which few organisations have experience today."*

2.6 EDI IMPLEMENTATIONS

EDI has achieved most of its implementation success in Europe and North America. Locally it is being implemented mainly as pilot projects. Few of these organisations follow a pre-defined methodology and tend to define the project plan for each implementation based on the problems encountered in the previous implementation. Few perform feasibility

studies and most make use of external consultants to assist with pilot projects.

2.6.1 Local Implementations

As far as implementation in South Africa is concerned, a number of large projects are under way. These are, inter alia:

- SA Customs, which is embarking on the EDI route, and will start off by receiving Customs Declarations via X.400. Later developments will include clearing, as well as migrating to EDIFACT. Customs have indicated in public that they are committed to implement EDI; the question is if funding will be available. Nevertheless, with the US Customs claiming that, over a 5 year period, their workload went up 100% whilst their staff complement increased by only 10% due to EDI, it would seem that EDI in Customs is vital.

- Safmarine, which is looking into setting up an EDI link with Spoornet for manifest data. Safmarine is also investigating the possibilities of EDI for use with the Delivery Release Order (DRO).

- Portnet (Harbours Authority): Hardware and software have been installed and tested. Portnet is making some internal system changes to handle EDI data. Once this is done, piloting will start. The Container Terminal Order (CTO) message has been designed, using a UN subset.

- Transmed, which is investigating EDI for use in Medical Aid administration. The design of a Medial Aid Claims message as well as Claims Response have been completed, and work is progressing well on integration of software. The Health Industry as a whole (Medical Aids, Pharmacies, Hospitals, Doctors and Drug companies) has recently indicated that a very large move to EDI is under investigation.

- Sasol, has spearheaded an Oil industry project, with Spoornet. A Freight Transit Order message has been designed; once again using a UN sub-set. All the major oil

companies are involved - Shell, BP, Engen (Mobil) to name a few.

- Transnet, has set up an EDI committee to coordinate all the EDI activities within the Transnet family. In future, the committee will look after Spoornet, Portnet, Petronet, Transmed and Roadnet developments.

- The Old Mutual life assurance company, which is investigating EDI as a means to streamline their Pensions Department. In addition, Old Mutual is propagating the development of an industry-wide EDI initiative.

- AECI (chemical) has started a Purchasing project some time ago.

- INFOGOLD, the information systems arm for Anglo American (Gold) has implemented an EDI ordering system, and currently is communicating with 22 suppliers. This project will be expanded in the near future.

- The motor manufacturers, under the umbrella of NAAMSA, has started implementing EDI. Toyota, Volkswagen, Mercedes Benz, SAMCOR, Nissan and BMW are all involved. Software has been installed, and currently trial messages are being sent. The ODETTE formats are being used, with the migration to EDIFACT to happen in conjunction with ODETTE (Europe).

- In the Retail Sector an EDI pilot installation between Checkers, a retail chain, and Colgate Palmolive. Pricing information, orders and invoices were exchanged electronically.

- The South African Banking industry is also busy investigating EDI as a vehicle to cater for the payment side of the transaction chain. The Banks have formed BEDIG, the Banks EDI Group, to handle this study.

- Denel Informatics, the data processing bureau of Armscor and the military, has implemented an EDI system between a military hospital and a supplier of pharmaceutical goods. This system is to be expanded into various other areas.

INFOPLAN is also looking into applying EDI in areas such as procurement and management.

- UNIFRUCO, the organisation responsible for marketing South African fruit overseas, has indicated that they wish to investigate EDI in the export environment. Consultants have been appointed to do this study, and an early start on implementation is expected.

It is expected that 1995 will see a leap in the number of EDI projects being implemented. Judging from the amount of enquiries received by SITPROSA, some significant players are expected to move into this field.

2.6.2 North American Implementations

EDI in health care in the USA claims the potential for 4 billion claims being transacted via EDI per year, with a saving of $1.00 per claim. EDI is being implemented for patient verification at all points in the health service chain. Currently 77% of Hospital Finance Corporation's hospital claims are processed via EDI and 44% of other claims. (Thierauf 1990).

Twenty nine of fifty states in the US require electronic tax payments for corporations and have developed new formats for tax filings via EDI. Other state applications being developed are: Sales tax, Social security, Unemployment, Property, Disability, Health insurance, Fuel and Income. (Thierauf 1990).

EDI in library management for book purchasing, inter-library transactions, invoicing, payment and shipping, is fast becoming a priority. Initial focus tends to be in the manufacturing industry with its vast logistical and inventory systems. These systems have gained in significance with the advent of Just-in-Time (JIT) manufacturing as promulgated by the Japanese.

A number of surveys in the US indicate that EDI applications in logistics are growing rapidly among Fortune 500 companies (EDI'92).

Banks are the world's largest and oldest EDI community in the establishment of the Society for Worldwide Interbank Financial Telecommunications (SWIFT). It is clear that electronic delivery systems are on the rise among financial institutions, and that these systems will become even more important for successful banking strategies in the future.

R.J. Reynolds Tobacco Co is now sending all its purchase orders via an electronic data interchange service. The company expects to save an estimated $5.3 million annually by stipulating that all of its suppliers also use EDI. Under its old paper-based system, each purchase order cost between $75 and $125 to process. Using EDI has reduced the figure to just 93 cents, including transmission. The company expects to transmit 90,000 EDI documents to 1,428 suppliers this year, with 11,000 of those transmitted via facsimile. Fax transmission was an important part of Reynolds' plan. The company uses Sterling Software Inc's GenTran EDI software running on an IBM 3090 mainframe. It connects to BT North America Inc's EDI network using two X.25 circuits. (Thierauf 1990).

Electronic Data interchange is identified as one of 13 strategic initiatives at Texaco Inc. Texaco, in the USA, and CEO James Kinnear views EDI as a prerequisite in today's business environment. Texaco has a Corporate EDI Task Force made up of representatives of 14 business units. The task force's mission is to ensure the success of EDI. Texaco's EDI arrangements are standards-based, and Texaco is active in national, international, regional and industry standards organisations. Texaco has more than 70 trading partners and records 12,000 EDI transactions a month. (Zimmerman 1992).

Two studies indicate that cost reduction is not a main motivation for corporations who adopt EDI. Rather, companies are concerned with issues such as accuracy or improved customer services. A study titled 'EDI Market Advice: Stick to Basics' was done by BIS Strategic Decisions. Twenty US companies who are either already using EDI or are planning to do so were questioned. The study revealed that most companies implement EDI separately from electronic mail. The other study, which is titled 'The Fifth Annual Bar Code/EDI/Quick Response Survey,' was done by Deloitte & Touche for the National Retail Federation. That survey, based on information gathered from the federation's 27 national retail associations and 50 state associations, shows that EDI use in the retail industry almost doubled in 1992. (Thierauf 1990).

Electronic data interchange is beginning to be taken up by Canadian companies, although the process has been slow. EDI can lower a company's costs, reduce error, improve efficiency and enhance customer service. At least 1,650 companies in Canada use the standard, 85 percent of which are in Quebec and Ontario. Analysts expect growth of Canadian EDI usage of 25 to 30 percent per year. The Canadian government is a major user of EDI, making 1.7 million internal transactions using EDI. The government has also provided funding for an Electronic Data Interchange Council of Canada (EDICC) office in Vancouver to advocate EDI usage in the western provinces. However, many users are still resistant to EDI because of the difficulty of changing to a non-paper-based system. (Thierauf 1990).

2.6.3 European Implementations

The organisation for Data Exchange by Tele Transmission in Europe is generally regarded as being the leading European EDI development. ODETTE was formed in 1985 following collaborative efforts by Austin Rover, General Motors, Peugeot Talbot and Ford through the UK motor industry trade association. (Preston 1988).

Many high street retailers exchange data with their suppliers, using the TRADACOMS message standards developed specifically for this business sector. For some of these, for instance B&O, Marks & Spencer, WH Smith and Tesco, EDI is becoming a routine feature of their supplier trading relationships.

The central role played by HM Customs and Excise in the importing and exporting functions has led to a significant involvement in both the port and airport EDI developments.

The DISH (Data Interchange for Shipping) pilot project was commenced in October 1986, and involved linking the computers of 12 major exporters, freight forwarders and shipping lines.

The SHIPNET pilot project involved 40 companies, all IBM users, in the freight industry. Aimed at finance, government departments, customs and export guarantee agencies,

SHIPNET documents conform to UN standards. The pilot project has now finished, and SHIPNET and DISH are now collaborating under the EDI Association to develop common message standards.

CEFIC is a pilot EDI project organised by the European Council for Chemical Manufacturers' Federations. The project, supported by ICI, involves 15 member companies.

The National Health Service places some four and a half million orders per year, and in return receives 12 million invoices and makes six million payments. As the NHS comes under increasing pressure to reduce cost , the potential for EDI developments within this sector is apparent, and both Istel and INS are active in the provision of EDI facilities for the Health Service.

SWIFT, the Society for Worldwide Interbank Financial Telecommunication, has been running live for over 10 years. It carries up to a million messages a day, and is used by some 1500 banks worldwide.

EDI activity in the insurance industry centres around three projects. LIMNET, the London Insurance Market network, will run on the IBM Managed Network Service, and plans to link over 1100 of Lloyd's underwriting agents, syndicates, brokers and insurance companies. RINET is a project created by European re-insurance companies, and it has chosen IBM as its network service supplier. INS's BROKERNET service includes Commercial Union, Norwich Union, Zurich Insurance and Eagle Star. The network is used to exchange private motor car insurance details using industry specific data messages.

UNICORN is the first of many expected EDI projects in the tourism and travel industry. It is an acronym for 'United Nation EDI for Co-operation in Reservation Networks'.

The European EDI software and service market is expected to grow from 1992's $134 million to $660 million in 1997 because of four factors (Thierauf 1990). These are the advent of the single European Community (EC) market, increasing EDI links between large corporations and suppliers, advances on international EDI communications standards and

changes in the way EDI is marketed. With advent of the single EC market agencies like the UK's Customs and Excise are moving to EDI data formats as a preferred way for collecting trade data. Large companies like British Gas are persuading their suppliers of the benefits of using EDI. The simplification of the way EDI is sold is expected to promote its use.

2.6.4 EDI Elsewhere

Electronic trading has been recognised worldwide as an essential business tool. Projects are already in progress in remote parts of the world, including Africa, South America, India and China. Many of these countries are also getting involved in the standards-making procedures of the EDIFACT board.

India

The Cargo Agents' Association is showing interest in EDI, and the customs department has recently started a pilot for accepting import general manifests from steamer agents in the Port of Madras. In 1991, a Gateway Electronic Mail Service (GEMS 400) was set up to provide an E-Mail service linking to international mail networks. A Gateway for Electronic Document Interchange (GEDIS) will be provided shortly. The Indian Government has decided to form an expert group to draw up a plan of action for EDI, and is hoping to speed up the pace of EDI implementation through membership of the Asia EDIFACT board.

China

The Chinese EDIFACT committee, set up last year, has created several industry sub-committees including one for customs. Regional sub-committees have also been set up for Shanghai and for Guangdong, the special industrial zone on the border with Hong Kong. In May 1992, a symposium on EDI strategy and standards was held in Beijing, attended by more than 100 representatives from government departments and universities. In August, there was a workshop on a Chinese version of the EDIFACT standards, and a proposal has been made to the Asian EDIFACT board for a joint working group.

Mongolia

The Mongolian government states that it "is aware of the need to implement EDIFACT in order to have competitive market position with high-technological neighbouring and international trading partners." Accordingly, it is creating the Mongolian network of Finance, Administration, Commerce and Transport telecommunications network (FACTnet), to form the technical infrastructure for EDI in Mongolia. FACTnet may use satellite channels from ASIASAT and INTELSAT, rather than land-based cable.

Africa

Electronic trading came to Africa with the launch of an extremely ambitious UN-backed container control network, Advanced Cargo Information System (ACIS). Although designed primarily to trace containers from the time of discharge from ship to arrival at final destination, ACIS opens the door to greater usage of computer communications between African business people and their overseas partners.

Tanzania, Malawi and Zaïre are taking part in the initial pilot, dealing with Southern Africa. Four container shipping lines - P&OCL, Harrison Line, MSC and CMB - are sending manifest data detailing incoming consignments to a central logistics unit in Dar-es-Salaam. The railways in Malawi, Southern Zaïre and Tanzania are already participating, allowing vast amounts of cargo movement by rail to be monitored.

Poor telecommunications equipment in Africa has led to the employment of satellite technology for ACIS. Although ACIS is basically an electronic mail system, it is planned to use the EDIFACT syntax throughout, as the messages become available. During 1992, UN-backing ceased, and a local management company took over the running of the system.

Brazil

In Brazil, six industries have become active in the use of EDI, running pilots or operating communities. As in Europe, areas of development are retail, automotive, wholesale, electronics, insurance and banking. Multinationals are the notable prime movers.

In the retail sector, Colgate-Palmolive and the Bompreco supermarket chain are using EDI, whilst in the automotive sector Autolatina and Mercedes Benz have linked up suppliers and dealers across the country. In the electronics market, IBM and Philips are both active. The major banks like Unibanco, Bamer Indus and Itau have begun assessing EDI and IRB, a reinsurance company, already has a number of EDI partners.

2.7 GROUPWARE AND COMPUTER-SUPPORTED COOPERATIVE WORK (CSCW)

The concept of computer-supported cooperative work, groupware and the relationship of EDI to groupware is explored here to gain an understanding of EDI as a technique and its position in the overall scheme of groupware.

Recent emphasis has been placed on the utilisation of computers to assist people in groups, rather than the traditional single-user computer interaction. This concept is known as computer-supported cooperative work (CSCW) and groupware, CSCW being the paradigm and groupware the software supporting cooperative work.

Broadly speaking groupware is a software application or group of programmes designed to help workers collude, communicate, and collaborate more effectively over computer networks.

Groupware facilitates a business environment in which information sharing and co-operative working become crucial for business success. As with other technologies, successful adoption of groupware requires a full understanding of its role, inherent benefits and more importantly, the implementation issues, covering the human factor as well as the technical procedures.

A groupware research team (Ellis 1988:4) modelled various possible scenarios of human and computer communication interfaces.

The single-user interface model as depicted in Figure 2.12 represents the bulk of personal computer - human interfacing.

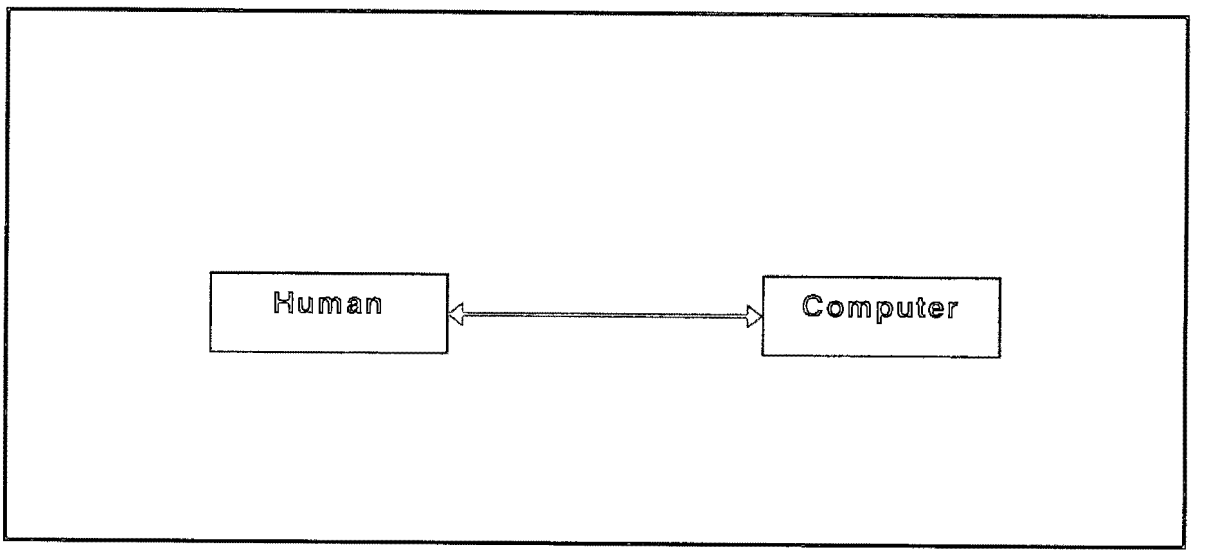

Figure 2.12 The single-user interface model

The networked user interface model in Figure 2.13 depicts multiple computers communicating with each other and still the single-user, computer interface.

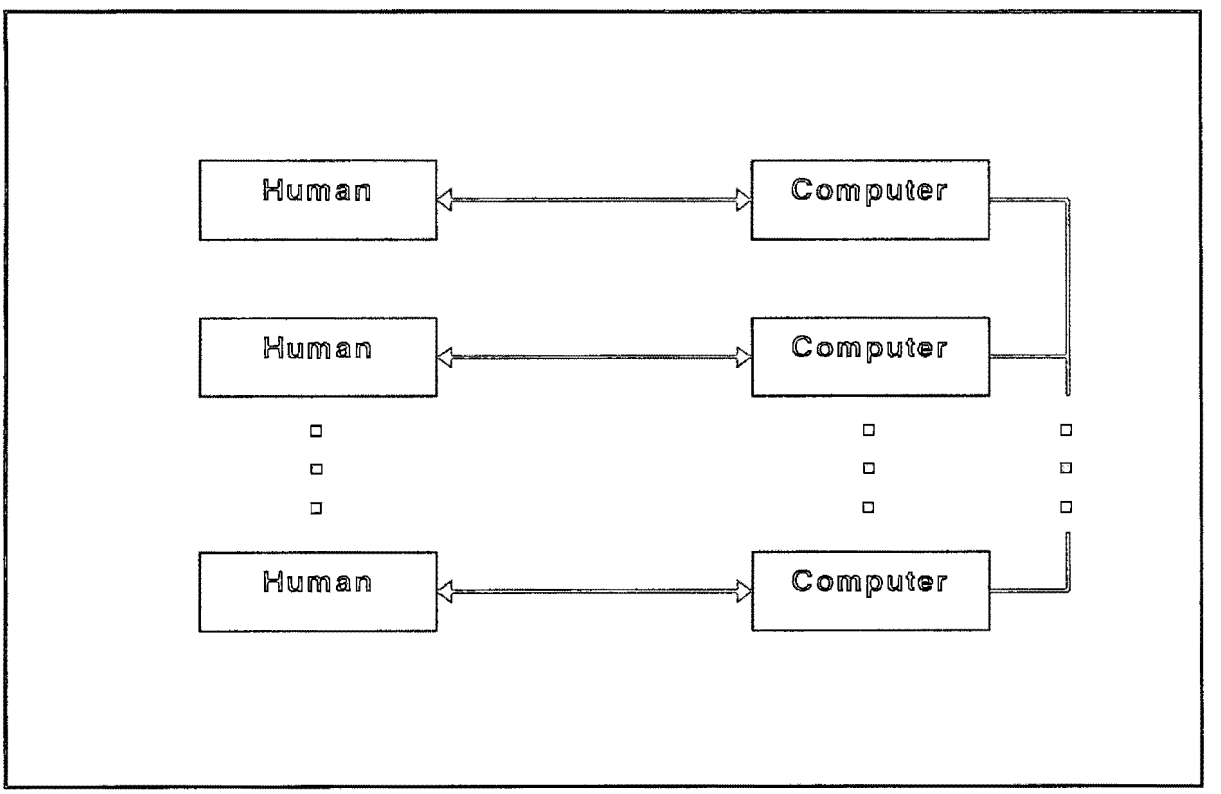

Figure 2.13 The networked user interface model

The networked user interface model still does not facilitate group communication and groups working on single objects. This scenario is reflected by the multi-user multi-machine interface model in Figure 2.14.

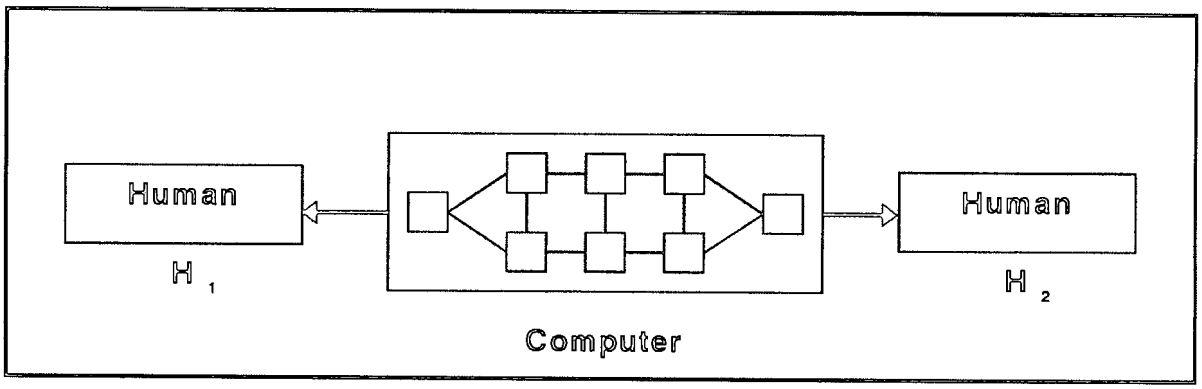

Figure 2.14 The multi-user multi-machine interface model

To facilitate non-computerised human interaction as well, the groupware interface model is generalised in Figure 2.15. The heavy lines indicate communication through computer media and the light lines indicate human communication via other media.

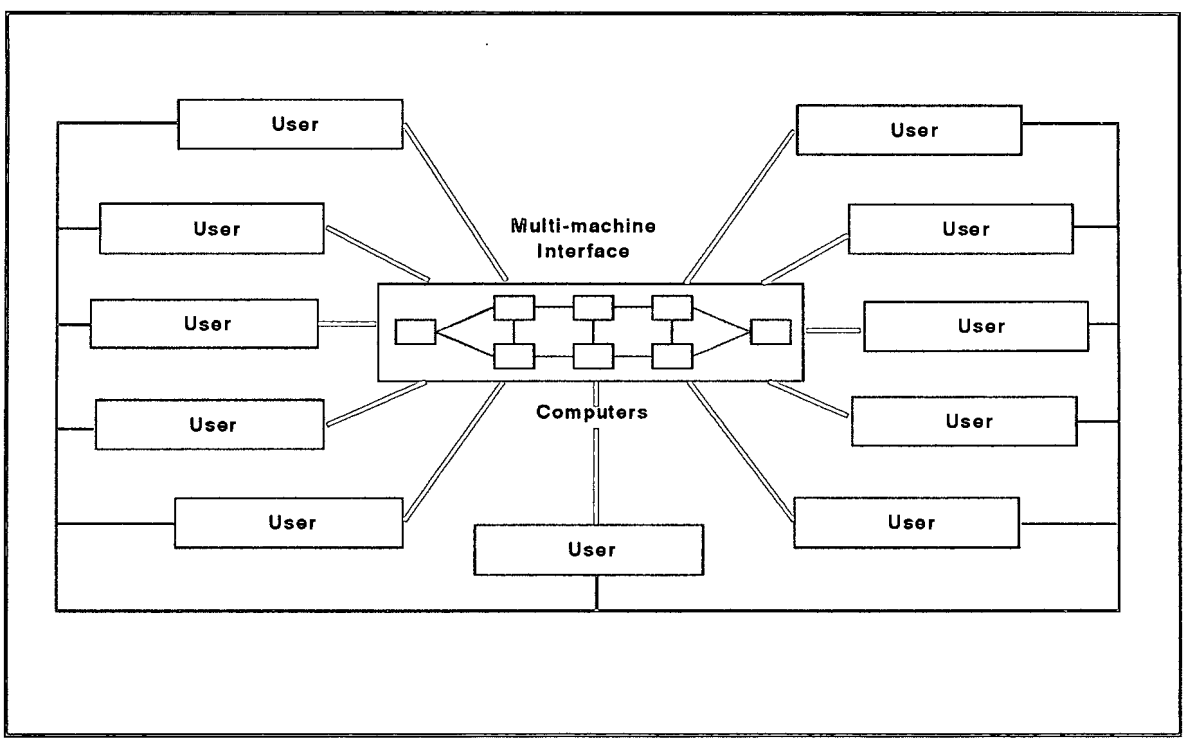

Figure 2.15 The Groupware interface model

It is apparent from these models that EDI may be characterised by the CSCW paradigm. Now CSCW is the scientific discipline that motivates and validates groupware design. It is the study and theory of how people work together and how the computer and related technologies affect group behaviour. CSCW is thus an umbrella collecting researchers from a variety of disciplines - computer science, cognitive science, psychology, management information systems and anthropology, to gain different perspectives and methodologies for acquiring knowledge of groups and how their work can be supported (Greenberg 1991).

Groupware is software that supports one or more simultaneous users and provides an interface to a shared environment. Such software is associated with groups of people working in a highly integrated fashion on a common task in real-time (Ellis 1988). Thus groupware differentiates from software products designed to assist individuals in pursuing isolated tasks. Examples of groupware are E-Mail, bulletin boards and video conferences.

As EDI is a computerised mechanism for people communicating from different locations, it can be viewed as one of the technologies which may be utilised to support group decision-making. In the CSCW model provision is made for non-computerised interaction as well as computerised interaction. This falls in line with EDI as a groupware instance, since a vast amount of communication may occur between parties from different organisations w.r.t. an electronic document that may have been dispatched.

The matrix in Figure 2.16 illustrates how people interact over time and space, and the EDI's position, within this interaction, specifically. People can communicate in the same geographic location (central space) or in different locations (distributed space). People can also interact in real-time (synchronous interaction) or at different times (asynchronous). Examples are:

face-to-face communication : central and synchronous
telephonic communication : distributed and synchronous
corporate interview : central and asynchronous
E-mail : distributed and asynchronous.

Although EDI communication can occur between sender and recipient/s in the same

geographic location, it's more likely to occur in a distributed mode and the user is oblivious to the location of the communicator. Thus we view EDI as an instance of distributed groupware. A point-to-point real-time implementation would be distributed synchronous as the EDI is sent and received at the same time. A VAN implementation would be distributed asynchronous as the data is sent but not received by the recipient. Thus EDI can be viewed as a technology that enables transaction processing amongst various groups of people.

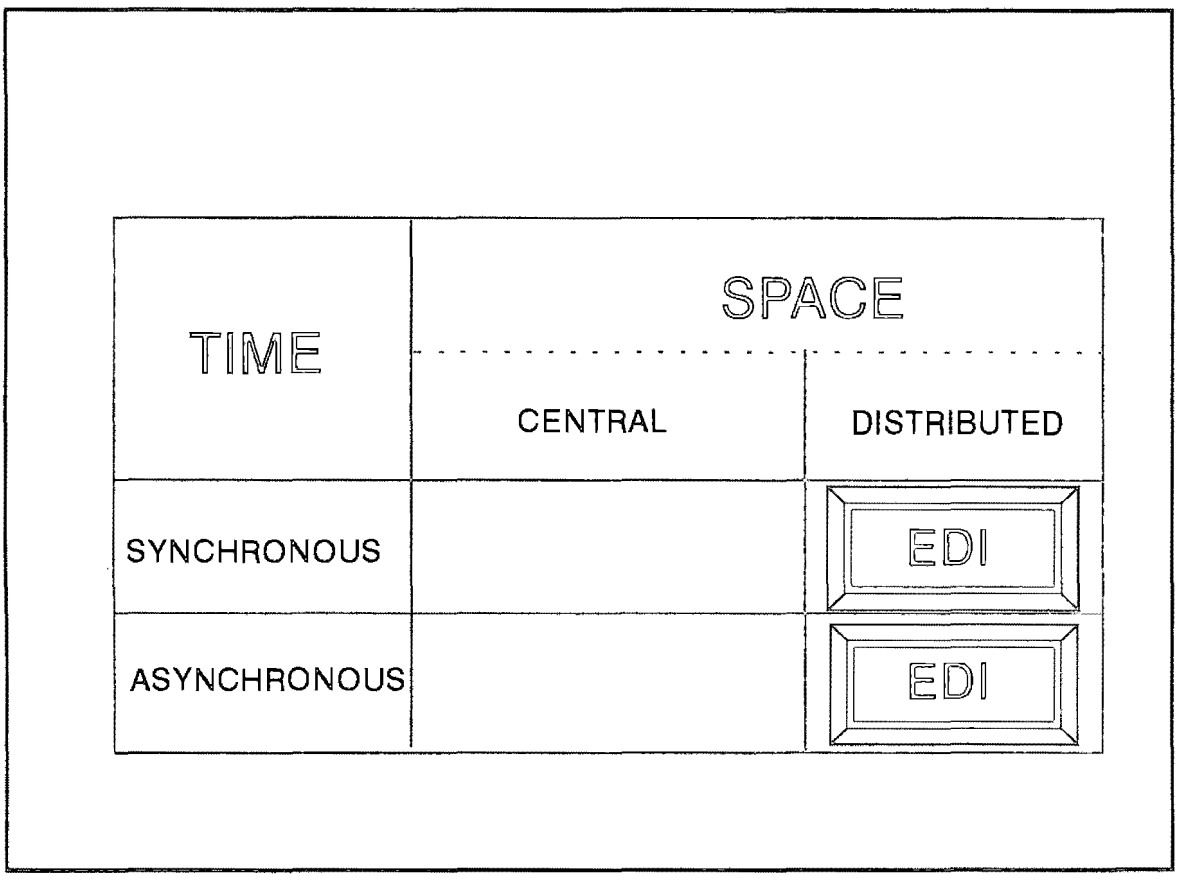

Figure 2.16 EDI interaction over time and space

A number of CSCW products have been categorised as follows (Wilson 1991):

- Message Systems;
- Computer conferencing systems;
- Procedure processing systems;
- Calendar systems;
- Shared filing systems;
- Co-authoring systems;

- Screen sharing systems;
- Group decision support systems (GDSS);
- Advanced meeting rooms;
- Team development and management tools.

Research on a CSCW paradigm for software development has recently been completed at UNISA (Viljoen 1995). The use of CSCW in the development of software is explored in that research and may be of future use to EDI development projects.

It is clear from the example of an EDI process in Figure 2.17, the categories mentioned above and the groupware interface model in Figure 2.15, that EDI is an example of groupware, and we define the EDI Interface Model in Figure 2.18, as an instance of the Groupware Interface Model. Figure 2.17 illustrates the interaction by remote individuals, via various computers, over a variable time period.

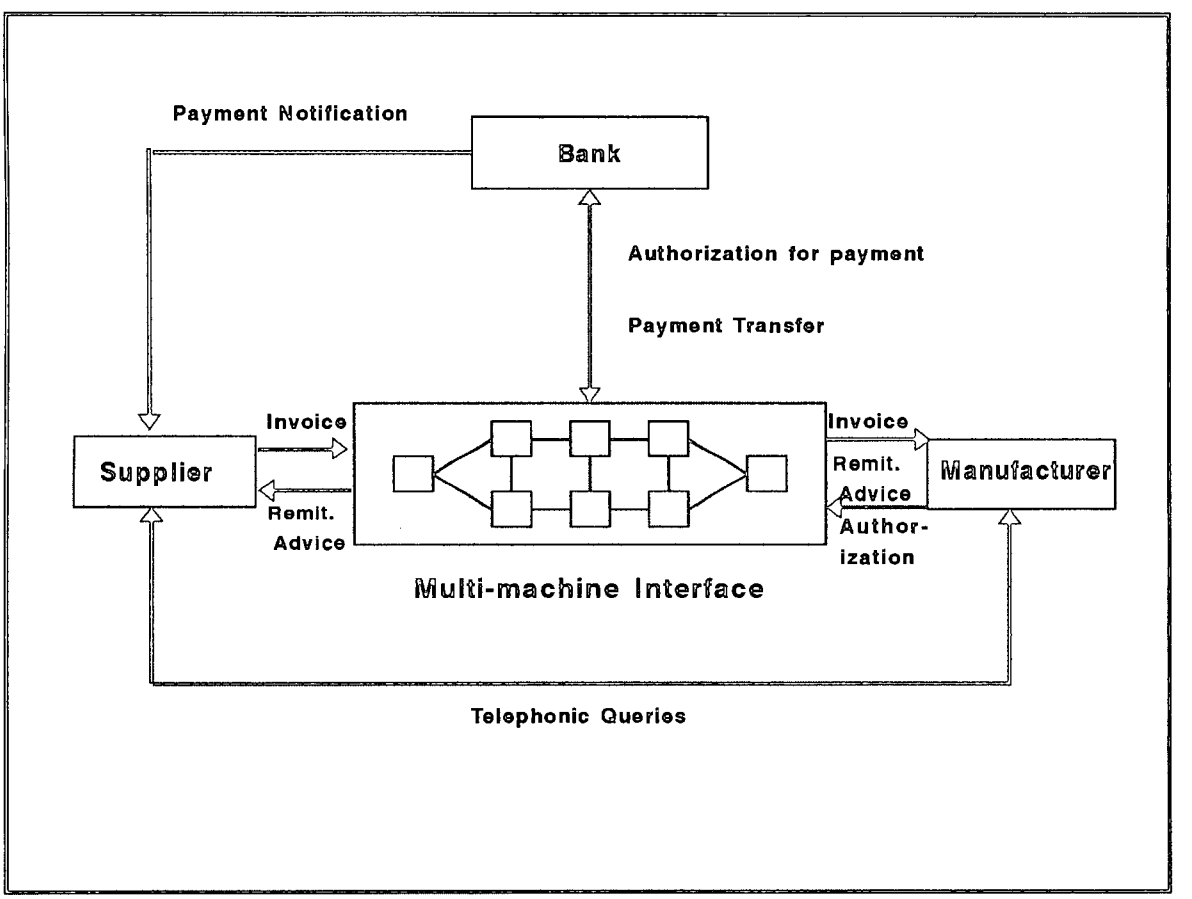

Figure 2.17 EDI group communication example

EDI processing would mostly be categorised under procedure processing systems above. Wilson (1991) defines procedure processing systems as systems which support the routing, input requirements and status reporting of electronic form-based processes.

In Figure 2.18 the multi-machine interface represents the computers of the various participants in the EDI network and can include both VANs and point-to-point interfaces, and the users represent the EDI participants.

In recent seminars on groupware, EDI has been included as a topic for discussion. At a seminar organised by AIC conferences in March 1995 at the Indaba Hotel, Fourways on Groupware, the integration of EDI, E-Mail and other groupware products were discussed.

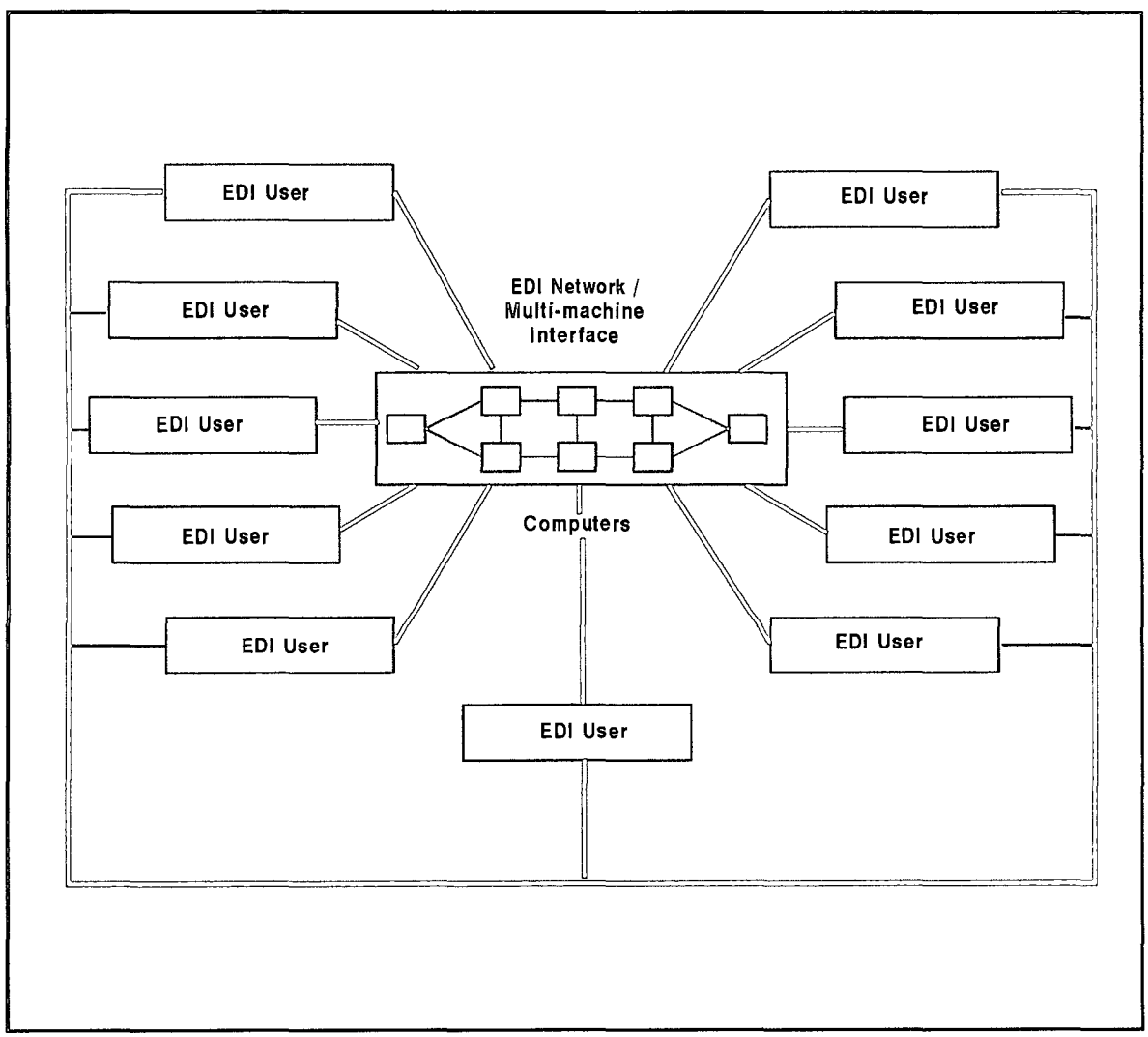

Figure 2.18 EDI interface model

2.8 SUMMARY

The notion of EDI is not new and initial EDI functions have been introduced as early as the late '60s in the transportation industry. EDI is much more than a faster method of moving documentation. When fully integrated into the business systems of the organisation, EDI will allow the business to change its ways of doing things, thus it's a reengineering facilitator.

EDI is being used across all industries, both in the private and government sectors, and as a result the emphasis being placed on a single international standard is crucial. The American National Standards Institute (ANSI) has set up an Accredited Standards Committee (ASC) in the late 1970's, to establish EDI standards to be used across all industries. As with any successful communication it is essential that both parties speak the same language and all the more so for EDI users. EDI standards provide the common language. The EDIFACT standard has become the predominant one in the USA and Canada, as well as in the customs industry worldwide. Other standards are in use elsewhere, but a move to a single standard, such as EDIFACT, is on the go.

EDI translation software is available for nearly all types of computer platforms. Thus regardless of the platform, the EDI software will translate data from an organisation-specific layout, to a standard format, then communicate the message, where the receiver's software, (which may be different software as well as other hardware), will translate the standard format to a different organisation-specific layout for use by its business systems.

A number of *Value Added Networks* (VANs) are available locally to link up various users on a single network to ease the communication strain on their own networks. It serves the purpose of an electronic mailbox. Currently a choice between a direct link between partners or using a VAN must be evaluated. The VAN eliminates communication compatibility problems, enables a single call to a number of mailboxes, audit information availability and creates a buffer between trading partners. VANs also have disadvantages, such as security and liability issues as well costs and loss of control.

EDI research is currently focusing on legal, security and audit issues. This is being done

with the intent of making EDI more acceptable to prospective users and their fears. Technological research issues include implementation strategies, application system integration issues, communication technology and standards. Constant monitoring of EDI usage and benefits gained from its implementation is being done. Finally EDI was recognised as an instance of groupware, enabling groupware models to be adapted for modelling EDI implementation.

The lack of clearly defined EDI implementation methodologies have led to trial and error implementations, which in turn has resulted in higher implementation costs, delays in achieving benefits, disillusionment, frustrations and even abandonment of EDI. This along with the need for integration into existing application domains, stresses the need for a formal EDI implementation methodology.

CHAPTER 3 : SOFTWARE ENGINEERING MODELS

3.1 INTRODUCTION

Before specifying an EDI implementation methodology an understanding of system development life cycles, methodologies and their paradigms, must be gained. It must be understood that EDI is not an information system being developed, but a technique, supported by IT, to be implemented in a business environment and thus the implementation methodology, merely a methodology for implementing this technique. Therefore a software development methodology as it stands is not appropriate and needs to be adapted. The techniques and tools used for the modelling of software development, however, can be utilised to model the EDI implementation process.

Although using EDI is not to be confused with software development, many of the same principles of software engineering can be applied to implementing EDI. The chapter ends with evaluation criteria for an EDI implementation methodology.

3.2 SOFTWARE ENGINEERING

Software engineering emerged as the organising force to overcome the barriers threatening progress in the development of computer programs on time and within budget. Thayer (1988) defines Software Engineering as follows:

- The practical application of computer science, management, and other sciences to the analysis, design, construction, and maintenance of software and the documentation necessary to use, operate, and maintain the delivered software system.
- An engineering science that applies the concept of analysis, design, coding, testing, documentation, and management to the successful completion of large, custom-built computer programs.

- The systematic application of procedures, methods, techniques, and tools to achieve a stated requirement or objective for a software system.

An interesting variation of the definition of software engineering is given below (Schach 1993):

> *Software engineering is defined not as a branch of engineering, but rather as a discipline whose aim is the production of quality software that satisfies the user's needs, and is delivered on time and within budget.*

Software engineering is not a solitary task, rather it involves users, designers, implementors, testers and management. There is no consensus regarding the best methods and tools. At a particular point in time some are considered more popular or more promising.

There are two basic principles involved in software engineering. The first being that software engineering is a modelling activity and the second that it is a problem solving activity. Thus it uses models to guide problem solving to express resulting solutions. Conceptual models are used to understand the problem and formal models to propose the solution.

3.3 LIFE CYCLES, METHODOLOGIES AND THEIR PARADIGMS (MODELLING)

Management in software development primarily involves planning, decision making including allocation of resources, progress monitoring and estimation. All of these areas depend on having an appropriate model of the software development process.

3.3.1 Life Cycles

The software systems development life cycle model, is such a software process model, which structures the development process into a number of phases starting with requirements identification and formalisation, the specification of system requirements, the design and implementation of a selected solution, and the ongoing product maintenance.

Such life cycle models facilitate the management of a large project since each phase has a prescribed work breakdown structure, deliverables, review points and management procedures for planning, monitoring and controlling a project.

By common usage, life cycle models are abstract descriptions of the structured development and modification process, typically showing the main stages in producing and maintaining executable software. The earliest software development life cycle (SDLC) model is the so-called Waterfall model which gave a simple abstraction of the software being developed (Royce 1970). The Waterfall model has a number of severe limitations, for example it does not adequately show iteration.

The information systems life cycle generally consists of four phases: planning, analysis, design and construction. The phases of this life cycle are supported by various methodologies. An analogy is drawn between the information systems life cycle and the EDI implementation life cycle as described in Chapter 4.

3.3.2 Methodologies

Methodology is used in the general sense, i.e., consisting of methods, each with a set of rules that aid the developer in obtaining a solution to a problem. Various software development methodologies have been proposed incorporating methods and techniques in support of the development and management tasks of each of the life cycle phases. The concept of modelling is inherent in any methodology, and the resultant conceptual models are used to depict the real world situation. Methodologies have underlying paradigms, which enable perspectives to be taken, such as process-oriented, behaviour-oriented or data-oriented. Some methodologies allow various complementary perspectives to be taken of the domain of discourse. Modelling a list of business activities would be process-oriented, modelling a list of events triggered would be behaviour-oriented and a list of attributes would enable the modelling of a data-oriented perspective to be taken.
(Olle 1991).

The term technique is used to refer to that part of a method, which may employ a well-defined set of concepts and a way of handling them in a step of the work.

The concept of modelling is inherent in any information systems development methodology. The development process typically starts with an analysis of a real world problem for which a solution is sought. The analytical model which results is followed by a prescriptive model of the proposed information system. These models may contain a set of submodels (e.g. a data model) and so forth. It is the integration of all the lowest level models that lead to the information systems model.

3.3.3 The Spiral Model

For the purposes of this research the spiral model was adopted, and the development of a software system mapped on three levels, namely the Universal Level, the Worldly Level and the Atomic Level (Du Plessis & Van Der Walt 1992). This mapping is depicted graphically in Figure 3.1. It is this model which will be adopted to depict the EDI implementation life cycle.

Here the Universal Level provides a global view to be taken by project and development management of a software system project. The global view may be structured by means of a system development life cycle (SDLC) framework which guides the project. The next level down is the Worldly Level which guides the sequence of development and management tasks of the phases of the SDLC. The systematic, prescriptive manner of performing the tasks of the Worldly Level is detailed on the Atomic Level. By defining three levels of software process modelling, different kinds of information needed by different levels of management within the development team are identified. The project manager will have more interest in information concerning the Universal Level. In large systems project management, the project manager is assisted by middle management to coordinate the different lower level tasks such as software development management, system integration and logistic support, system verification, testing, customer training and system implementation. Junior management is concerned with the Atomic Level issues of software development. (du Plessis & van der Walt 1992).

The next phase of the cycle is the evaluation of alternatives relative to the objectives and constraints. Frequently, this process will identify areas of uncertainty that are significant sources of project risk. If so, the next step should involve the formulation of a cost-

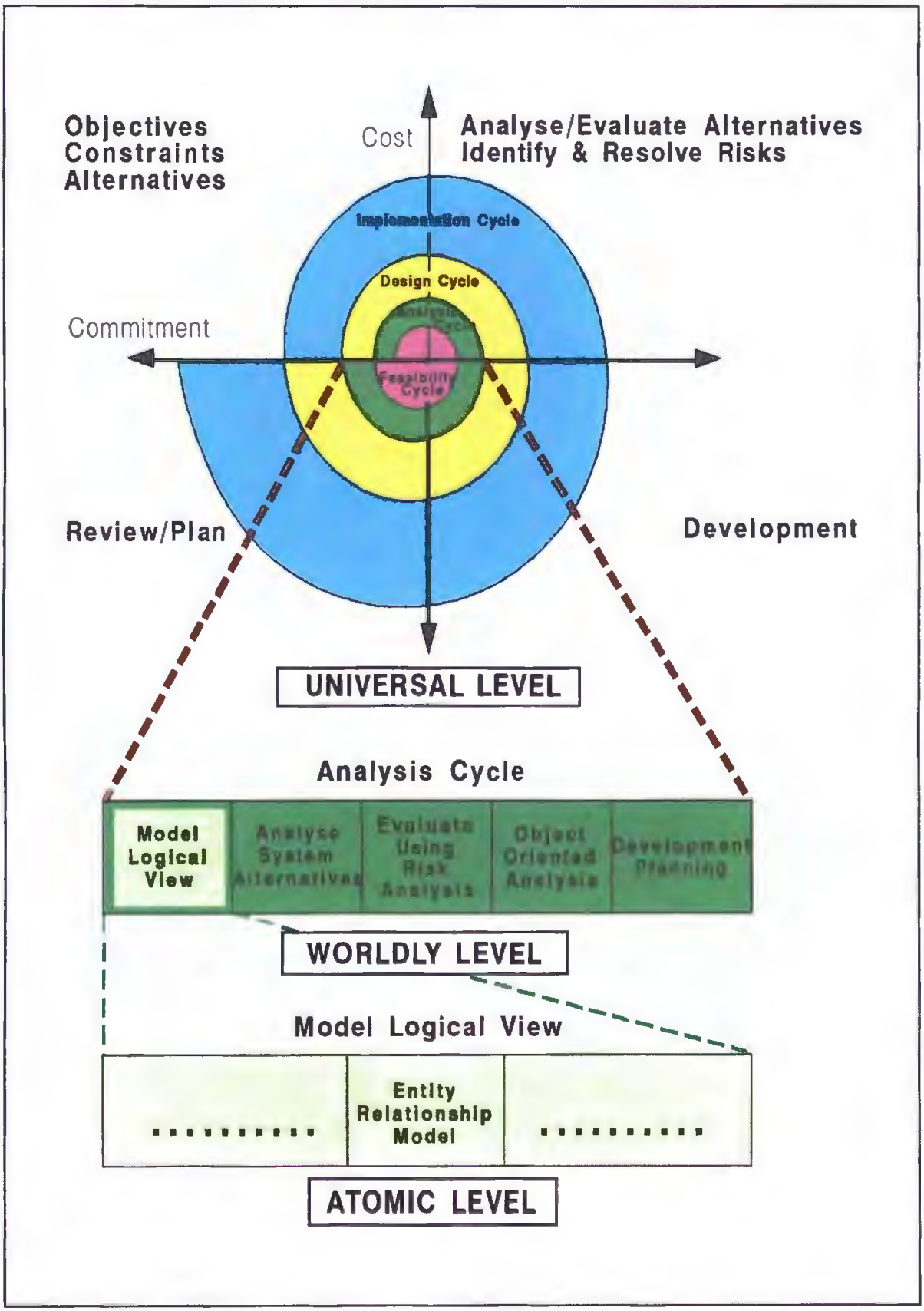

Figure 3.1 Three levels of software development modelling

effective strategy for resolving the sources of risk. This may involve prototyping, simulation, benchmarking, reference checking, administering user questionnaires, analytic modelling or combinations of these and other risk resolution techniques.

Thus risk considerations can lead to a project implementing only a subset of all the potential steps in the model.

As shown in the model in Figure 3.1, each cycle is characterised by four quadrants:

- Issue Formulation (determine objectives, alternatives, constraints);
- Analysis and Evaluation of Alternatives (identify, resolve risks);
- Development (develop, verify next-level product);
- Review / Planning (plan next phases).

These are the basic features of the model that are of interest in developing a model to represent a methodology for implementing EDI.

An important feature of the spiral model, as with other models, is that each cycle is completed by a review involving the primary people or organisations concerned with the product. This review covers all products developed during the previous cycle, including the plans for the next cycle and the resources required to carry them out. The review's major objective is to ensure that all concerned parties are mutually committed to continuing with the next phase. The plans for succeeding phases may also include a partition of the product into increments for successive development, or components to be developed by individual organisations or persons.

The spiral gets started by a hypothesis that a particular operational mission could be improved by a software effort. The spiral process then involves a test of the hypothesis: at any time, if the hypothesis fails the test (for example, if delays cause a software product to miss its market window, or if a superior commercial product becomes available), the spiral is terminated. Otherwise, it terminates with the installation of new or modified software, and the hypothesis is tested by observing the effect on the operational mission.

The spiral model of the software development process has been evolving for several years (Boehm 1988). The spiral model can accommodate most previous models as special cases and further provides guidance as to which combination of previous models best fits a given software situation.

The spiral model reflects the underlying concept that each cycle involves a progression that addresses the same sequence of steps, for each portion of the product and for each of its levels of elaboration.

A typical cycle of the spiral. Each cycle of the spiral begins with the identification of:

- the objectives of the portion of the product being elaborated (performance, functionality and ability to accommodate change);
- the alternative means of implementing this portion of the product (design A, design B, re-use and buy); and
- the constraints imposed on the application of the alternatives (cost, schedule and interface).

The primary advantage of the spiral model is that its range of options accommodates the good features of existing software process models, while its risk-driven approach, avoids many of their difficulties.

The spiral model has a number of strengths. The emphasis on alternatives and constraints supports the reuse of existing software and the incorporation of software quality as a specific objective. In addition, a common problem in software development is determining when the products of a specific phase have been adequately tested. Spending too much time on testing is a waste of money and delivery of the product may be unduly delayed. Conversely, if too little testing is performed then the delivered software may contain residual faults, resulting in unpleasant consequences for the developers. The spiral model answers the questions in terms of the risks that would be incurred by not doing enough testing, or by doing too much testing. Perhaps most important, within the formalism of the spiral model maintenance is simply another cycle of the spiral; there is essentially no distinction between maintenance and development. (Schach 1993).

Boehm's spiral model identifies different management activities such as planning, risk assessment and control. The ability to structure the software development process into phases and to structure the work through a breakdown structure, provides the basis for good project control. Software development methodologies complement the software development life cycle. They provide comprehensive and detailed support for the entire software development life cycle by:

- incorporating step-by-step tasks for each phase or cycle;
- specifying individual and group roles to be played in each task;
- prescribing quality standards and required deliverables for each task; and
- technology in the form of tools to support the development process.

In the technical domain, most of the improvements in technology for developing large-scale software systems have depended on finding improved abstractions or improved structuring techniques for writing or specifying programs.

As EDI implementation is not software development this is not entirely applicable.

A software process model provides a descriptive representation of the software process architecture, and includes the set of technical and management activities that are applied during the production of software (Du Plessis & Van Der Walt 1992).

An adaption of the spiral model for EDI implementation is presented in Chapter 4.

3.4 SUMMARY

In this chapter a framework was created to enable the modelling of an EDI implementation life cycle and methodology. This was done by introducing the concept of software engineering, software development life cycles, methodologies and an overview of Boehm's spiral model. The three levels of the spiral model were described with a view to its conceptual use as a basis for an EDI implementation methodology.

CHAPTER 4 : EDI IMPLEMENTATION METHODOLOGY

4.1 INTRODUCTION

The process of implementing EDI in an organisation is not simply installing communications software and turning on a switch. There are many organisational, technical and inter-organisational issues to consider. Because EDI ultimately aims at ridding the organisation of paper documents and integrating electronic documents into application systems, it requires management endorsement throughout the organisation. Thus EDI implementation needs to be part of the corporate strategic plan.

The hypothesis formulated at the beginning of this investigation, namely that the spiral model can be adopted to define an implementation methodology for the EDI application domain, that will (i) facilitate the integration of EDI into the organisation, and (ii) optimise the benefits accruable from EDI utilisation, motivated research into suitable process software models for EDI implementation. After defining such a model, an EDI implementation methodology was developed.

The purpose of this chapter is to present the proposed methodology, the objectives and deliverables of each major step of the implementation process, followed by a discussion of the activities of each step and considerations to take into account when performing these activities. The chapter ends with criteria to evaluate EDI implementation methodologies.

4.2 EDI IMPLEMENTATION LIFE CYCLE

The spiral model as been adopted as a framework for an EDI implementation methodology due to the following reasons:

- The iterative process involved;
- The consideration of many alternatives:
  - documents for conversion
  - trading partners
  - communication issues (VAN vs point-to-point)
  - translation software
  - standards;
- The need for management control;
- The need to revisit previous cycles;
- The emphasis on risk analysis.

Another feature of the spiral model is the incorporation of prototyping. With EDI implementation prototyping per definition is not performed, rather the pilot projects act as prototypes for future implementations. The pilot project, however, is not in itself a prototype or simulation of another project, but is a real live implementation. Thus each iteration of the implementation can almost be viewed as a prototype for the next iteration.

A Universal Level model of EDI Implementation is presented in generic form in Figure 4.1. As discussed in Chapter 3, Section 3.3, the Universal Level provides a global view of the implementation project and serves as a framework guiding the overall project.

Figure 4.2 provides a more detailed view of the three cycles of the implementation model (at the Universal Level). The next level of modelling, the Worldly Level, guides the implementation process and management tasks of the project. The atomic level describes the actual tasks to be performed at the lowest level to effectively implement EDI. This model demonstrates the three main cycles in the EDI system implementation methodology: Feasibility Cycle, Sub-system Analysis Cycle and the Sub-system Implementation Cycle.

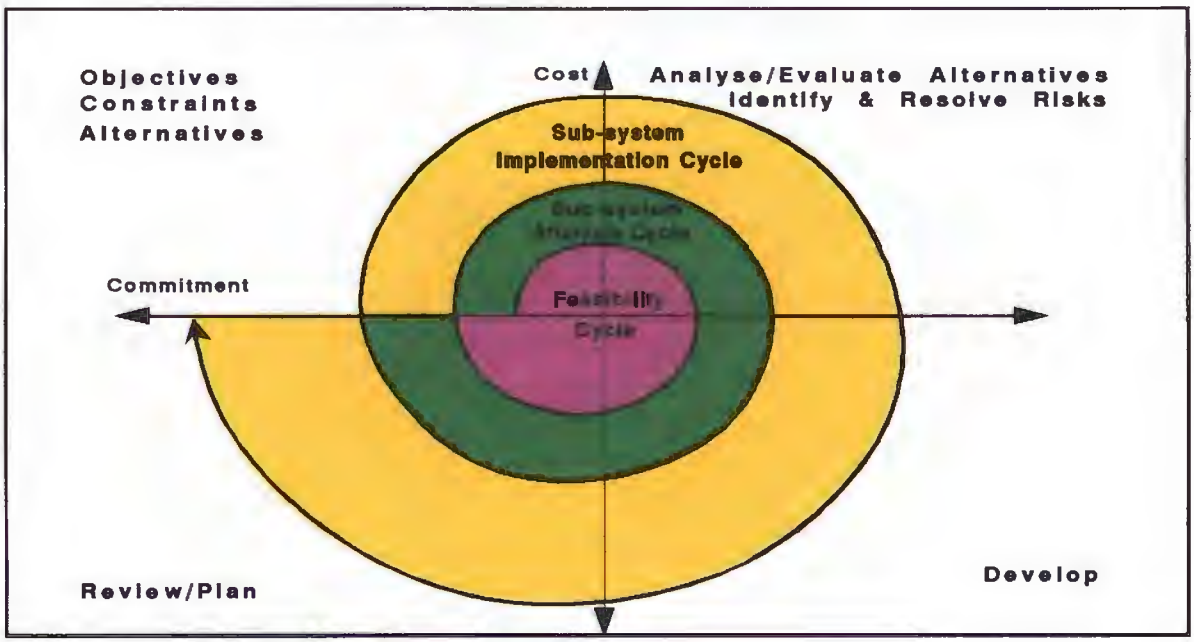

Figure 4.1 Generic EDI Life Cycle model (Universal Level)

A more detailed view of the three cycles is presented in Figure 4.2, where the information of concern to project management is presented at an overall level. This includes issues such as: "What is the project status?", at any given point in time, with regard to scheduling and cost.

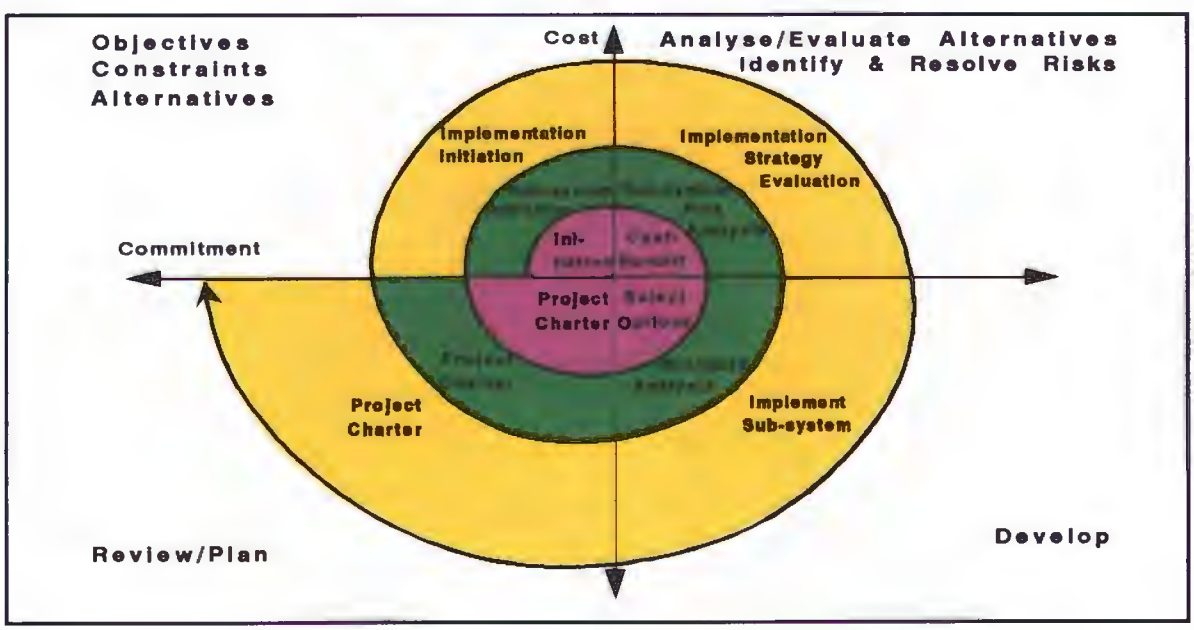

Figure 4.2 Detailed EDI Life Cycle model

Figure 4.3 demonstrates the Feasibility Cycle at the Worldly Level and a discussion of the tasks at an atomic level is presented in section 4.3.1. At this level the responsible management team, (which varies depending on the scope of the implementation) is concerned with lower level tasks, such as technology requirements, integration issues, reengineering and participant coordination. The emphasis is placed on management control and early error detection. On the horizontal axis it facilitates the return to a previous phase. Thus, should errors be detected another alternative may be reviewed and embarked on.

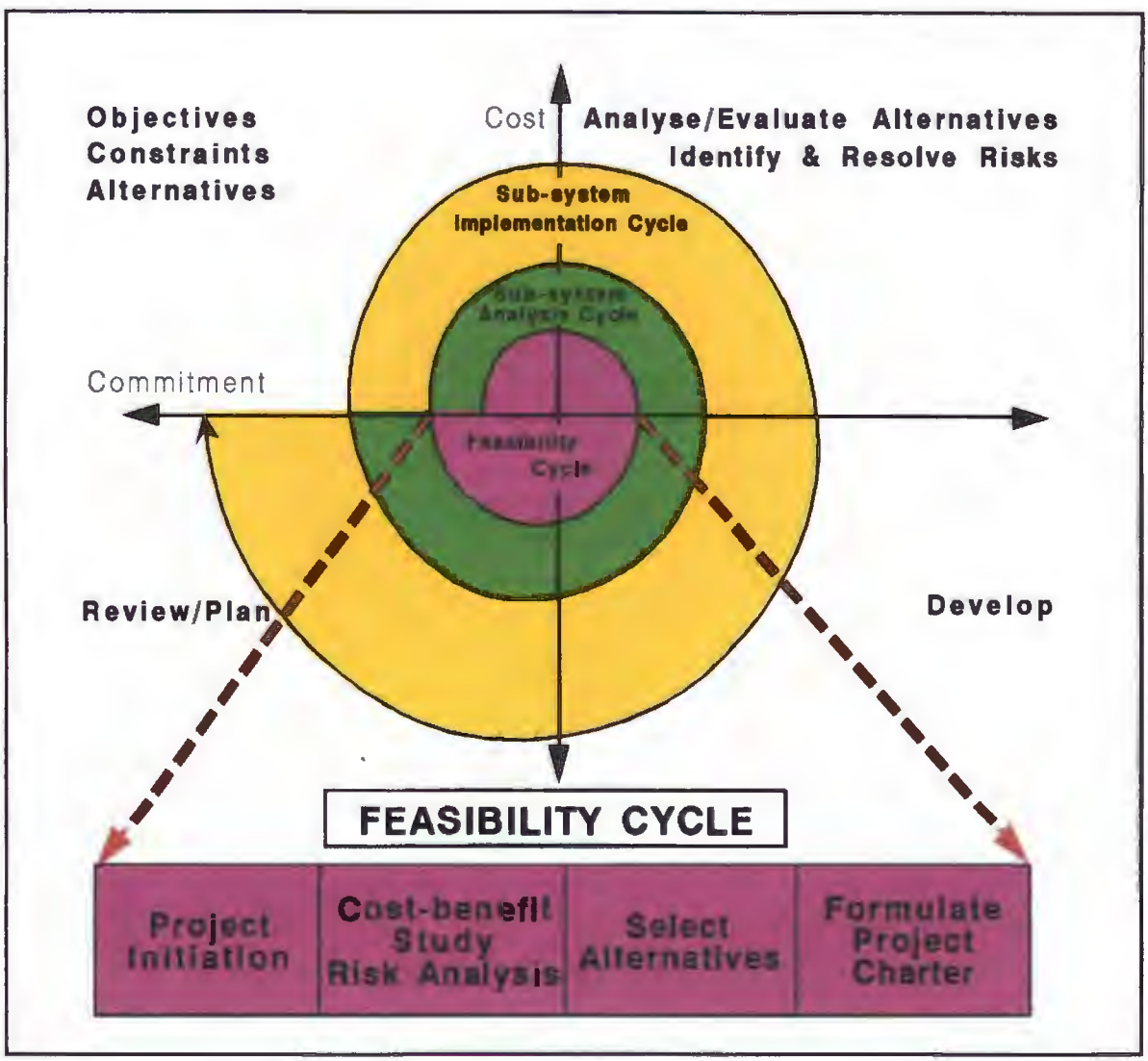

Figure 4.3 EDI Life Cycle model: Feasibility Cycle (Worldly Level)

Figure 4.4 illustrates the Sub-system Analysis Cycle at the Worldly Level and a discussion of events at an Atomic Level is presented in section 4.3.2. This cycle involves setting the

direction of a specific EDI project, i.e. the direction to be taken for a specific trading partner(s), specific document(s), the business area impact and the technology route for the specific implementation. If contentious issues are uncovered a return could be made to the Feasibility Cycle.

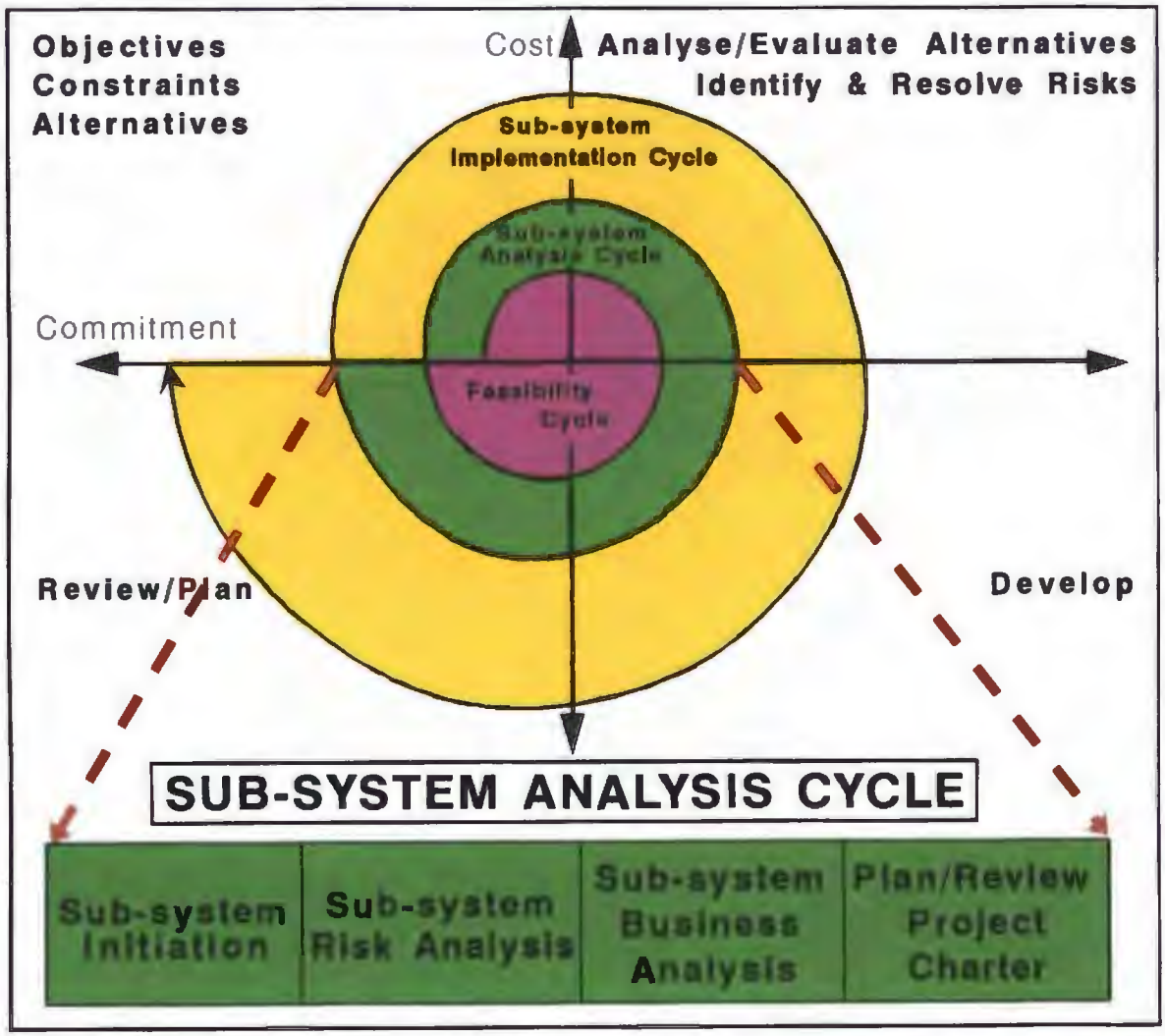

Figure 4.4 EDI Life Cycle model: Sub-system Analysis Cycle (Worldly Level)

Figure 4.5 demonstrates the Sub-system Implementation Cycle at the Worldly Level and a discussion of events at the Atomic Level is presented in section 4.3.3. At this level the responsible management, which varies depending on the scope of the implementation, is also concerned with lower level tasks, such as signing of interchange agreements, implementing software and hardware links, testing links and live implementation. The same emphasis on management control and return to previous cycles is relevant here.

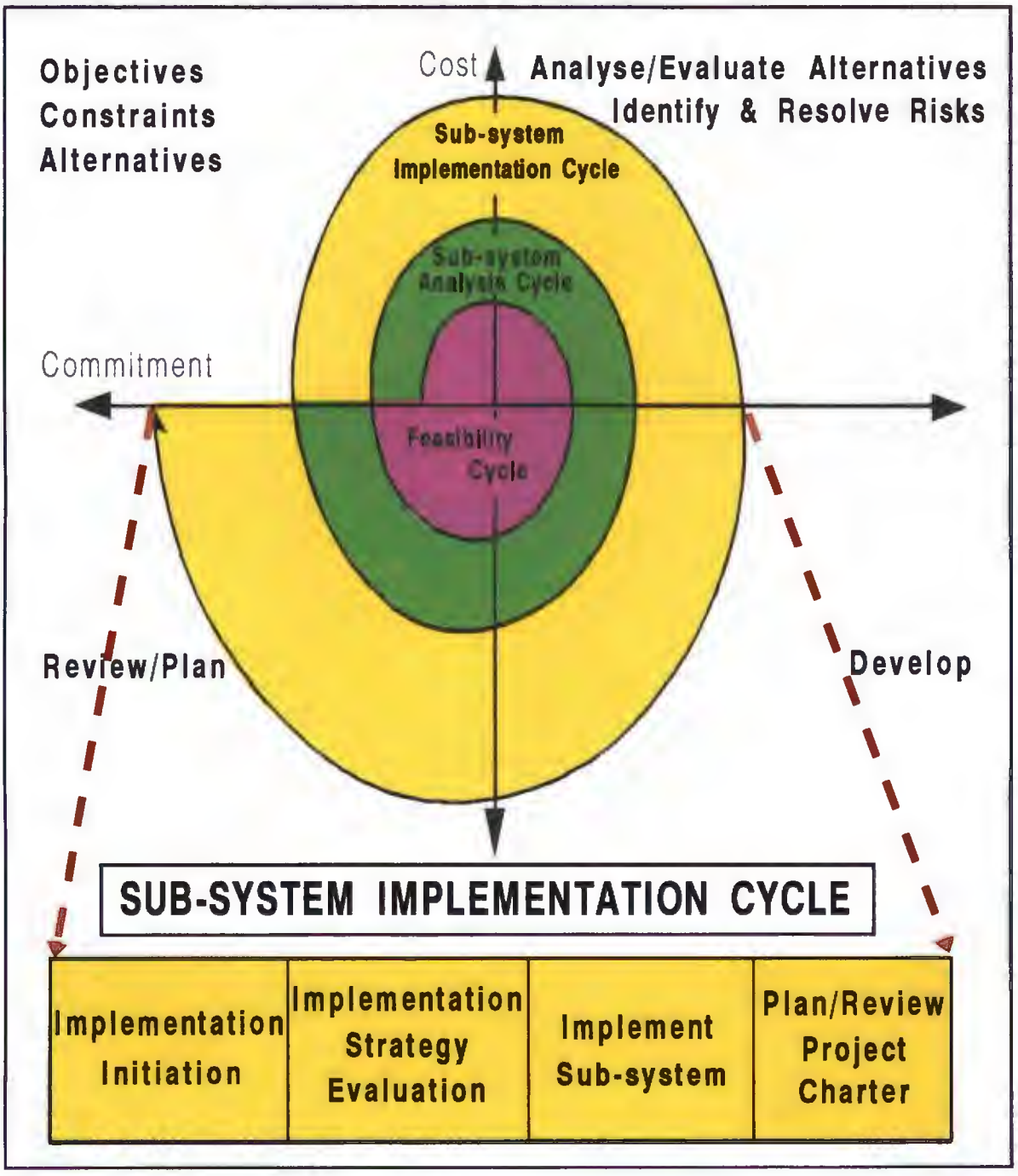

Figure 4.5 EDI Life Cycle model: Sub-system Implementation Cycle (Worldly Level)

4.3 EDI IMPLEMENTATION METHODOLOGY (ATOMIC LEVEL)

Each task of the three cycles is broken down to its Atomic Level to enable implementors of EDI to embark on an implementation project. For each cycle the work steps are summarised in a tabular form and thereafter explained in greater detail.

4.3.1 Feasibility Cycle

A summary of the tasks required to complete the Feasibility Cycle is given in Table 4.1, whereafter the processes involved in these activities are explained in greater detail.

Although management commitment is not a recognised step in the implementation process it is essential to the success of the project.

Feasibility Cycle
Project Initiation Define objectives of the EDI project as a whole. Define alternatives (to implementing EDI and w.r.t. implementation strategy). Define constraints to implementing EDI (Costs, environment etc.).
Risk Analysis / Cost-Benefit study Analyze and evaluate alternatives. Identify and resolve risks: ▪ Integration ▪ Participants ▪ Technology ▪ Orientation ▪ Reengineering ▪ Cost-benefit study.
Select Alternatives Review results of risk analysis and decide on course of action.
Formulate Project Charter Project Charter with pilot sub-system project plan drawn up based on selection of alternatives, objectives and constraints.

Table 4.1 Summary of tasks in the Feasibility Cycle

Management Commitment

As EDI is part of an organisational strategy which will eventually affect the entire organisation, it is imperative that top management's commitment be obtained for the implementation project to succeed.

In order to obtain management commitment an environmental analysis should be done to assess the organisation's readiness for EDI. This is done by doing a survey of staff awareness of EDI within the organisation, analysing opportunities for implementing EDI within the organisation, as well as the impact of EDI at a high level on systems, users and

trading partners. A high level infrastructural analysis is done to assess the existing hardware and software network installation and the impact thereon of implementing EDI, and lastly determining any existing skills within the organisation with regard to EDI.

EDI is normally initiated by the person or persons who eventually become the so-called champion for EDI in the organisation. This role player will endeavour to obtain management commitment for an EDI project and usually becomes responsible for managing the feasibility study. Often external consultants may be contracted to perform the feasibility study if a lack of knowledge and skills exists within the organisation.

4.3.1.1 Project Initiation

Top management commitment to EDI and to a particular EDI project requires interdepartmental cooperation and in the long term have the potential of attaining the long-term benefits of EDI.

Top management must be made aware of the benefits of implementing EDI by producing proof of such benefits. This may take the form of case studies or research, projects which stress improvements in productivity, strategic competitiveness or the fact that EDI may be a necessity for survival.

Whether a company is taking the initiative in an industry or is being forced into EDI, a thorough preliminary plan is crucial to success. Since an organisation must make substantial investments to implement EDI, a prudent approach must be documented, identifying high payback applications, tasks that need to be completed, milestones that must be met, and identification of both financial and human resources necessary to ensure a quality project within time and budget constraints.

Barriers to EDI

When trying to obtain management commitment for embarking on an EDI project, several objections that have been encountered in the past have been documented inter alia by Hinge (1988:46-48):

- EDI start-up costs;
- Security risks;
- Lack of standards;
- Impersonality of EDI alienates trading partners;
- EDI is a technical issue involving systems people;
- Confusion of EDI buzzwords and terminology;
- Job reduction;
- Project size.

Bentley (1989:16) mentions other barriers, such as the natural hesitancy of many accountants to move from their established environment to one that is possibly less tangible, especially one without the traditional use of paper. Another barrier is the desire to manipulate the borrowing from trade creditors to suit cash flow needs ("...the cheque is in the post!"). There is also the problem of visibility, i.e. an invoice not physically seen is not deemed to exist and therefore not handled by the recipient. An important consideration is the need for built in checks and safeguards with automatic document handling.

There are a number of other barriers which may be encountered in practise, and each one of them should be addressed as deemed fit by an organisation. Most of these will be addressed by a proper cost benefit analysis, but prior to such an analysis, case studies done by other organisations should be evaluated to identify the possible benefits that may be reaped by utilising EDI. For all the above mentioned barriers there are responses, such as long term benefits will outweigh set-up costs, security can be insured by encryption/authentication and passwords, and the increasing use of international standards will assist in the problem of non-uniform standardisation. At this stage one should obtain permission to perform a feasibility study.

This includes defining objectives, alternatives and constraints to serve as a guide to project management and EDI implementation for the duration of the project.

4.3.1.2 Risk Analysis / Cost-benefit Study

It is crucial that all parties understand the impact of EDI on a business. Figure 4.6

illustrates the impact at the various management levels. The first planning objective is to decide on the project's scope, which can be partially determined by the size and complexity of the organisation.

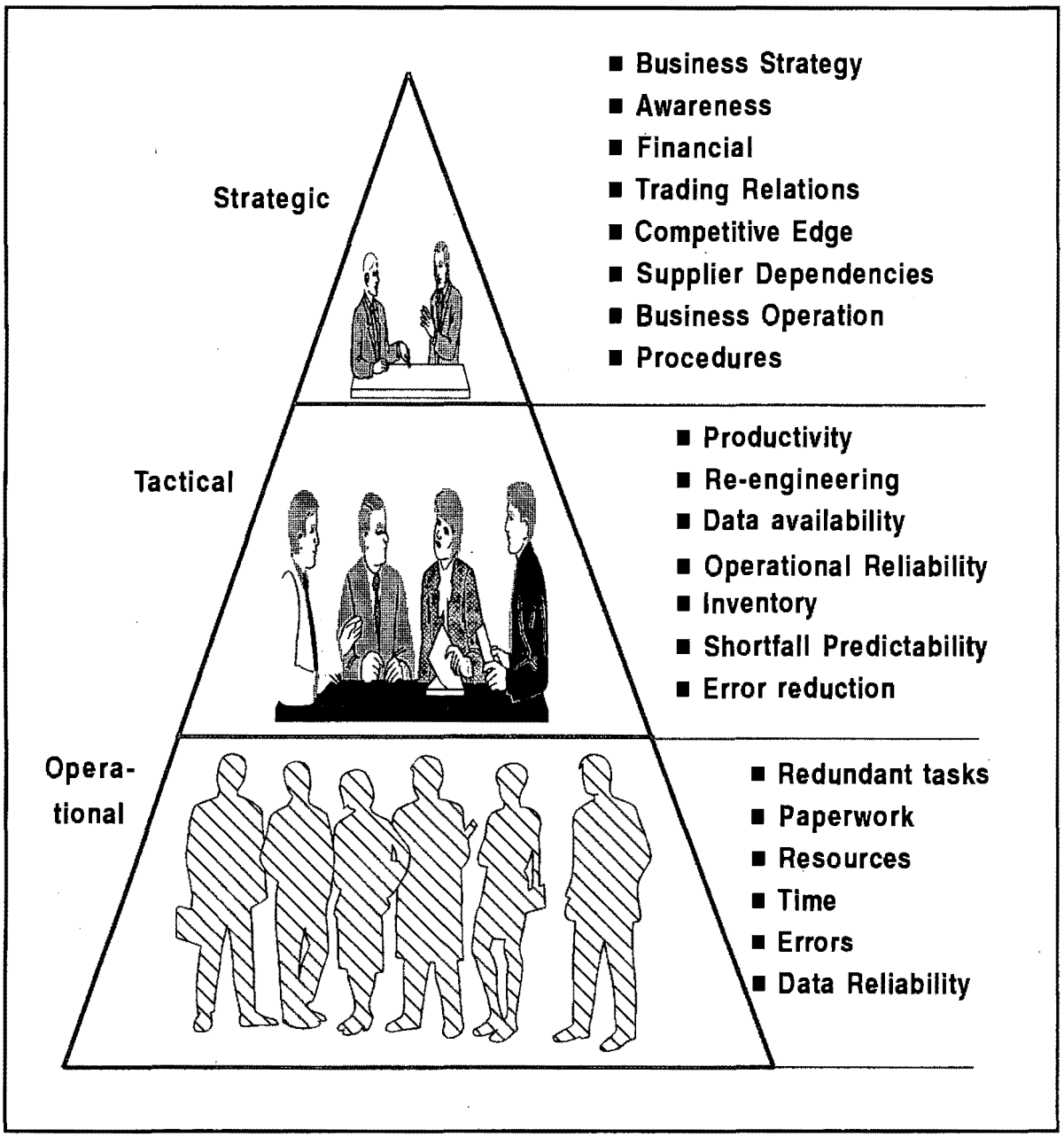

Figure 4.6 Impact of EDI on a business

Many companies are so large that it is unreasonable to expect a feasibility study that encompasses all of their operations. In this case, the scope must be limited to a specific division, function, or geographic area. Once a preliminary scope has been determined,

formalise it by issuing a memo to all appropriate individuals clearly defining what will and will not be included in the feasibility study. This document should seek their agreement and approval. In doing so, the project boundaries will have been clearly delineated and management can approve it, thus there will be no unexpected surprises three months hence when the feasibility study is completed.

Many organisations believe so wholeheartedly in the concept of EDI that they do not even bother doing a detailed cost benefit justification. This is mainly due to strategic reasons for implementing EDI and the relatively low cost implications. However, there are benefits to be gained from performing a cost benefit justification. By justifying EDI economically it will facilitate *selling* the concept within the organisation as well as to the executive management. A complete analysis should be made on the feasibility of an organisation and its trading partners using EDI. This evaluation should be ongoing since EDI is rapidly changing. An application that isn't feasible today might be in a year or two. So a constant re-evaluation of how and where EDI is used, is needed to avoid missing any opportunities.

EDI is a technology that will require budgeted resources and the cost justification will quantify the resource requirements over a period of time, thus making it easier for the project team to acquire the resources whenever needed, rather than to try and justify each expense as it is made. Another reason for the cost benefit justification is that it will give direction to the EDI implementation strategy. If the necessary funding for a full integration and business reengineering process is not available, stand-alone implementation options need to be considered. Another option to consider is to front-end a micro computer to the mainframe, until such time as the volumes force the more expensive mainframe software option (provided a mainframe environment is being used). Costs and benefits to be considered are summarised in Table 4.2.

The method to be used for performing the cost benefit analysis is beyond the scope of this research, and hence only items to be considered will be pointed out. Generally organisations will apply existing cost-benefit analysis techniques.

The costs, mostly initial ones, are easy to quantify whereas the benefits are only reaped in time. Benefits will also only increase as volumes of EDI usage and the number of trading

partners increase. This implies that the benefit will be at its lowest when cost is as its highest and vice versa. Costs are both one-off and on-going and there are a number of cost categories to consider.

Costs	Benefits
Start-up Costs	Direct Benefits
Hardware Software Training Personnel / Consultants Initial investigation / Research	Reduction in Data Capture Personnel Savings Reduced Inventory Reduced Paper Utilisation Data Accuracy & Timeousness
On-Going Costs	Indirect Benefits
Transmission Costs Software Maintenance Costs Personnel / Consultants Hardware Maintenance Costs Training Costs	Improved personnel usage Improved access to & use of information Strategic advantages

Table 4.2 Summarised cost and benefit components

Cost Considerations

- *Hardware Costs*

Hardware costs include both the initial acquisition and the maintenance of any equipment necessary to perform EDI. Most organisations will start off with a micro computer as a front-end to a mainframe and will require communications modems and some sort of PC-to-mainframe link, e.g. TCP/IP and XCOM 6.2. Some organisations would even consider purchasing hardware for their trading partners to facilitate the process. Hardware maintenance costs also need to be considered.

- *Software Costs*

Once again, software costs have initial acquisition fees and on-going maintenance costs. The software to consider is the translation software and the communication software, which is relatively inexpensive. Costs do increase as the platform goes from micro to mainframe. Annual license fees are relatively low for the software on micro computer platforms and increase at the mainframe level (up to 15% of the

purchase price on an annual basis). If EDI is integrated into existing application systems, the costs for doing these modifications can be very high and will depend on the level of integration and availability of staff.

Evaluating a translation software package is not much different than evaluating a normal software package. Initially, the hardware platform to be used must be determined. Is it going to be a PC, mid-range or mainframe? Historically, PC-based EDI applications have been prevalent. They were and still are the cheapest and fastest way to implement EDI. However, as EDI penetration grows, translation software requires greater integration with business application systems, more processing power, and enhanced security features. The current trend is away from PC-based translator packages to mid-range and mainframe systems.

The next thing to determine is what operating system the translation software is going to run on. Is it going to a MVS, VM, DOS, UNIX, OS/2, or some other proprietary-based operating systems? Generally, the hardware platform will greatly influence the operating system. If the decision is made to run on an IBM Mainframe, the choice of operating systems is limited. A decision to implement a new operating system is costly and one that cannot be justified based on the need for a specific EDI translator package. Conversely, the PC environment offers a number of different operating systems environments that can be easily and inexpensively changed.

Once the hardware and operating system requirements or restrictions are understood, it is an easy process to compare vendor specifications to determine which packages meet the basic needs.

Generally, it is fair to say that there are more third-party products available supporting the IBM hardware and software environment than any other. If the translator must be run on non-IBM platforms, the choices are more limited, but still good.

Once the field of prospective vendors has been narrowed, vendor stability and reliability must be evaluated.

- *Training Costs*

Training costs will be incurred for both the EDI project team as well as company personnel and in some cases even trading partner staff. These costs will be both at an initial stage as well as on-going as project team and personnel change, and EDI standards and technology changes.

- *Transmission Costs*

These are mostly the on-going costs incurred in the actual data communication, except in the case of a VAN being used where there will be both initial charges as well as on-going costs. These costs will be dependent on the volume of data communicated. A new trend to consider initially, whilst trading partners are limited and volumes low, is an industry VAN. Such a VAN has no initial costs for licenses or software, but only transmission costs and is set up for a specific industry, e.g. EasyServ in the motor industry. Although these types of VANs tend to focus on a specific industry, they are quite capable of expanding their operations to any other industry.

Value-added networks are important because of the variety of services they offer. By reducing transmission cost and improving operational efficiency, the use of a VAN should be thoroughly explored before a decision to go direct-dial is made. This is especially true if one has to link up with dissimilar machines or incompatible communication software.

All present and future communication requirements should be considered when selecting a VAN. Not only should it offer the store and forward capability required today, but other technologies that allows migration to interactive EDI or other types of inter-organisational systems.

Understanding supported protocols is important, especially when taking the differences between transmission speeds (baud) into consideration. For example, if a VAN only supports 1200-baud binary synchronous communication in a dial-up mode, it could take many hours to transmit a large file. The cost could outweigh any

advantage. However, in this example, substantial savings could be achieved in using a leased line. A leased line would permit access to higher-level protocols that support fast transmission speeds which might outweigh their higher cost. Geographic coverage of a VAN is important. However, the relative importance depends on the location of current and expected trading partners. When evaluating geographic coverage, include the number and geographic dispersion of interconnecting networks as well.

Pricing is important, especially in a high transaction environment. Factor volume discounts into the equation for a realistic estimate. Value-added services are important and a thorough evaluation should be performed. This includes in-network translation, trading partner marketing programs, and error detection and correction procedures. However, the importance of these services are relative; if one expects to purchase translation software, disregard in-network translation; if only a few trading partners are being dealt with, which is typically the case, a trading partner marketing program is immaterial. However, error detection and correction are always important! So are accuracy and completeness of billing, and disaster/recovery plans. If a company is implementing EDI for the first time, new and future technologies have minimal impact. However, it is important to be aware of them so that there are no surprises later.

- *Personnel Costs*

EDI implementation will use both information technology personnel as well as staff from other functional departments. Consultants may also be acquired with the initial stages and pilot projects. On-going information technology maintenance will be required and these costs need to be considered, as changes will be needed as identified by any reengineering processes. Integration of the EDI transaction with existing systems will require maintenance to these systems.

- *Initial investigation and research*

An initial investigation should be done to focus on aspects such as EDI technology, business implications and feasibility studies.

▲ *Indirect Costs*

In addition to the above-mentioned direct costs of EDI, indirect costs may also be incurred. Indirect costs include the following (Harrington 1994):

- EDI has the potential to bring about fundamental change in the way business is done. Ready acceptance of such change is rare. It is difficult to quantify the costs of changing the way an organisation does its business.
- EDI introduces a risk to the integrity and confidentiality of transmitted information. Sensitive or competitive information may be divulged (either accidentally or deliberately) on networks or in the mailbox storage system. In addition, EDI messages may be corrupted or lost while being transmitted. As a result, security policies and procedures must be put into place to ensure authorised transaction processing and the prevention and detection of data manipulation or loss.
- The removal of paper documents and the traditional audit trail in an EDI system makes the tracing of transactions from their source to the records in the books of account, or vice versa, more difficult. The cost involved is dependent on the resource and time needed to resolve such problems.
- The legal structure and rules are built to serve a paper-based trade system. As many of the existing terms and conditions of trade include references to paper and postal systems, it is necessary for trading partners to negotiate and enter into a well-structured interchange agreement.
- The elimination of human processing of documents changes the organisation's internal control environment, necessitating the modification of existing internal controls.
- EDI poses a risk to the continuity of business. Procedures need to be developed and implemented to enable the organisation to continue transacting should the system be unavailable for an extended period.

▲ *Other Costs*

Other costs include membership fees to EDI committees and organisations, attendance

of seminars, cash flow implications and subscription fees to EDI journals. In Table 4.3 taken from a recent survey on cost assessment of EDI in South Africa, (Harrington 1994), a range of costs of some quantifiable EDI cost components are presented.

Cost category	PC	Mid-Range	Mainframe
1. Hardware Requirements			
Upgrade Existing	R0-R2000	n/a	n/a
Purchase New	R6000-R10000	n/a	n/a
2. Communication Equipment			
Dial-up lines: Modem	R1000-R4000	R0-R4000	R0-R4000
X.25 Network: Equipment	±R12000	R20000-R30000	no data avail
3. EDI Software	R10000-R22000	R55000-R500000	no data avail
4. Training	R1000-R4000	R4000-R8000	R5000-R10000
5. EDI Software Maintenance (per annum)	R500-R4300	R7500-R12000	no data avail
6. VAN Costs transmission costs	R500-R2000	±R1000	±R1500

Table 4.3 Cost ranges for quantifiable EDI cost components

Benefit Justifications

Some benefits are obvious and measurable, others are not easily cost justified. The EDI implementation strategy selected not only has cost implications, but benefit implications as well. Factors that may influence benefits include the hardware platform, volume of transactions, number of EDI trading partners and the degree of application system integration. Some of the tangible and intangible benefits to be considered are discussed below.

▲ *Personnel Savings*

The savings in staff that can be achieved when utilising EDI due to the reduction or elimination of activities performed. For example:

- re-keying operations of data from one document onto a computer system and

back to another document are redundant;

- re-keying operations of data as a result of previous erroneous data capturing are redundant;
- mailing costs (Packaging mail, addressing mail, distribution of mail);
- filing and storage costs;
- reconciliation time;
- document tracking for queries.

The greater the EDI volume the greater the personnel saving that may be achieved. The actual cost will be dependent on the cost of personnel that perform these tasks, and what is achieved with the time saved by these staff members. Thus savings can be measured in terms of the additional staff needed to perform tasks that may now be re-assigned to existing staff and /or costs saved by eliminating staff.

▲ *Paper Benefits*

The costs of acquiring paper for storage and mailing will be reduced depending on the level of EDI usage.

▲ *Inventory Savings*

EDI facilitates the usage of the just in time principle which results in reduction in inventory levels, which reduces the inventory costs.

▲ *Time Value Benefits*

EDI usage on transactions such as payments and invoicing, facilitates earlier receipt of documents, resulting in time saved.

▲ *Information Cost Savings*

EDI usage facilitates the availability of more timely and accurate information which results in savings in reduction in premium freight charges (as rush orders are

eliminated), reduction in out of stock situations and reduction in production line shut downs.

▲ *Undetected Errors*

The reduction of manual input of data has lead to concern that errors can enter the system unnoticed. However, EDI Systems, if anything, are less likely to generate errors than manual systems, as re-keying and duplication of information is avoided.

▲ *Other Benefits*

Some of the less quantifiable benefits include improved internal operations, closer relationships with vendors, increased sales due to increased productivity of personnel, and supply-chain management.

The acceptance of a feasible EDI implementation must be gained from top management before continuing with the project.

Risk Management

In order to minimise the risks of EDI, the following guidelines can be followed:

1. Consistently enforce recognised EDI standards.
2. Appoint someone responsible for EDI coordination.
3. Implement specific controls to ensure accuracy, completeness and authorisation for EDI transactions:
   - adequate and timely reporting of information for decision-making and error-detection;
   - transactions must be passed to all relevant applications and only these applications;
   - temporary work files should be adequately secured to prevent unauthorised access;
   - differentiate between processed transactions and transmitted processed

transactions;

- use the appropriate EDI message structure with the relevant headers, trailers, and identifiers;
- policies and procedures for validating trading partners;
- high risk transactions should be monitored effectively;
- encryption, as a technique for data protection and the control pertaining to it, should be considered;
- information should be generated to enable the reconciliation of VAN charges;
- check digits should be used in control fields and counters should be kept within limits to ensure transaction control.

4. Lack of interconnection between networks; The technical aspects of interconnection present few problems but such issues as 'who pays for what?', 'where does responsibility lie?', and the thorny question of loss of trading revenue to rival network suppliers, must be addressed.
5. Legal Aspects; The legal aspects include the provision of new forms of contract, and deciding when and where the contract is formed, an issue of some importance where EDI transactions cross national boundaries. Possible computer fraud and theft of data need to be addressed.
6. Negotiable Documents; For example the Bill of Lading is used in the shipping industry as a document giving title to the goods in transit, and must be produced (properly endorsed), before the purchaser can take possession of the goods. Account must not be lost of such required documentation when reengineering the business process.
7. A limited number of suitable EDI packages restrict options.
8. A limited number of standard EDI documents may be defined in a specific industry.
9. A critical mass of EDI users has not yet been reached, thus delaying the optimal benefit gain.
10. A wide range of participants may be involved in a particular business transaction, complicating the coordination and management of the project.
11. Consider the implications of a network collapse.
12. Consider the handling of received data that was not processed due to internal errors in the recipient's computer system.

4.3.1.3 Select Alternatives

The results of all the various alternatives for implementing EDI are evaluated according to risk and cost/benefit. This determines the course to be taken for EDI implementation as a whole and will also specify the strategy that will be followed for the pilot project and subsequent sub-system implementations.

4.3.1.4 Formulate Project Charter

The results of the risk and cost/benefit analysis are formulated in the Project Charter. A project plan for the pilot sub-system implementation is also drawn up, based on the selection of specific alternatives, objectives and constraints.

4.3.2 Sub-system Analysis Cycle

A summary of the tasks required to complete the Sub-system Analysis Cycle is given in Table 4.4, whereafter the processes involved in these activities are explained. This is part of the iterative cycle of the EDI implementation methodology, with variable factors such as trading partners and documents to be considered in each repetition of the cycle, from where a return to the Feasibility Cycle may be made, as defined by the model, should the need arise due to results of the evaluation steps, or continuation onto the Sub-system Implementation Cycle.

4.3.2.1 Sub-system Initiation

EDI sponsors need to be identified in each functional department. This process will later facilitate the identification of potential EDI-ready departments and serves as an initial informal education process.

Internal orientation will be an on-going process and communication channels need to be kept in place with regard to actual and proposed EDI developments within the organisation. User training courses should be set up and methods to deal with objections and negative attitudes towards EDI within the organisation should be developed.

Sub-system Initiation Team selection Define objectives of the EDI sub-system analysis. Define alternatives (w.r.t. sub-system analysis strategy). Define constraints to the sub-system analysis.
Sub-system Risk Analysis Identify and resolve risks: ▪ Audit issues ▪ Legal issues ▪ Centralisation / decentralisation ▪ Sub-system participants / documents internally and externally ▪ Sub-system interchange agreement ▪ Sub-system integration / reengineering ▪ Sub-system technology.
Sub-system Business Analysis Training Interchange Agreement Business reengineering Application system integration analysis
Plan/review Project Charter Verify sub-system analysis: ▪ Strategy (integration, technology, reengineering) ▪ Participants ▪ Contracts

Table 4.4 Summary of tasks in the Sub-system Analysis Cycle

Objectives / Alternatives / Constraints

The objectives, alternatives and constraints of the specific business area, document/s and trading partners involved are defined and analysed, bearing the overall objectives, alternatives and constraints, set during the Feasibility Cycle, in mind.

EDI Project Team

The elements of an EDI project team are the Steering Committee (also referred to as the Strategy Committee, the EDI Project Manager and the various EDI Implementation teams each headed by an EDI Project Leader. At any point in time there may be one or more implementation teams at work depending on the organisational implementation strategy. The EDI role players and their organisational structure is depicted in Figure 4.7.

▲ *The EDI Project Manager*

The EDI project Manager has an unusual mix of personal skills and technical ability. To emphasize how professional and skilled the EDI project manager is, the EDI project manager (in our experience) must:

- Continually affirm project scope and objectives and keep these in mind;
- Prepare the implementation plan;
- Establish the project schedule and monitor progress towards it;
- Manage and coordinate the vendors;
- Report to senior management;
- Manage project team members who probably do not report to him or her;
- Assure communication with end users;
- Manage in-house software development.

His external tasks are as follows:

- Rationalise the lists of prospective trading partners from end users and determine whether these partners have EDI capability;
- Plan the Trading Partner Conference;
- Conduct the conference;
- Gauge a trading partner's degree of commitment and readiness;
- Monitor the progress of new trading partners;
- Answer trading partner's questions or get them answered;
- Assure that the trading partners properly perform testing.

▲ *Other Project Team Members*

In selecting the EDI project team it is important that members throughout the organisation be identified to ensure successful implementation. Typical functional areas that should be represented include Finance, Sales, Purchasing and Distribution, whereas support areas include Legal, Auditing and Information Technology. It is also important to realise that EDI implementation will be a phased approach, throughout

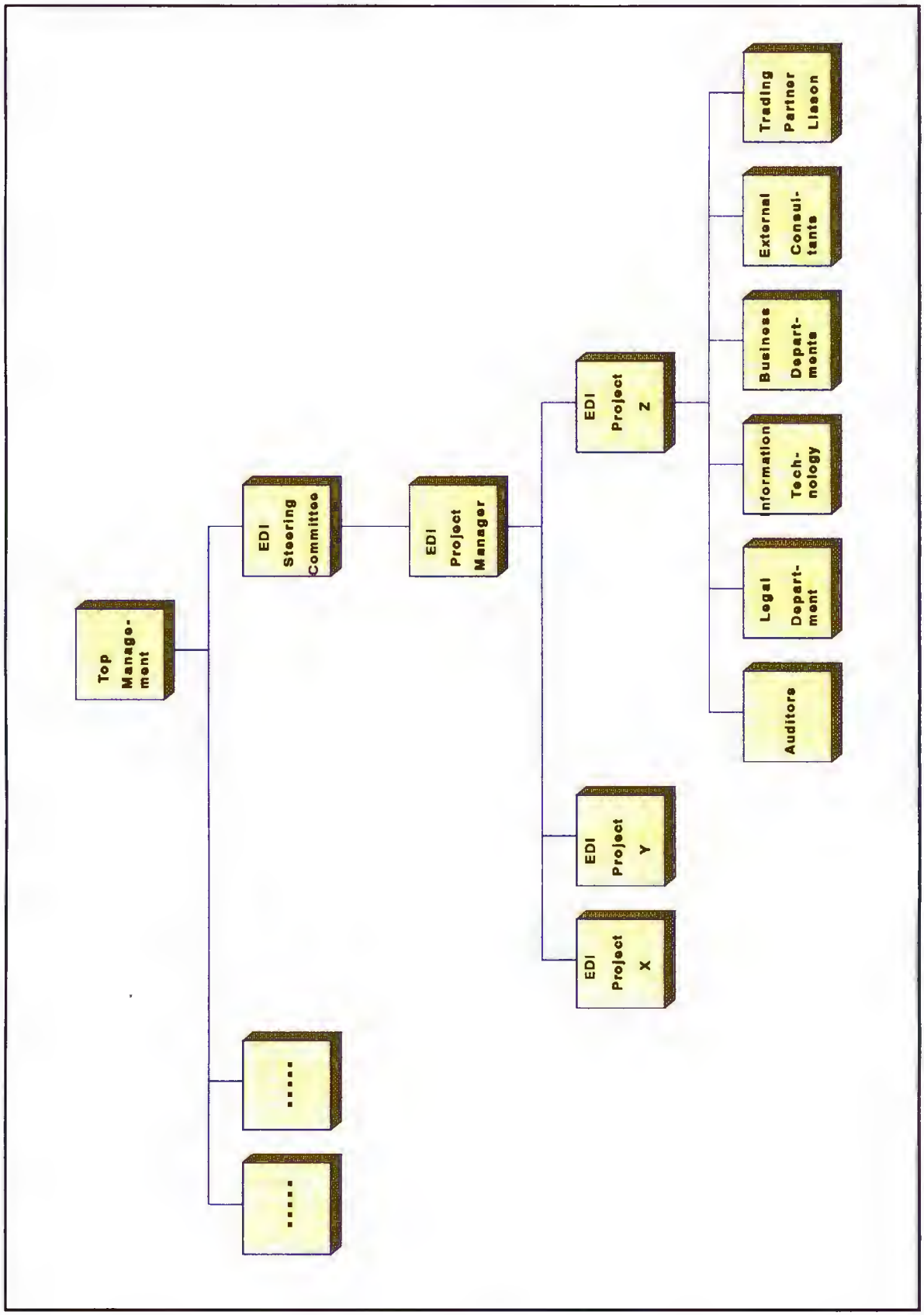

Figure 4.7 The EDI role players

the organisation, over a long period of time. Thus the project team will not remain fixed for the duration, but will continually change, depending on the cycle involved and the business area concerned. Different people could be involved with the feasibility study versus the Sub-system Analysis Cycle and even for different iterations of the Sub-system Analysis Cycle. This is because on different iterations, different business areas and different trading partners could be involved. Similarly IT technical specialists may be involved in the Sub-system Implementation Cycle and would probably not be involved in the Sub-system Analysis Cycle.

Top Management must provide active direction to the EDI project. **Only top management has the appropriate authority to allocate EDI resources (both money and manpower) and the perspective to direct a balanced EDI implementation across functional departments throughout the organisation.** In its role as the Steering Committee, top management keeps the project focused on the goals of the business plan and assures cooperation between the EDI project manager and functional managers.

Top management must both understand and commit to the EDI project. Commitment alone is not sufficient. Top management must also understand the EDI planning process and the resources needed to implement EDI strategically.

Appointing an EDI project manager requires the approval of top management. A functional manager in the organisation will usually be appointed as the project manager. Managers of Information Services or Purchasing are common candidates. **EDI must be the top priority for the project manager.** Otherwise, the project will inevitably languish as other activities demand attention. Consequently, it should be noted that the project manager must reduce the time allocation for his primary job in order to fulfill the new responsibility. Obviously, top management must approve the new priority of time resources. Alternatively, if it is decided that outside expertise is more practical, top management must approve an EDI budget that either addresses the expense of an external consultant as project manager or the cost of hiring a full time EDI project manager externally.

The project manager becomes a dedicated EDI resource, champion of solutions as well as the focus point of EDI information sharing. **The project manager becomes a resource for interested departments exploring potential applications, assisting with implementation planning and educating departmental staff on EDI.** The project manager coordinates overall planning and implementation. He also manages the relationships with trading partners, software vendors, and network service providers. Where only a single project team is active in implementing EDI, the Project Manager could fill the role of Project Leader, whose purpose is to serve as communicator between the Project Manager and the implementation teams.

The project team is usually composed of managers from those functional areas most likely to benefit from EDI, as well as other departments involved in the document flow and impacted by the information processing.

Members of the project team are responsible for specific information gathering involving their functional areas and for implementation tasks assigned by the project manager. In this fashion, the project team leverages the limited time of the EDI project manager.

Each EDI project team consists of a number of specialists headed up by the EDI project leader, who reports to the overall EDI project manager, who will provide overall direction and supervision, communicate with top management and arrange the necessary resources. The implementation strategy and arrangement of funding will also be determined by the project manager. It is the EDI project manager's responsibility to approve implementation schedules, technology vendors and to supervise the actual implementation. Very often an EDI technology expert will form part of the management team and is normally an outside consultant. This person is normally responsible for assisting management in making decisions on issues such as standards, VANs, hardware and software configurations. Management will be assisted by a support group who may not form a permanent part of the EDI implementation team, but rather a support on an as and when needed basis. This support group consists of legal experts as well as an auditing panel and coordinators from the training department. The rest of the team will consist of technical

personnel, such as communications experts, consultants and applications systems integrators. The operations part of the team will consist of managers from the functional areas to assist in identifying EDI applications and to prioritise them. They will also be actively involved in the reengineering process. A liaison person or persons may be included in the team to assist in selling EDI both internally and externally. The role of the liaison person/s will be crucial in selecting trading partners for implementation and to maintain relationships between the organisation and the trading partner by coordinating queries between all parties involved in each implementation.

Before any detailed decisions can be made by the project team, team members need to be familiarised with the concept of EDI, and as the project team will change from time to time, this education process will be on-going. The education will be of both a theoretical and practical nature, the theory being a familiarisation with the concepts of EDI and its implementation, the practical being an investigation into related organisations' EDI implementations.

It is as important that the project team also has an understanding of the legal and auditing implications surrounding EDI and the necessary experts should be assigned to assist the project team where necessary. Emphasis should also be placed on information security and trading partner relationships, and the importance of the interdepartmental and inter-trading partner communication channels with regard to the project performance and strategic decisions.

4.3.2.2 Sub-system Risk Analysis

The risk analysis step of this cycle will be performed for every EDI project performed. As more experience is gained in implementing EDI within a specific organisation, the less time and effort will be spent on these steps of the cycle.

Auditability Issues

When implementing EDI it must be realised that the implementation will be replacing some

process being performed in the organisation and thus that process and the flow of data in whatever form, must be analysed and understood. The following aspects should thus be considered prior to any EDI implementation:

- What data is traded with partners? Purchase orders, invoices, messages, faxes and phone calls;
- How and where is such data initiated? Manual input, voice input, screen input or computer generated;
- Internal flow of the data: Number of copies, format, destination, purpose, storage requirements and storage format;
- Control and reporting measures used: Status reporting, audit trails, security safeguards;
- Data passed to existing application systems: Data format, flow of data between applications and data entry;
- Information generated by application systems: results produced, format of the output.

These considerations will also assist the project team when doing the actual implementation to properly specify the action needed to integrate EDI into the system or to reengineer a specific process, ensuring that the organisation has **at least** the same functionality after EDI than before EDI.

Legal Issues

Legal aspects of EDI within the organisation should be considered by the legal department or legal advisors of the organisation so that the infrastructure for tackling any legal problems that the project team may be confronted with, is prepared. Of utmost importance is the infrastructure required to finalise trading partner agreements needed to clarify EDI relationships between the organisations, and to maintain such agreements.

Centralisation / Decentralisation

Another aspect to consider when defining an EDI implementation strategy is whether to have a centralised or decentralised translation scheme. In a centralised translation scheme

a single host is used with a single version of the translation software, whereas with a decentralised translation scheme, a number of departments may each have their own translator. The centralised scheme has less risk of redundancy and enables stricter control measures to be implemented. This decision will be influenced by the organisation's ability to facilitate decentralised communication, as centralised communication with decentralised translation is not feasible. This is mainly due to audit and error handling problems that arise. EDI facilitates the choice and the decision to handle document processing centrally or not is best left to the results of reengineering the processes involved.

Sub-system participants / documents: internally and externally

A program should be prepared defining a consistent approach towards trading partners. At this point some committees may be set up to establish support for the selected standards and information security procedures. Another aspect of EDI strategy to consider is whether to initially implement EDI in a functional area, or for specific documents across the organisation, or specific documents within a functional area. The decision will be influenced by the strength of management support, commitment from trading partners and availability of resources.

As a guideline for an implementation strategy the team should establish business objectives with the cooperation of top management for using EDI. An interdepartmental communication channel should be set up, and the following steps need to be performed in order to assist in identifying priorities for implementing EDI projects:

- compile a list of all business transactions performed (paper, phones, faxes etc.);
- design a revised dataflow within the organisation should EDI be in place;
- reengineering business processes;
- list and prioritise all potential EDI partners according to importance, trading volume, EDI literacy, hardware and software issues.

Ultimately an organisation may wish to implement all documents in an EDI environment. However, in each project only a limited number of documents will be selected for EDI implementation. The choice of which documents to convert is normally dependent on

demand from trading partners, benefits to be reaped from the conversion, availability of standards for that document, the implementation strategy adopted and usage by trading partners and other organisations of these specific documents in an EDI environment.

Similarly departments affected should be examined, usually based on the documents selected, the education level and understanding of EDI in the department, the volume of transactions in the department and the resources available within the department for handling an EDI implementation. This is important as both the existing transaction processing as well as EDI processing will need to be continued until all trading partners are utilising EDI.

Trading partners need to be carefully selected. Selection is based on the volume of transactions being processed between the organisation and the trading partner, the trading partner's ability to implement EDI or trading of existing EDI implementations as well as considering the strength of the relationship between the trading partner and the organisation. Most organisations find that eighty percent of their transactions are being processed with twenty percent of their trading partners and thus these partners are likely to yield the biggest pay off in terms of a cost benefit. Should a trading partner have an existing EDI implementation, the organisation will gain by not having to re-invent the wheel. It is also important to realise that initial implementations will not go as smoothly as subsequent one's, and one needs to take care that the relationship with the trading partner is not jeopardised during this demanding process. For each project the original EDI implementation strategy should be revised with regard to whether it will be a stand-alone, integrated or reengineering process. The chosen strategy may not always agree with the original strategy as a result of influences from the trading partner.

In selecting trading partners a training process and information communication process should be performed whereby EDI's standards, transactions and integration issues are discussed and approved with the trading partner.

Interchange Agreement

For each trading partner an EDI agreement should be set-up. The agreement should reflect

the road-map to be used in implementing EDI with the trading partner.

The agreement should stipulate a number of conditions:

- software connectivity;
- point of legal receipt of a document;
- the time span the receiver has to acknowledge receipt of a document;
- standards to be used;
- the collection time if mailbox (VAN) is to be used for documents and the placement time of documents in mailboxes;
- the responsible organisation accepting costs for documents sent or received;
- terms and conditions from other existing agreements;
- identify error responsibility and action, in transmission errors and hardware damage;
- audit requirements;
- security and access issues;
- general legal issues;
- contact and query person/s and procedures.

The agreement could also stipulate a number of optional conditions:

- sequence of implementing EDI documents;
- minimum information requirements per document (message type, version, release), normally placed in an addendum, which will be added to and amended as time go by;
- specify the pilot test period and nature of the pilot test data;
- incentives and penalties should timing issues be critical.

As change is usually inevitable (one of the only constants in life), the interchange agreement will have to be reviewed for each sub-system implementation. It is strongly recommended that some form of interchange maintenance authority be created. Such an authority would be responsible for the control and maintenance of the interchange agreement, with particular responsibility for the production and circulation of amendments to the agreement, and for control of change-over to new versions of messages.

Sub-system integration / reengineering

Although a detailed discussion of these two steps is beyond the scope of this research project, points to consider will be addressed.

Two major components to consider are the integration level and the identification of functional areas for implementation. When considering the level of integration it should be decided whether EDI will be implemented as a stand-alone concept, whether it will be fully integrated into the existing application systems, or whether the business processes will be reengineered as part of the EDI implementation. This decision is often dictated by the application software. If packages are used that do not yet have EDI integration links it may prove impossible to integrate even if desired. At pilot project level it is very often wise to implement EDI as a stand-alone implementation in order to test the hardware and software acquisitions that may have been made for the actual document translation process and document communication processes. The next phase may be to integrate the electronic document handling into application systems or to reengineer the business process supported by the application system, and then integrate. Thus a combination of these implementation strategies may be considered. A desirable long term strategy would certainly be to reengineer all processes once confidence in the concept has been attained by means of a number of successful pilot projects.

Sub-system Technology

The type of EDI to be implemented, e.g. point-to-point or proprietary EDI, also has to be established. Appendix G provides a document produced by SITPROSA to assist its members in evaluating a VAN facility.

The EDI project manager should continuously monitor actual implementation projects to ensure adherence to their decisions and standards. He needs to continually review the technology strategy.

At this point the organisation must identify its technology requirements with regard to implementing EDI. EDI software should be identified and evaluated. Any hardware

requirements must be identified and acquired as well as any network implications. A decision should be made whether a VAN will be used and if so, which one. These decisions are continuously revised as software products improve and as the EDI volume increases in the organisation, at which point in time a VAN may become a more serious consideration than at pilot project stage.

The typical software requirements to be addressed are translator software, network connection software and finally EDI service software. The translator software tends to be generic and table driven so that they are message or standard independent, whereas the service software is responsible for generating the commands necessary to drive the EDI service. It should distinguish between messages received for the EDI service and those actually containing the data to be transmitted. Once all the necessary technology requirements have been identified, potential vendors must be found for these products and an evaluation process started, whereafter the purchased products need to be implemented in the organisation.

4.3.2.3 Sub-system Business Analysis

Issues such as the requirements of the interchange agreement, technology, reengineering and integration are investigated.

Training

Actual training requirements identified in the previous phase are to be met. This training could be aimed at the implementation team, the department involved internally or even the staff of the trading partner.

Interchange Agreement

The interchange agreement risks identified in the previous step, must be analysed with regards to the specific trading partner, documents and business areas involved, to enable the actual agreement to be drawn up. The agreement may go as far as to mention specifics, w.r.t. the interpretation of the standards for a specific document, e.g. optional fields to be

used. Larger organisations tend to force their smaller trading partners into accepting their agreements, rather than it being a mutual acceptance.

Business Process Reengineering

Business reengineering is dependent on the implementation strategy and can occur almost anywhere in the EDI implementation process and would normally be conducted by a separate team other than the EDI implementation team. A detailed method for business process reengineering is beyond the scope of this research project.

One of the dangers threatening the EDI implementation project team, consisting mainly of information technology personnel, is that the concept of business process reengineering may not be enacted. EDI is a catalyst to bring about a reengineering exercise. It gives organisations the opportunity to think about existing processes for trading with suppliers and customers and question why such processes take place, what the alternatives are and how both internal and external processes may be improved. Areas for consideration are discussed in Chapter 2.

Application System Integration Analysis

The standard analysis performed for enhancements to existing application systems is performed by the relevant IT personnel and users, to identify the amendments necessary to these systems, to integrate the EDI software with these systems. Care must be taken to do this in accordance with the integration strategy laid down during the Feasibility Cycle.

This is yet again a step that is dependent on the implementation strategy. Should a stand-alone implementation be considered then the EDI implementation will be used purely as a transmission of documents rather than a fully integrated EDI environment. The application integration process is one that is normally carried out by the information technology department's maintenance staff, who need to make the necessary adaptations to the existing application systems in order not to receive data from a data capture screen only, but also have the ability to receive data from an EDI created file, with the same validation and controls required. Similarly changes need to be made not to create output on paper but an

electronic file for transmission by EDI communication software. This can be done before or after hooking-up of the trading partner.

4.3.2.4 Plan / Review Project Charter

This step is performed to obtain go-ahead to the actual implementation for specific document/s and trading partner/s. Any deviations from the objectives and directions set previously needs to be communicated to management for approval. These changes need to be reflected in the project charter. Any scheduling amendments need to be made as well.

Verify Sub-system Analysis

The EDI analysis done should be evaluated by both the organisation and its trading partners. Management report back is to be done with the purpose of reviewing the implementation strategy for the next project. Continuation to the Implementation Cycle is not only dependent on the organisation itself, but also on the trading partner/s involved.

Revise Project Charter based on evaluation / Plan sub-system implementation

The Project Charter is reviewed w.r.t. implementation strategy, participant selection criteria, technology, application system integration, business process reengineering and interchange agreements. The Project Plan for the actual sub-system implementation is drawn up, in consultation with all the relevant participants and implementation issues identified to allow the implementation of the sub-system to commence.

4.3.3 Sub-system Implementation Cycle

A summary of the tasks required to complete the Sub-system Implementation Cycle is given in Table 4.5, whereafter the processes involved in these activities are explained in greater detail.

This is the third cycle of the EDI implementation methodology, with actual EDI implementation being scheduled in a live environment, from where a return to the

Feasibility Cycle may be made, as defined by the model, should the need arise due to results of the evaluation steps. Mostly return to the Sub-system Analysis Cycle would follow as part of the iterative process of implementing the next document/s and trading partner/s.

Sub-system Implementation Initiation Team amendments. Define objectives of the EDI sub-system implementation. Define alternatives (w.r.t. sub-system implementation strategy). Define constraints to the sub-system implementation.
Implementation Strategy Evaluation
Implement Sub-system Training Signing Interchange Agreement Auditability and Legal Issues Centralisation / Decentralisation Business reengineering implementation Set-up links: ▪ software links ▪ hardware links Application system integration Test link Live implementation.
Plan/review Project Charter Verify sub-system implementation: ▪ Strategy (integration, technology, reengineering) ▪ Participants ▪ Contracts Revise Project Charter based on evaluation Plan next sub-system implementation.

Table 4.5 Summary of tasks in the Sub-system Implementation Cycle

4.3.3.1 Sub-system Implementation Initiation

A review of the objectives, alternatives and constraints is done to enable a clear understanding of the project team amendments required for the final phase.

Project Team Amendments

Any team changes required to do the actual implementation are made, e.g. IT specialists to assist with the software implementation and hardware configuration, or programmers to do the enhancements to integrate the EDI software into application systems.

4.3.3.2 Implementation Strategy Evaluation

The implementation strategies as defined by the Analysis Cycle are evaluated and refined with a view to actual implementation. Centralisation and decentralisation alternatives are evaluated and action lists drawn up. Integration and reengineering results of the Analysis Cycle are evaluated and decided upon. If need be, new products are evaluated as per the Sub-system Analysis Cycle. As more and more trading partners are linked up, less time and effort will be spent here.

4.3.3.3 Implement Sub-system

This step sees the efforts of the Feasibility and Analysis Cycles come to fruition.

Training

Actual training requirements identified in the previous phase are to be met. This training would be aimed at the department involved internally or even the staff of the trading partner.

Interchange Agreement

The interchange agreement finalised in the previous phase, must be signed by all parties involved.

Auditability and Legal Issues

The team members responsible must ensure that the requirements defined in the Feasibility Cycle and Sub-system Analysis Cycle, with regards to auditability and security, are met. This must be done with the involvement of the auditors.

Centralisation / Decentralisation

Necessary steps need to be taken to ensure that no problems will occur with regards to the

directive identified for centralisation or decentralisation.

Business Reengineering Implementation

The results of the business area reengineering analysis are implemented by the specific business area, with regards the documents in question. Due to the fact that not all trading partners implement EDI for a specific document at the same time, the old procedures still need to be maintained until they are not needed.

Set-Up Links

This step should be done for every trading partner that is hooked-up on the system and is tested by using dummy data for transmission to check that all links are working; that the software is communicating between the two different organisations and that data is being correctly sent and received. This simply means checking that technology is in working condition and helps the users to become familiar with the operation of the EDI technology. The identified hardware requirements need to be set up.

Application Integration

IT personnel do the necessary enhancements to existing application systems to facilitate the EDI software integration as per the guidelines established in the Feasibility and Sub-system Analysis Cycles. This would also include the updating of application system documentation.

Testing the Link with Live Data

This step tests the transmission with actual application documents and is done in parallel with the paper sending and receiving of documents in order to test the EDI implementation in parallel with the live environment. This approach makes provision for sorting out any problems that may arise.

Procedures must be set in place to ensure that a document is not processed in both an EDI environment as well as in a paper environment, thus preventing duplication of document

processing. These procedures should be specified by the individuals responsible for setting the audit requirements for the project. Once satisfaction is reached the next step will be to go live.

Live Implementation

The live implementation may occur only with a limited number of transactions to ensure that the live environment is as stable as the results achieved in the test environment. Once satisfaction has been achieved in the live environment, the physical paper flow process can be removed between the organisation and that trading partner for the documents in question.

4.3.3.4 Plan / Review Project Charter

Emphasis is placed on verifying that the objectives set out initially are met, with the aim of defining the objectives for the next sub-system implementation, especially with regards audit, security and legal requirements.

Verify Sub-system Implementation

The EDI implementation should be evaluated by both the organisation and its trading partners. Issues to be verified and evaluated are: integration, reengineering, audit, legal, and the actual document communication process. Management report back is to be done with the purpose of reviewing the implementation strategy for the next project. At this point the EDI usage should be expanded by identifying further trading partners or additional documents to be converted, and commencing the next project. Expansion can now be done in two ways.

Existing EDI transactions can be expanded with relative ease to other trading partners, or new documents can be identified to be transacted electronically with existing EDI trading partners. As part of the management report-back, the EDI implementations should be publicised in order to get the EDI implementation momentum going and to reap benefits sooner. This should be done both in-house as well as externally.

Revise Project Charter based on evaluation / Plan next sub-system implementation

The Project Charter is reviewed w.r.t. implementation strategy, participant selection criteria, technology, application system integration, business process reengineering and interchange agreements. The Project Plan for the next sub-system implementation is drawn up, in consultation with all the relevant participants and implementation issues identified to allow the implementation of the next sub-system to commence.

4.4 EDI IMPLEMENTATION METHODOLOGY EVALUATION CRITERIA

To date no criteria have been specified for EDI implementation methodologies. Thus a need for such criteria does exist and will assist in evaluating the methodology proposed in this research. As a basis, criteria for software development methodologies were scrutinised (Olle 1991) and practical experience in EDI implementation was used to identify a set of criteria. A brainstorm session was held amongst the project team involved in the case study, discussed in Chapter 5, to establish further criteria for an EDI implementation methodology.

Some of these criteria may be difficult to evaluate and others difficult to satisfy, but it is hoped that prospective methodologies would attempt to adhere to most of them. Due to the lack of existing methodologies and criteria for evaluating prospective methodologies, it has been accepted by the researcher that the proposed criteria would be subjective in nature.

Reliability/consistency

With reliability and consistency, it is meant that if faced with the same circumstances, repetitive application of the methodology must produce the same results. Thus the user of the methodology must be able to clearly interpret each step of the methodology without fear of inconsistent results.

Completeness / Life Cycle Framework

The methodology should be complete so that there is no need for the user to have to apply

any other set of steps to implement EDI. Due to the non-existence of previously defined life cycle frameworks for EDI implementation methodologies, modification to this framework is natural.

Application independence

The methodology should be suitable to any application where EDI is being implemented, e.g. a methodology that is so specific that it could only be applied to financial documents would not be of much use to an organisation when it wishes to implement non-financial documents.

Industry independence

It must be usable in any industry. A methodology that is only applicable to the manufacturing industry causes problems when a manufacturing company wishes to trade electronically with its bank for example. Thus even organisations in a specific industry will do EDI with organisations outside of that industry.

Technology independence

It must not prescribe any technical solutions, e.g. a VAN or point-to-point implementation.

Technique independence

At the atomic level, the methodology should not prescribe specific techniques for performing individual activities. This will allow users to apply existing techniques for those steps that they already perform in the organisation. Examples are the method with which a cost-benefit analysis is performed or the methods used to plan for EDI integration to existing applications.

Adaptability

It should be adaptable to suit the specific needs of the user, e.g. should organisations

already have pilot projects in place they would wish to use only subsequent phases of the proposed methodology.

Modifiability

It must be modifiable to cater for life cycle evolution and changes in EDI and communications technology.

Alternative evaluation

The methodology should facilitate early error detection as well as early eradication of unattractive alternatives.

Environment Issues

The fit of a methodology to an organisation's needs and the demands it places on the organisation are important. The resources required by the implementation process must be considered. Methodologies requiring a great deal of technological support may not be feasible for the small shop. Similarly, small- to medium-sized shops may not be able to afford consultive efforts aimed at customizing a particular methodology to fit their needs. Other issues such as those of educational requirements are also of importance.

4.5 SUMMARY

This chapter conceptualises an adaptation to the Spiral Model of Boehm at various levels of detail in response to the hypothesis of the investigation. An EDI implementation methodology is proposed based on this levelled framework. The methodology need not be followed in exact sequence, and some organisations may skip certain steps (e.g. Feasibility Study), although this is not recommended. Issues to be stressed are the on-going review of the implementation strategy and to continually sell and educate EDI concepts, both internally to the organisation and externally. The methodology supports three implementation cycles, the last two being iterative, to cater for the implementation of subsequent trading partners and/or different documents. Strong emphasis is placed on

continuous review of the implementation strategy, with regards to reengineering, integration and technology. Emphasis is also placed on risk management. Finally criteria for the evaluation of the methodology have been defined. It must be understood that these criteria are subjective by nature. The optimal implementation methodology would be one that supports all of the criteria.

CHAPTER 5 : EDI IMPLEMENTATION: CASE STUDY

5.1 INTRODUCTION

In this chapter the summarised results of a case study are presented and concluded with an evaluation of the project and of the implementation methodology.

During the course of the case study a number of worksheets were developed by the project team, which could be incorporated into the methodology defined in the previous chapter, as documentation tools supporting the methodology. To set the scene for the case study, a background is provided.

Background

The electronic data interchange project was initiated by the Managing Director of CEB Networks, in charge of about 50 personnel. The underlying reasons for the EDI project were two main business objectives: to increase buyer productivity and to decrease inventory, for the Computer Equipment Broker (CEB) group as a whole (approximately 200 employees). EDI was to reduce each buyer's workload. Furthermore pressure was being placed on the group by its UK trading partners to implement EDI.

The CEB group consists of sixteen related but separate companies dealing in both new and second user computer equipment, from PC to mini-computer to mainframe level. The different organisations are situated in all the major centres in South Africa and they have dealings with a number of companies world-wide for the supply of their equipment. As they had little knowledge of EDI, external consultants were approached for assistance. The researcher was permitted to use this implementation as a case study for the proposed implementation methodology.

5.2 THE EDI METHODOLOGY APPLICATION

The results of the CASE study embarked on will be presented according to the model developed in Chapter 4, after definition of the scope of the case study, based on the background provided above.

Scope of the Case Study

Due to time constraints of implementing EDI, the EDI implementation of a single document, namely the delivery instruction, between CEB Networks and a single supplier, namely Marksec, will be implemented by means of the proposed methodology. Appendix B provides further information with regards the delivery instruction message layout.

The objectives of the case study are thus to test the proposed methodology by means of an actual EDI implementation project following all the steps of the methodology and furthermore to evaluate the said implementation according to the criteria specified at the end of Chapter 4.

5.2.1 Feasibility Cycle

In order to set the framework for the project, a staff survey and high level infrastructural analysis were performed. A survey of CEB staff established that the majority of employees are computer literate with a reasonable understanding of EDI concepts (see Figure 5.1). It was, however, clear that external consultants would be required to perform the project management and implementation. A number of opportunities for implementing EDI were

established in the invoicing and purchasing areas. The existing hardware and software base caused no immediate concern preventing possible EDI implementation. Management gave the go-ahead for a full feasibility study.

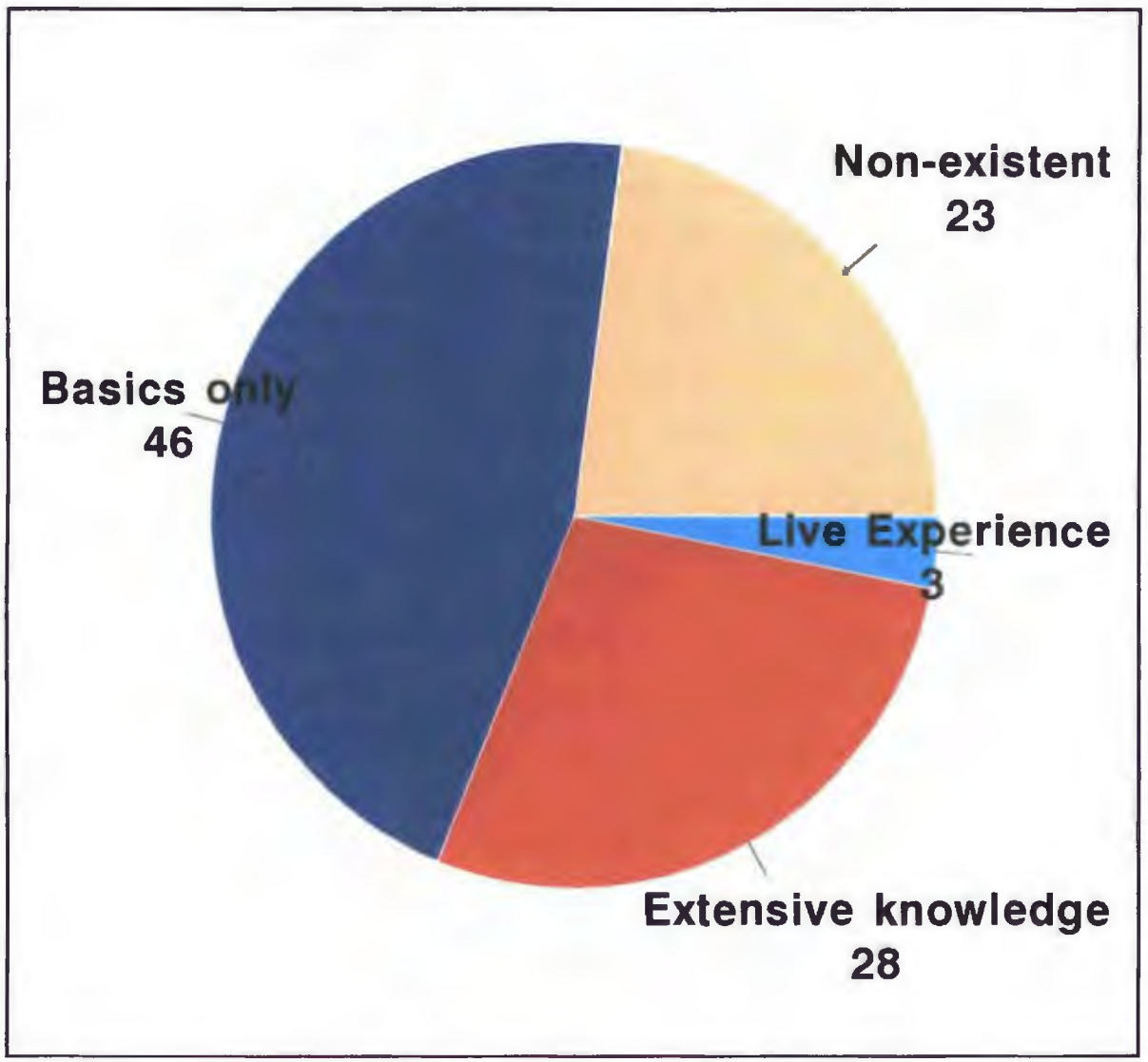

Figure 5.1 EDI Awareness at CEB

The results of the Feasibility Cycle for CEB follows.

5.2.1.1 Project Initiation

As the computer literacy at CEB is high, few barriers were encountered initially, with the only exception being costs versus benefits, which was the purpose of the feasibility study.

Thus the objectives, alternatives and constraints were defined.

Objectives

The first objective was to establish the feasibility of EDI implementation, i.e. to identify the costs and benefits and risks involved. Business areas that could benefit from EDI needed to be identified and the impact on business processes and systems identified. Time and resource estimates were to form part of the cost/benefit analysis.

To meet business objectives, some general goals were set for the EDI project. Within one year, the EDI document volume was to be at least 15% of the former paper document volume of five million purchase orders per year. The project aimed at linking at least 20% of trading partners that received delivery instructions. The number of EDI trading partners at the end of the year was to be in the region of twenty.

Purchasing management also established relationships with suppliers, to encouraged the use of EDI, because it was important to purchasing's business objectives and would be a good business decision for the supplier.

The project was adequately staffed in the user area. An external consultant was assigned as full-time EDI project manager. In addition, a purchasing clerk was assigned one-third time and an internal purchasing manager was assigned 80 % of his time.

Alternatives

An alternative to implementing EDI was to continue all document processing as before, with the possibility of identifying some processes for possible computerisation. The concern of pressure from clients to implement EDI was noted.

Constraints

Possible constraints identified initially were costs and pressure from clients (it had been rumoured that some large corporations were going to put pressure on their suppliers to

embark on EDI implementation or forfeit being suppliers).

5.2.1.2 Risk Analysis / Cost-benefit Study

Management was presented with the various cost implications that certain avenues of EDI implementation may incur, as well as the perceived benefits and finally a risk management plan to embark on should the implementation go ahead.

Cost Considerations

The cost considerations were presented in terms of initial, on-going, essential or optional.

- *Hardware Costs*

  The existing hardware being utilised by the organisation would suffice in the short and medium term. Long term needs would be determined by the transmission traffic. This included personal computers and modems. Disk storage space would be required in approximately three years time. The costs of disk storage have dropped drastically and would amount to approximately R5000 in present day value.

- *Software Costs*

  ODEX/XLATE software communicating point to point via the X.25 network would seem the most cost effective route for those members of the industry that have not already chosen the TRAFEX VAN route. See Appendix C for a breakdown of this product. The entry level for this option is R27 350. The operating cost is substantially lower than that of the TRAFEX VAN as shown in Table 5.1.

  CEB mostly utilises off-the-shelf packages, making integration of EDI into applications an area of concern. Suppliers of these packages are to produce EDI integration options within the next twelve months as part of current license fee agreements on these packages. Thus no added costs are expected to enable integration of EDI software with existing applications.

EDI COSTS	TELKOM X.25 (RAND)	TRAFEX VAN (RAND)
Setup cost (hardware and software)	12 350	11 486
Operating cost (fixed monthly)	456	1 034
Data transmission cost (variable) 20 Mbytes	45	1 800
30 Mbytes	67	2 700
40 Mbytes	90	3 600
50 Mbytes	112	4 500

Table 5.1: Cost comparison on Telkom X.25 to the TRAFEX VAN.

▲ *Training Costs*

As consultants were being utilised to implement EDI, training costs were limited to personnel and excluded the implementation team. Training would be required with regard to changed internal procedures, rather than technical and could be done internally as document processing is converted to electronic handling. The cost associated is negligible.

The courses agreed upon were the following:

EDI - Introduction and Implementation - 1 day p.p. R 570 - R 713

UNE - UN/EDIFACT and Message Design - 1 day p.p. R 570 - R 713

▲ *Transmission Costs*

Table 5.1 above contains the transmission cost via point-to-point and a VAN option. Appendix F summarises a VAN option to be considered when dealing with smaller, less sophisticated partners. This VAN's major benefit is its cheap setup and transmission costs for low volume users.

▲ *Personnel Costs*

External consultants have been contracted to perform the feasibility study at a cost of R20 000. The costs of implementing EDI software by the consultants had been

quoted at a further R10 000 and the costs of integrating the electronic documents with the EDI software at R2000 per document. Seventeen documents have been identified for conversion, leading to a total cost of R34 000. These costs did not include any possible assistance to trading partners and would be charged at R150 per hour if required and authorised. As most trading partners are in fact large corporations it was not envisaged that they would require assistance.

Legal fees to the amount of R4000 were envisaged should existing legal agreements defining the relationship with trading partners not suffice. Larger corporations tend to insist on their agreements being utilised, thus it was required mainly for smaller suppliers.

- *Initial investigation and research*

As external consultants were utilised, there was no additional cost, due to their expertise in EDI implementation.

- *Indirect Costs*

The inputs required to ensure the necessary audit and security procedures, which were to be put in place, were difficult to cost and were felt to be needed irrespective of EDI implementation. The internal auditors provided assistance as part of their daily activities.

- *Other Costs*

Membership fees to various bodies, including SITPROSA, for 1995 were R2500 and subscription fees to EDI publications for 1995 were R378.

Benefit Justifications

Where possible benefits have been quantified in monetary terms, however some have not been easily justified and will be reaped only once the majority of paper transactions have

been converted to electronic media and the majority of trading partners linked.

It was perceived that the major benefit due to EDI would be that of a closer, stronger, working relationship with major customers, who it perceived as being of strategic importance to the long-term plans of the company. By being seen to be progressive and willing to embrace change, the company aimed at being appointed a preferred supplier. Other benefits would also include:

- earlier receipt of orders. It was calculated that even while orders were being printed out there is a saving of two to three days. In a situation where lead times could be anything between one to four weeks, this early arrival of orders could be very beneficial;

- a longer-term benefit would be the standardisation of order input information from all customers, regardless of whether they are using EDI or not;
- once integration is achieved a further day would be saved in entering the data to the existing application system and any possible rekeying errors would be eliminated.

▲ *Personnel Savings*

It was believed that the accounts department could be reduced from 15 to 10 people over a three year period. It would not be necessary to retrench staff as natural attrition over a three year period would cause a natural staff reduction. This would lead to a monthly saving in the region of R20 000. Thus paying for the EDI implementation within a few months.

▲ *Paper Benefits*

Paper costs would be reduced by approximately R7000 per year.

▲ *Inventory Savings*

As the organisation is a computer equipment broker, they are mostly unable to order

inventory as and when required, but rather on a basis of as and when available in the market place. Thus it is not envisaged that EDI will reduce inventory levels.

- *Time Value Benefits*

  CEB client payment terms were found to be sixty days in real terms, although their business terms are thirty days. It is envisaged that EDI implementation will reduce this to approximately thirty days within three years. This will result in reduced interest payments towards overdraft facilities, a saving of approximately R2000 per month.

- *Information Cost Savings*

  As CEB is not a production line environment, no savings are expected in this regard. The value of more timely and accurate information has been accepted as a benefit.

- *Undetected Errors*

  EDI implementation would lead to reduced errors in manual recapturing of data and error processing. These benefits ultimately lead to staff reduction in administrative areas, the focus being on the accounts department. This has been specified under personnel savings.

- *Other Benefits*

  The less quantifiable benefits perceived were: improved customer and supplier relationships; smoother internal operations; improved information accuracy leading to improved management decision making.

Risk Management

Although EDI implementation at CEB originated as a strategic decision, due to pressure from clients on suppliers to implement EDI, management needed to be assured that it was

a cost-justifiable exercise. Management was also concerned as to the steps that needed to be taken to ensure that any risks were identified and minimised.

▲ *Security*

For proper control of EDI transactions, e.g. the tracing of document movements, audit trails are essential. The storage of all EDI messages on optical media for audit and the use as evidence in the case of a dispute has to be addressed in the Interchange Agreement.

▲ *Risks*

The business risks are dependent on the internal risk profile of each company. **To minimise the risk for each project, each organisation involved in that project must ensure that:**

- the functional manager involved in the business process drives it from his organisation;
- the correct level of management commitment exists within each company;
- the project be resourced by the correct personnel from each company;
- the change in the organisations be managed e.g. impact on personnel, business procedures and systems;
- the development of internal systems take EDI into account when developed;
- EDI standards be finalised and adhered to.

The following risks were identified:	L/M/H*
■ Losing data in the transfer cycle	L
■ Accounting for changes to electronic documents	M/H
■ Failure of internal systems and network (need for diaster recovery and contingency plans)	L/M
■ Reduction of human intervention in business process	M

■ Relying on technology to support business processes	M
■ Changes in internal business procedures and failure to communicate within organisation.	M/H

*KEY: L = Low
M = Medium
H = High

In short, **senior management time** and **involvement** was deemed essential. Responsibility for ensuring these steps are taken are to be with management in conjunction with the implementation team.

Each company involved in a project should provide the following resources to ensure the success of the project:

- A **business person** from the functional area covered by the project;
- **Technical resources** e.g. communications skills, systems analysts and programmers to complete the technical work as and when required. The Company's specific requirements are reflected in the project charter for that project and its participants.

Each company involved in a project has to ensure that they have a **budget** for:

- purchase and installation of EDI software;
- setting up a communications link with X.25 or VAN or X.400;
- building the interface between EDI software and business systems;
- development or change to internal systems to take advantage of electronic data;
- training of personnel;
- fixed and variable operating costs;
- a project manager; and
- contingency.

▲ *EDI Software Evaluation Factors*

As the EDI software market is ever changing, a set of software evaluation criteria was established in the form of questions to be asked:

- Is there menu-driven access to the package so that the package is easy to use?
- Is there acknowledgement of all transactions?
- Is there a capability of data translation between different internal and external formats?
- Is there sufficient on-line management of all transactions so that a single transaction can be traced from beginning to end?
- Does the package actually do what the users want?
- Is the package designed for the organisation's size or will it be outgrown in a few years?
- How can changes and updates in the package be handled?
- Does the package provide flexibility?
- Will the vendor support the installation adequately?
- On what hardware does the package run?
- Is all documentation clear and easy to understand?
- Can the potential user visit another user of the packages?
- Is the package competitive in price?

These criteria were set to evaluate future EDI software packages proposed by vendors or trading partners.

A data communications worksheet was drawn up (by the project team), to be used in establishing the data communication requirements and costs involved, of each trading partner. This worksheet can be found in Appendix E.

5.2.1.3 Select Alternatives

The factor favouring the use of the PC in the beginning was due to the majority of systems being on a PC LAN environment. Those that were on the mainframe were due to be down-

sized within two years.

It was decided that initial EDI implementation will be done with a point-to-point implementation (utilising an EDI software package known as ODEX) and to reconsider a VAN implementation once transaction volumes justify the costs. Features, benefits and prerequisites of ODEX can be found in Appendix C.

Integration into software packages that already cater for EDI will commence as and when a particular document is converted. Pressure must be applied to vendors of packages that do not yet cater for EDI, to supply versions that do as soon as possible. EDIFACT standards are to be used for document conversion. For pilot projects smaller suppliers will be used to minimise impacts on both organisations. Subsequent implementations may consider larger customers who are "EDI-ready". The implementation phase was authorised with regard to a number of pilot projects.

5.2.1.4 Formulate Project Charter

The project charter and project plan for the pilot implementation was developed and approved by top management.

5.2.2 Sub-system Analysis Cycle

Only the initial iteration of this cycle of the EDI implementation will be described for the purposes of this case study. Subsequent iterations were similar in nature and differed only with regard to either trading partners or documents or both.

5.2.2.1 Sub-system Initiation

The objectives, alternatives and constraints of the sub-system were defined.

Objectives and Team selection

The first objective was the selection and training of an implementation team. This team

was to consist of an outside consulting team along with the manager of the accounts department, who would facilitate other staff resources as and when needed. This manager was also responsible for any data processing requirements of the organisation. This manager and the external consultants did not require any additional training at this point.

The second objective being to identify the trading partners and documents for conversion, for the pilot project.

The third objective was to select the EDI software and communication methods.

Alternatives

No alternatives were identified at this point.

Constraints

Concerns were raised with regard to the EDI readiness of the potential pilot project trading partners. This it was decided to stick to trading partners who were putting pressure on the group to implement EDI. This would alleviate the pressure and it would reduce the need for training partner education and coaxing.

5.2.2.2 Sub-system Risk Analysis

Steps were identified to be performed to minimise risk for the pilot and future implementations. These are discussed below and are mainly audit and legal issues, as well as the question of centralisation or decentralisation. Other criteria are the documents involved and trading partners.

Audit Issues

Company auditors specified their requirements from electronic documents in cooperation with the external consultants.

Legal Issues

The corporate lawyers specified their requirements in conjunction with the external consultants.

Centralisation / Decentralisation

As the organisation had four branches in the major cities, it was decided that EDI pilot projects would be implemented at head office only. Future documents that are processed at the branches will only be addressed at a subsequent iteration of the implementation. Thus the need for decentralised translation will be addressed at that time.
Decentralisation will increase the cost of EDI software and that of enhanced audit and control procedures. However, as certain documents are processed at branch level, EDI would need to be decentralised in the long run to reduce the overheads at head office. Initially those documents will continue to be processed as in the past (at the branches).

Sub-system participants / documents external and internal

Contact was made with all the organisation's trading partners and they were formally informed of the company's intent to implement EDI. A survey was done with these organisations to firstly identify their EDI-readiness and secondly their willingness to start trading electronically, to assist in identifying and prioritising potential trading partners. The survey also attempted to establish the ideal documents for initial conversion per trading partner. An example of the trading partner survey worksheet (developed by the project team) can be found in Appendix D.

The following questions needed to be answered by the survey:

- Are you involved in EDI now?
- Where are you located? (To determine the geographic coverage of a VAN)
- Are you using a VAN? If so, which one(s)?
- Are you using a translator? If so, which one(s)?
- What documents are you currently transmitting electronically?

- What documents will you be transmitting in the future. When?
- What standards are you using? What release? What version?
- How many trading partners are you exchanging EDI documents with?
- Has your experience been a good one? If so, how come? If not, why not, what problems have you encountered?

Due to the close links with CEB's UK-based import/export company, Marksec, it was decided to use Marksec for pilot projects, as close ties existed between the two organisations and management wished to become experienced in EDI implementation before involving customer organisations. CEB decided to place emphasis on its delivery documents, but other departments were to start initial preparation for EDI implementation.

Interchange Agreement

An interchange agreement was set up (based on that supplied by SITPROSA to its members) and commercial agreements that cover the conditions of trade for each EDI message needed to be attached. All the legal departments need to be involved in accepting the agreement.

A sample interchange agreement (as distributed by SITPROSA) is given in Appendix A.

Sub-system integration / reengineering

Minimal business reengineering was performed. It was decided to consider reengineering once volumes justify new procedures. Existing supplier contracts needed to be amended to include EDI as a means of communication.

Sub-system Technology

As previously stated the decision had been made to initially implement EDI on a point-to-point basis and to reconsider a possible VAN implementation once volumes of data and trading partners become significant.

Telecommunications specialists began the permanent design. They began answering such questions as:

- Should they dial direct to suppliers, use a third-party network or use more than one network?
- If a network was to be used, should they dial out to the network or lease a line to it?
- Were there existing lines with capacity at the necessary times of day?
- Would additional modems or muxes be required?
- Would additional telecommunications ports be required?

Although a decision had been made to go point-to-point for the initial pilot projects, a VAN was also selected, which was thought to have superior EDI support capabilities and which would be cost effective. The following network features were deemed important:

- Local dial access;
- Availability of several standard protocols;
- Secure access;
- Store-and-forward and store-and-retrieve;
- Status reports;
- Audit trails;
- In-network translation, if necessary;
- Cost effectiveness.

The network selected was willing and able to provide the following trading partner services to CEB and its suppliers and customers:

- Selling trading partners on the concept of EDI;
- Contracting for user IDs;
- Making EDI software available to the trading partners;
- Providing customer service and installation assistance;
- Training;
- Documentation.

Part of the decision on the EDI network was based on the network's ability to provide software. The functions of the selected EDI software were as follows:

- Receipt of transactions that originate in an in-house system;
- Terminal emulation;
- Translation of the transactions from the in-house system to a national standard variable length EDI format;
- Limited keyboard data entry capability;
- Ability to connect with an EDI network;
- Outbound file transfer capability;
- Status reporting;
- Audit trails;
- Recording of documents to wait for notification that the documents have been received.

About half of the calendar time for the development of the interface was actually spent in "mapping". The purchasing system was relatively new and well designed but, as is true of every other in-house system, its database did not exactly match the Odette EDI format. Most of the fields in the hub's purchasing database had a one-to-one relationship with elements in the Odette standard. Most fields were shorter in length than Odette allowed. The few fields larger than Odette allowed had to be examined for content and frequency of use. The EDIFACT standard message for delivery instructions was not yet complete, forcing the interim use of the Odette standard.

5.2.2.3 Sub-system Business Analysis

The risk issues identified in the previous step were analysed to facilitate decision making.

Training

The training requirements identified in the feasibility study were authorised and steps taken to make the necessary bookings to ensure timely training of all concerned. Where possible people involved in future projects were also trained.

Interchange Agreement

The interchange agreements were approved by the company lawyers as well as by the pilot trading partners lawyers. This also involved the layouts of the standard ODETTE message for delivery instructions. The ODETTE standard was to be used due to incompletion of the EDIFACT standard. It is believed that the EDIFACT standard will be available at the end of 1995. The layout of the message can be found in Appendix B. Agreements were authorised by all parties involved.

Business Reengineering

No major business reengineering had been envisaged for the pilot project. Procedures had to be set up in the purchasing department to prevent duplication of processing, i.e. both the manual and electronic processing of a delivery instruction.

Application Integration

The invoicing package, SBT, already catered for EDI integration, thus the users set up the links to the EDI translation software, with some assistance from the external consultants, without encountering any problems.

5.2.2.4 Plan / Review Project Charter

The EDI project manager verified that the results of the Analysis Cycle were consistent with the strategy set in the feasibility study. Go ahead for the actual live implementation was obtained from management.

5.2.3 Sub-system Implementation Cycle

Only the initial iteration of this cycle of the EDI implementation will be described for the purposes of this case study. Subsequent iterations were similar in nature and differed only with regard to either trading partners or documents or both.

5.2.3.1 Sub-system Implementation Initiation

At this stage the external consultants brought in a network technician to set up the hardware links necessary and CEB's internal IT personnel were included, so that they could get on the job training.

The objectives, alternatives and constraints of the sub-system implementation were defined.

Objectives

The objective was to install the EDI software and test the communication links and the last objective being to test the links with Marksec for the delivery instruction.

Alternatives / Constraints

No alternatives or constraints were identified at this point.

5.2.3.2 Implementation Strategy Evaluation

As there were no alternatives outstanding, there was no evaluation to perform, other than to formally accept the prescribed route for the pilot project.

5.2.3.3 Implement sub-system

The implementation was to proceed as planned.

Training

The external consultants and the suppliers of the EDI software provided a training session on the technical aspects of the EDI software and the project team was taken to an existing customer of the software vendor's, to witness EDI in operation. Original training sessions booked for were also attended.

Interchange Agreement

Agreements were signed by all the parties involved, along with the delivery instruction standard message layout.

Audit and legal issues

The external auditors did not perceive any problems with the auditability of the delivery instruction. Future financial documents would, however, require greater inputs from them. The legal department were involved with the drawing up of the interchange agreements.

Centralisation / Decentralisation

As the Analysis Cycle had decreed that initial projects would only be head office based this was not yet an issue.

Business Reengineering

The users were trained to cater for the handling of automated delivery instructions. As a vast majority of delivery instructions would still be handled manually, the reengineering process was not fully implemented.

Set-Up Links

The software was installed and the communication links tested with the only two technical problems which had occurred in the pilot being quickly resolved. The first related to an error in constructing the ODETTE delivery instruction, and the second was a network access problem, resulting from an upgrade of equipment.

Application Integration

The invoicing package, SBT, already catered for EDI integration, thus the users set up the links to the EDI translation software, with some assistance from the external consultants.

Testing the Link with Live Data

One or two minor problems were encountered with misinterpretation between sender and recipient of certain fields within the standard delivery instruction message. This led to emphasis being placed on a field-by-field acceptance of all future standard message layouts between the sender and recipient, prior to live testing. The pilot trading partner was expected to respond to test data by entering the data into their own systems.

After the stringent testing, parallel testing was also performed. It was planned for a three-week time frame but left up to the discretion of the trading partner.

Live Implementation

Once both parties had agreed to satisfactory message handling the future handling of all delivery instructions was to be done electronically.

5.2.3.4 Plan / Review Project Charter

It was a time of learning more about EDI and the EDI coordinator's workload, and verifying that the business objectives could be met in the time-frame required.

The pilot was fraught with minor problems, as one might expect. An applications programmer was brought in to supervise PC operation and pilot partner testing. A few software bugs were found and corrected. Procedures were set up for archiving data and for storing the audit trails.

These typical internal pilot tasks required less time than coordination of the trading partner.

As pilots do, this pilot went longer than originally scheduled, but it did have written criteria for completion. Once the first documents were processed in a live environment the next phase was to evaluate the experience in order to improve and simplify future implementations. This led to amendments to the project charter (for the overall EDI implementation strategy) and project plan for the next iteration of the methodology.

Evaluate Sub-system Implementation

An evaluation report was drawn up and submitted to management and contained references to actual costs versus expected, actual duration of implementation versus expected and general comments regarding problems experienced. It was still far to early in the process to claim any benefits, other than quicker processing and less error-prone processing of delivery instructions.

Revise Project Charter based on evaluation / Plan next sub-system implementation

It was decided that a two-way expansion of EDI implementation had to occur. On the one hand it would require less effort to allow electronic trading with other partners with regard to delivery instructions, as there was no additional internal work to be done within the organisation, only with regard to the trading partner. Secondly as the electronic and legal links had already been established with Marksec, it made sense to utilise them for expansion with regard to other documents. It was accepted to remain with the accounting department and to consider statements and electronic funds transfer for implementation. As a parallel process electronic delivery instructions with other trading partners would be implemented as soon as possible.

No technology amendments were identified and the existing interchange agreement should not be tampered with unnecessarily to avoid inconsistencies in agreements with various trading partners.

5.3 PROJECT EVALUATION

CEB believe that perhaps the most intangible area of benefit is that of "added value through improved service".

By reducing errors, response times and improving document handling efficiency CEB is convinced they are improving service to clients and suppliers alike. They wish to proceed with more trading partners and more document implementations as soon as possible.

CEB had learnt a number of lessons from its venture into the world of EDI. These include:

- the realisation that EDI is a business rather than a technical issue;
- the possible competitive position achieved from EDI usage is sufficient justification;
- the importance of selling the case for EDI to the board of directors on business, not technical grounds - they can understand it better;
- the need to keep an EDI installation simple and straightforward;
- the importance of not getting embroiled in detailed technical issues - leave that to the consultants;
- the fact that integration is a key issue and that, increasingly, packaged software suppliers are providing integration capabilities.

CEB is aware of the inevitability of the move towards EDI. Although all the early cost-savings predicted have yet to materialise, its implementation is justified on the basis of better business practices. They are confident that the pilot project was successful and that future implementations will proceed even more smoothly.

Measurement of Benefits

In addition to all of the other project activities, progress toward the business objectives was continuously measured. This was to be done on a monthly basis after every few trading partners comes into production. The in-house programs for measuring paper volume versus electronic volumes were to be run and inventory effects were to be measured formally.

5.4 METHODOLOGY EVALUATION

Firstly the criteria and scope of the evaluation is discussed, followed by the results of the evaluation.

5.4.1 Evaluation Criteria and Scope

Due to the subjective nature of evaluating the methodology, a questionnaire was drawn up by the researcher (see Table 5.2 for an extract) and presented to management, users, IT

staff and the external consultants (involved in the implementation project), to evaluate the methodology. This was drawn up according to the criteria specified at the end of Chapter 4 and the complete questionnaire can be found in Appendix H.

The spread of participants is reflected in Figure 5.2 (the author did not complete the questionnaire) and the results of the questionnaire are summarised below for each criteria specified.

As a result of the single implementation, certain criteria could not be evaluated by the participants and therefore the option of **Not Applicable** (N/A) was specified on the questionnaire. During discussions with participants they were asked, however, to specify a subjective estimate of these criteria, if they had any opinion. For example criteria such as **industry independence**, was not applicable as the users and management personnel were not involved in other industries and could only supply a subjective estimate. However the external consultants have been involved in a number of implementations and could thus give a more objective estimate.

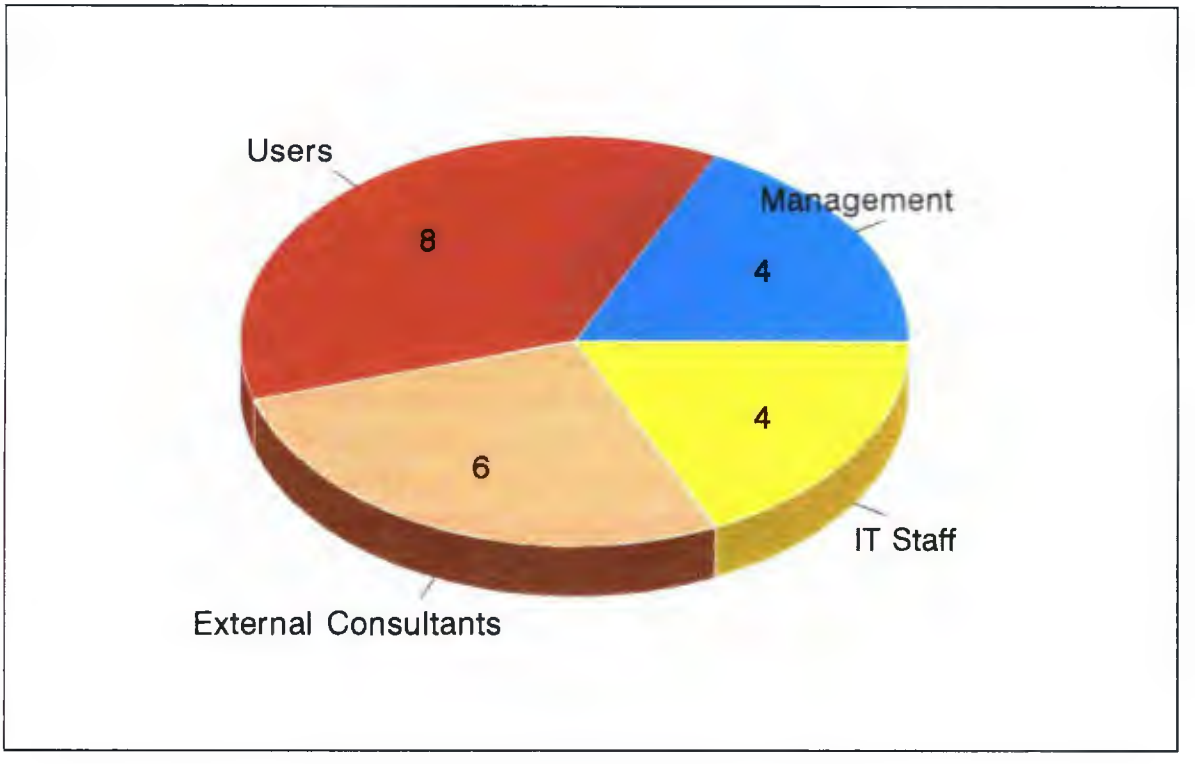

Figure 5.2 Respondents roles in the EDI project

5.4.2 Survey Results

Each criteria is discussed separately (per respondent level), based on the results of the survey and where applicable comments from individual questionnaires are presented. The average score and rating at each level are also presented.

Reliability/consistency

Management:	N/A (2.5 average); Never put to the test in practice, but perceive no problems.
Users:	N/A (2.5 average); Never put to the test in practice, but perceive no problems.
Consultants:	Good (4.2); Perceived the methodology to be reliable and consistent.
IT Staff:	Good (4.25); Could not find any reasons for it not to be, but would prefer to perform a number of iterations.

The average rating at the different respondent levels is reflected in Figure 5.3.

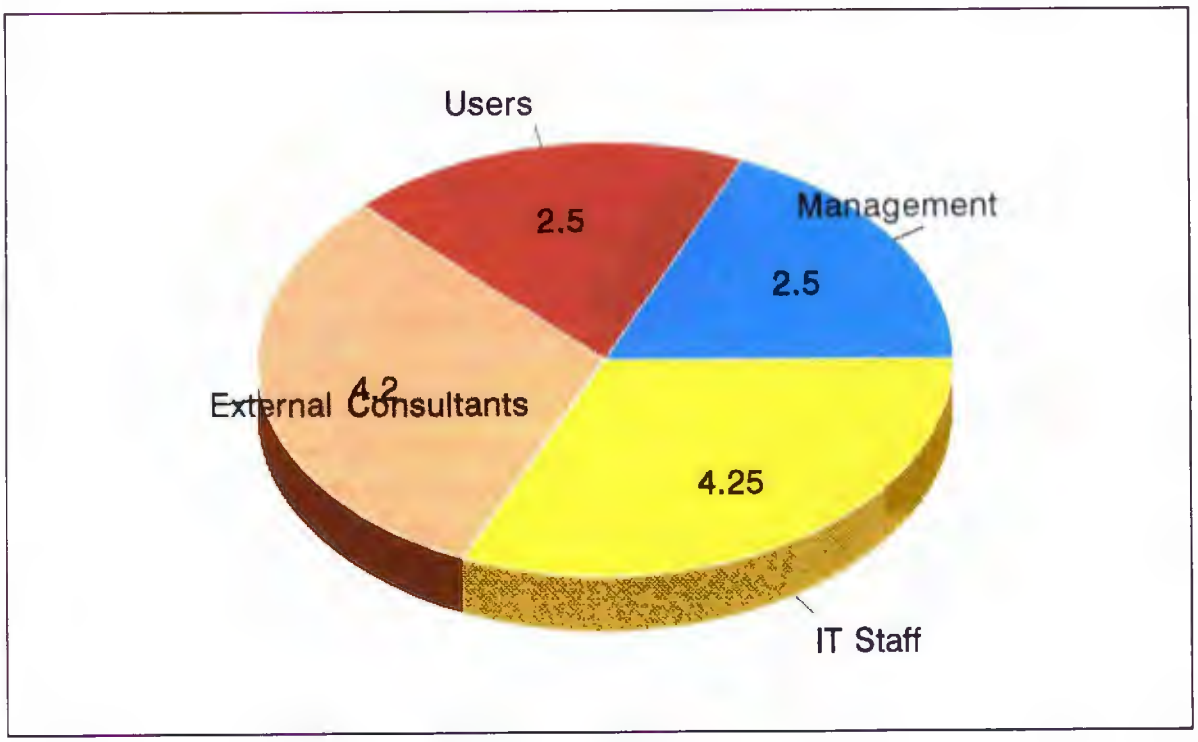

Figure 5.3 Reliability / Consistency rating per respondent level

Level:	Management	User Department	External Consultant	IT Staff

Criteria

1. Reliability / Consistency

With reliability and consistency, it is meant that if faced with the same circumstances, repetitive application of the methodology must produce the same results. Thus the user of the methodology must be able to clearly interpret each step of the methodology without fear of inconsistent results.

Rating:

	0	1	2	3	4	5
N/A	Poor		Fair		Good	

Opinion:

Subjective	Objective

Comment on rating:

2. Completeness / Life cycle framework

■
■
■

Table 5.2: Evaluation questionnaire extract

Completeness

Management: Fair (2.5); Followed the prescribed steps without deviation or the need to apply other steps.

Users: Fair (2.5); Perceive no problems.

Consultants: Good (4.3); In utilising the methodology no need was identified to perform any steps not catered for in the methodology.

IT Staff: Good (4); In utilising the methodology no need was identified to perform any steps not catered for in the methodology.

The average rating at the different respondent levels is reflected in Figure 5.4.

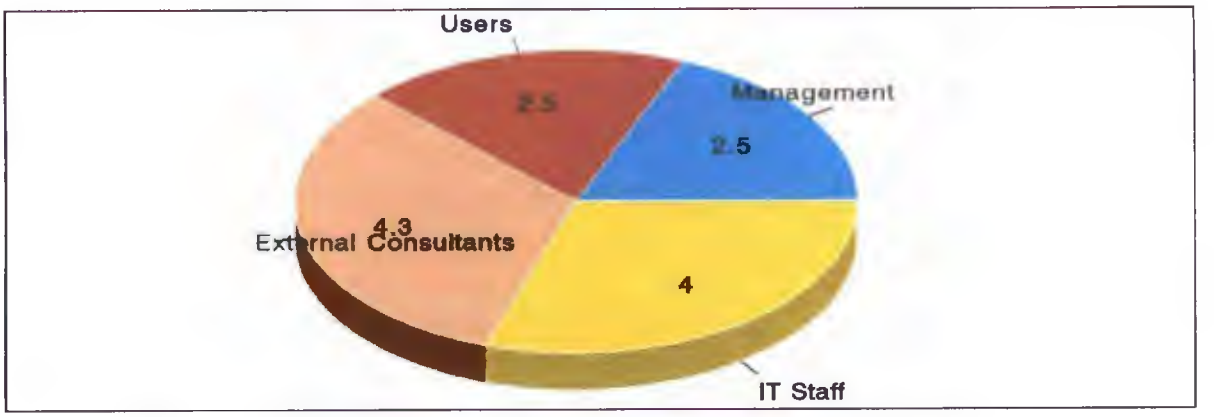

Figure 5.4 Completeness rating per respondent level

Application independence

Management: Good (4); No problems were expected with different applications as the concepts should remain the same.

Users: N/A (2.5); Different users would be involved in different iterations.

Consultants: Good (4.5); The external consultants have been involved with a number of applications implementations such as debtors, creditors, sales and expect no problems in utilising the methodology with those as no specific application related references are made within the methodology.

IT Staff: Good (4.5); Perceive no problems.

The average rating at the different respondent levels is reflected in Figure 5.5.

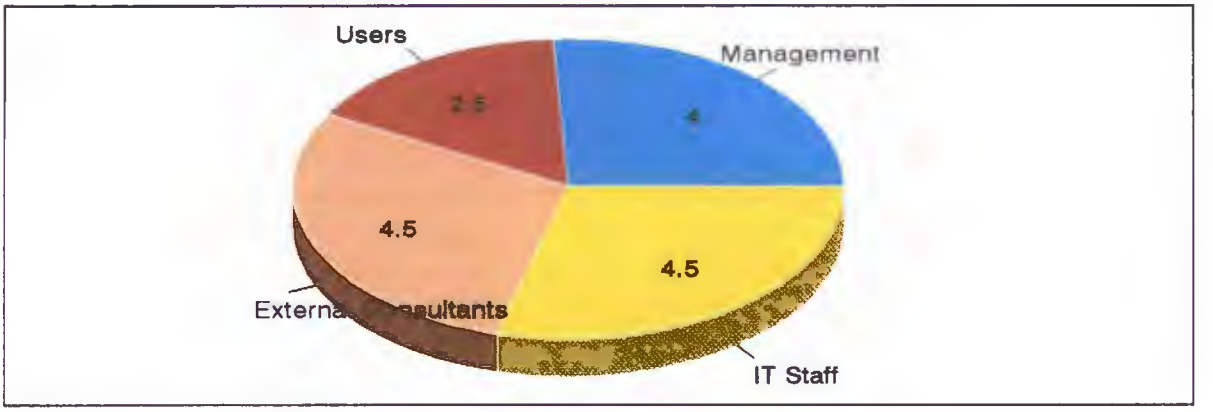

Figure 5.5 Application Independence rating per respondent level

Industry independence

Management: N/A (2.5); Perceive no problems.

Users: N/A (2.5); Perceive no problems.

Consultants: Good (3.7); The external consultants have been involved with a number of industry implementations such as motor industry, retail, banking and expect no problems in utilising the methodology with those. Although certain industries may place more emphasis on aspects such as risk analysis (e.g. the financial industry).

IT Staff: Fair / Good (3.5); No problems perceived.

The average rating at the different respondent levels is reflected in Figure 5.6.

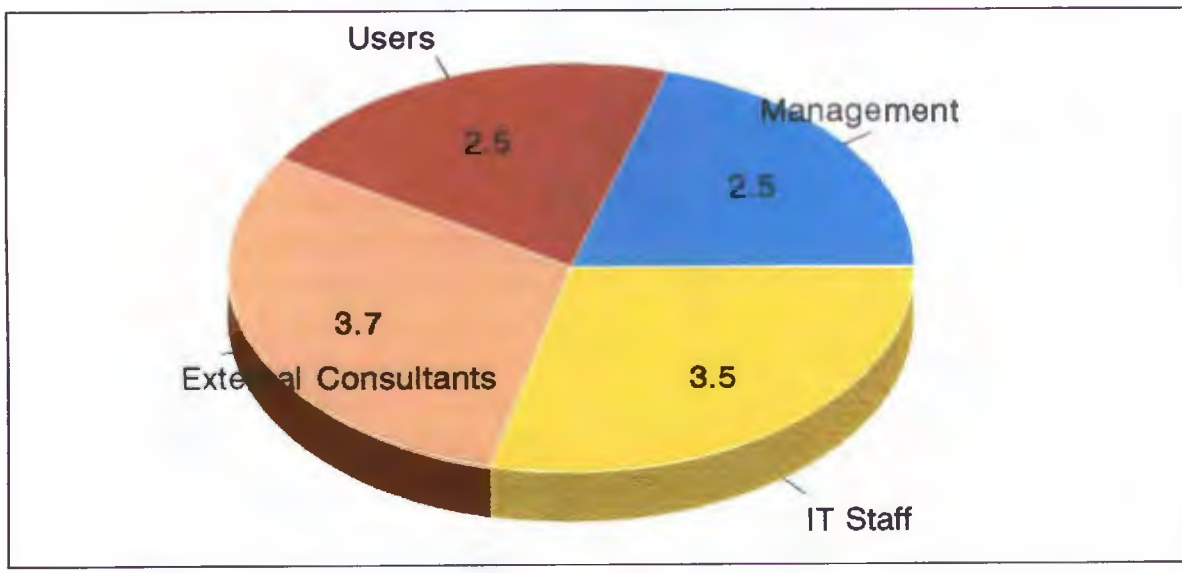

Figure 5.6 Industry Independence rating per respondent level

Technology independence

Management: Good (4); Found methodology to be non-prescriptive with regards technology issues such as the software, hardware and communication options.

Users: N/A / Good; Uncertainty amongst some users, perception of technology independence amongst others.

Consultants: Good (4); The consultants were involved with various technical implementations: VANs, point-to-point, integrated and non-integrated environments and perceive no problems.

IT Staff: Fair / Good (3.5); Would have preferred if the methodology was more prescriptive in evaluating different technology options, but understand the difficulties due to the ever changing technology environment.

The average rating at the different respondent levels is reflected in Figure 5.7.

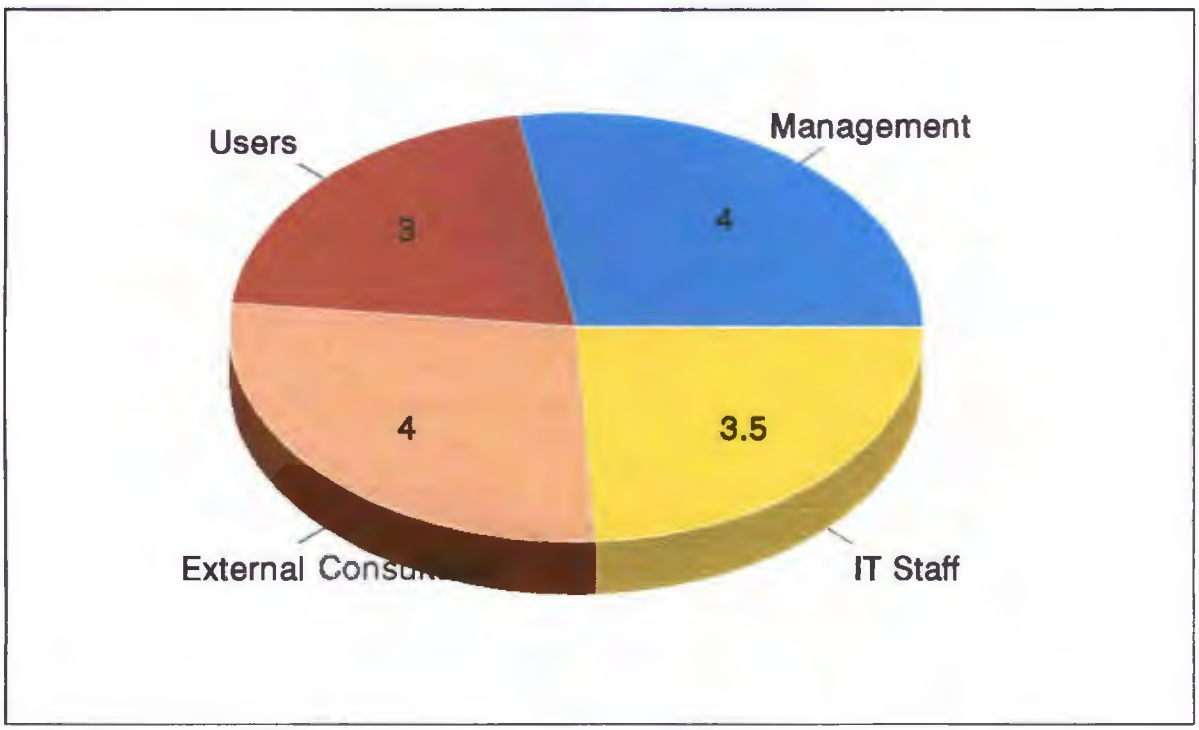

Figure 5.7 Technology Independence rating per respondent level

Technique independence

Management: Fair (3); Would have preferred if some techniques were prescribed, e.g. performing a point-to-point vs VAN evaluation.

Users: Fair (2.5); Basically followed techniques introduced by consultants.

Consultants: Good (4); The methodology allows the user to utilise any (existing in the organisation) techniques for performing steps at the Atomic Level, e.g. reengineering and cost-benefit analysis. If the organisation has no

techniques in place then it may be problematic for them.

IT Staff: Fair / Good (3.5); Fine for existing techniques, but for example a VAN vs. point-to-point evaluation implies dependence on the external consultants for guidance.

The average rating at the different respondent levels is reflected in Figure 5.8.

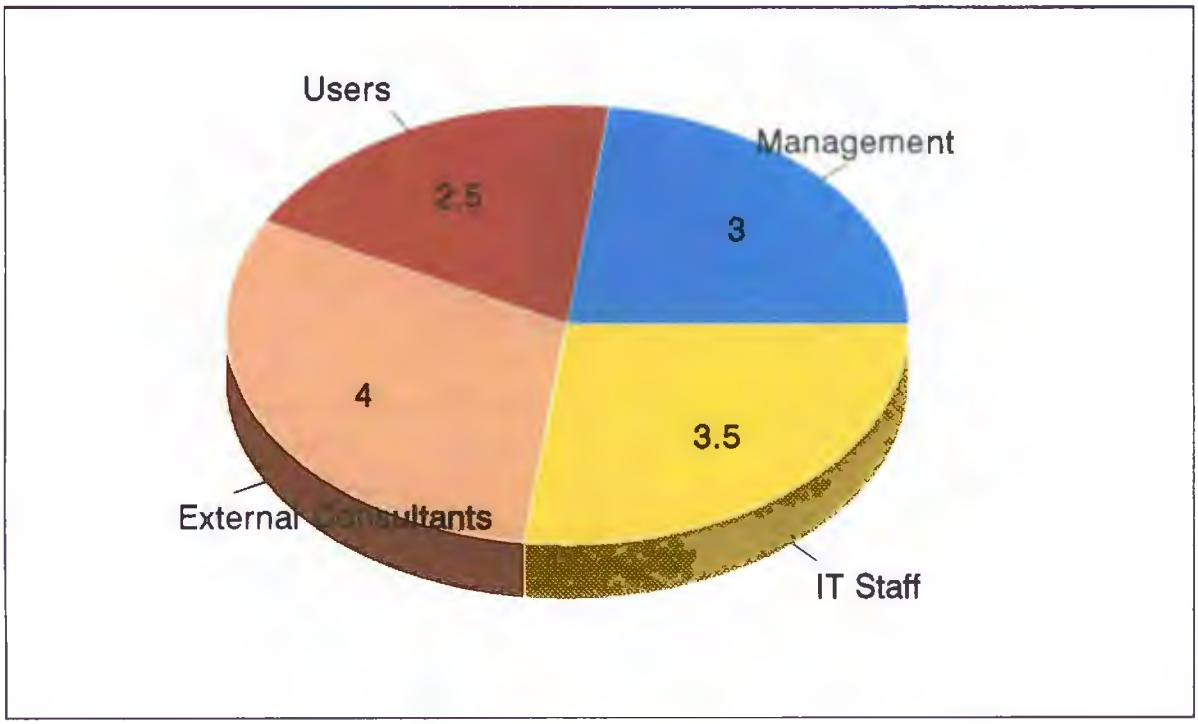

Figure 5.8 Technique Independence rating per respondent level

Adaptability

Management: N/A (2.5); Would have to attempt the methodology without doing for example the feasibility cycle, but perceive no problems.

Users: N/A (2.5); Perceive no problems.

Consultants: Fair (3); No problems perceived.

IT Staff: Fair (3); No problems perceived.

The average rating at the different respondent levels is reflected in Figure 5.9.

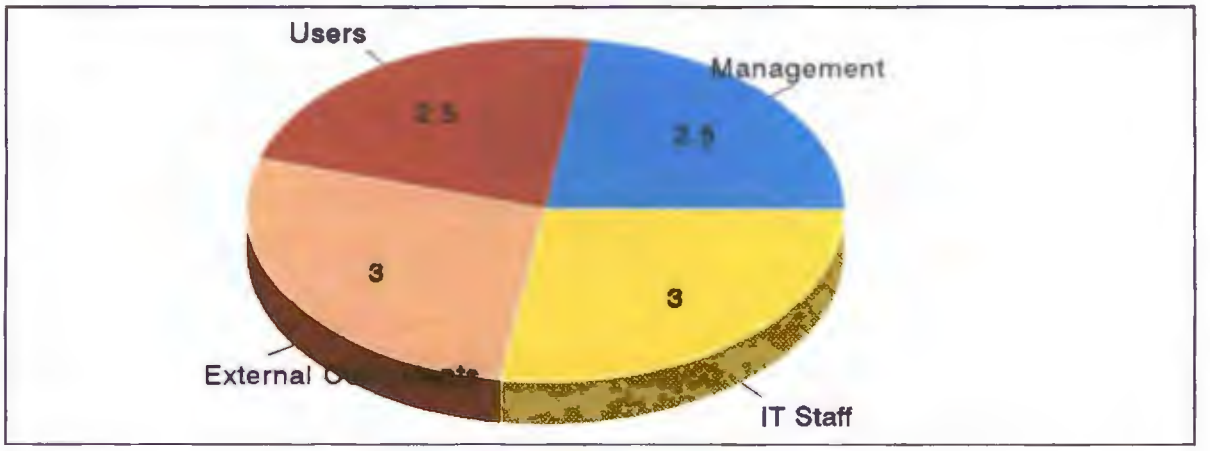

Figure 5.9 Adaptability rating per respondent level

Modifiability

Management:	N/A (2.5); No comments.
Users:	N/A (2.5); Not certain.
Consultants:	N/A (2.5); The methodology has not yet been exposed to evolutionary changes.
IT Staff:	N/A (2.5); No comments.

The average rating at the different respondent levels is reflected in Figure 5.10.

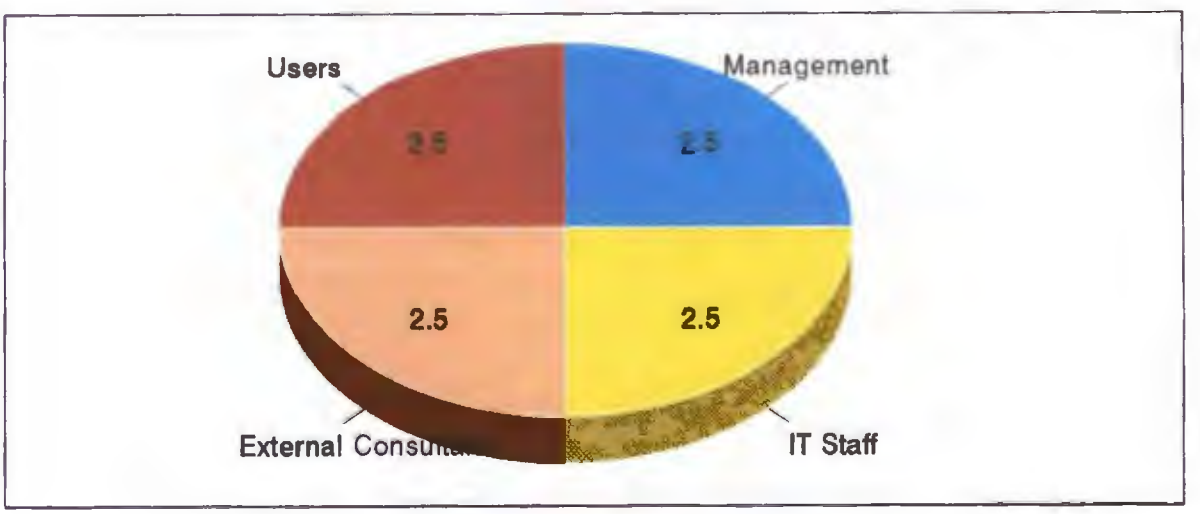

Figure 5.10 Modifiability rating per respondent level

Alternative evaluation

Management: Good (4); Alternative evaluation more dependent on the techniques being utilised at the lowest level than on the methodology itself as it is technique independent.

Users: Fair (3.5); No comments.

Consultants: Good (4); Emphasis on risk analysis and alternative evaluation.

IT Staff: Good (4); No problems encountered with alternative evaluation.

The average rating at the different respondent levels is reflected in Figure 5.11.

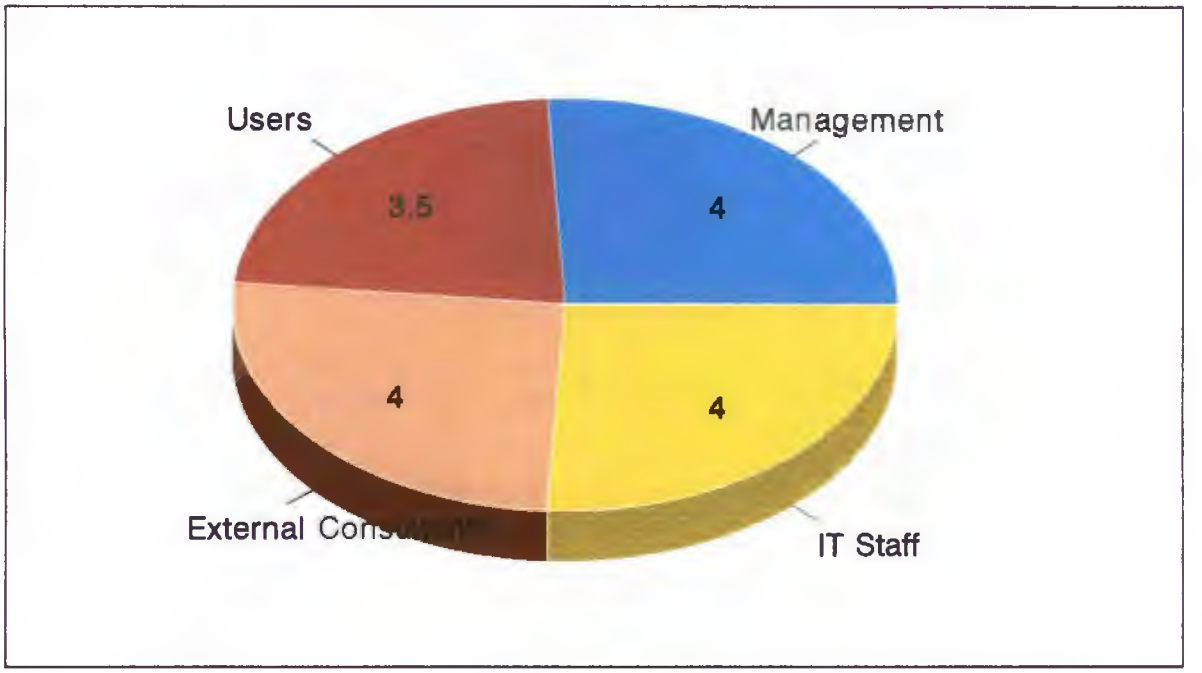

Figure 5.11 Alternative Evaluation rating per respondent level

Environment Issues

Management: Good (4.25); Emphasis on training, management involvement, project management and control.

Users: Good (4); Staff involvement and training emphasis.

Consultants: Good (4); The methodology lends itself to management control and risk analysis and due to its technology and technique independence it facilitates

use by organisations of different sizes and needs. Furthermore it concentrates on overcoming user fears of change by focusing on education and involvement.

IT Staff: Good (4); Training and staff involvement emphasis.

The average rating at the different respondent levels is reflected in Figure 5.12.

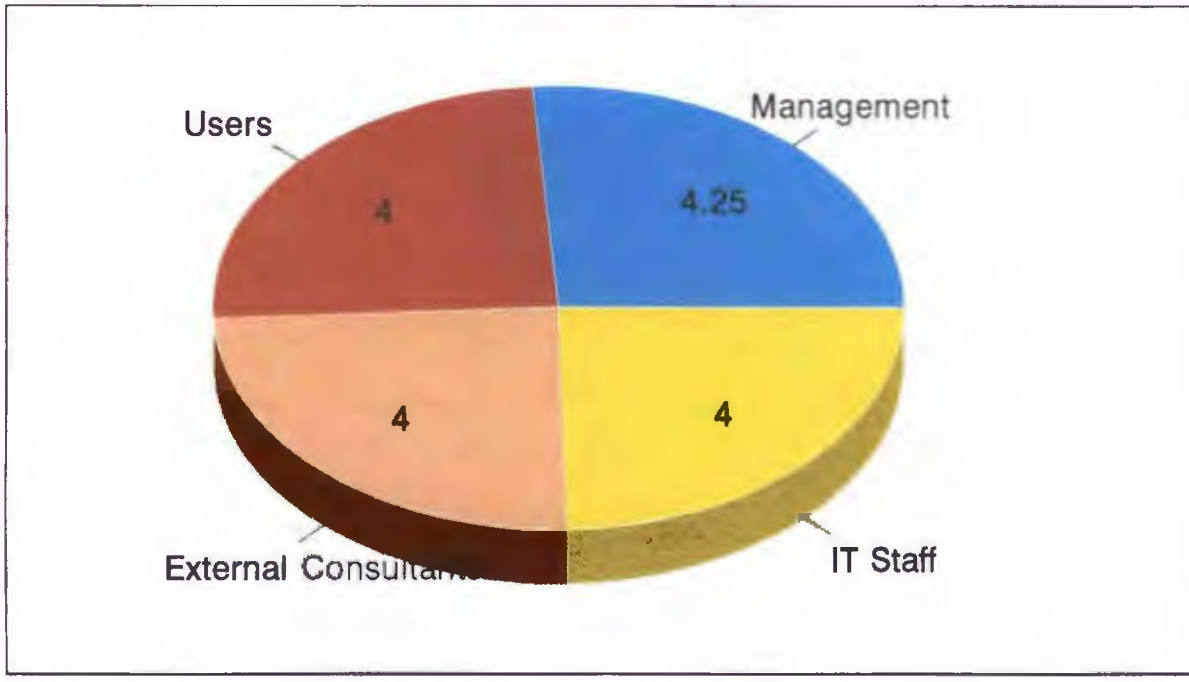

Figure 5.12 Environment Issues rating per respondent level

Overall

Generally the methodology was found to be geared to management deliverables and risk management. The issue of techniques at the Atomic Level was raised as being contradictory to the criteria. The consensus was that under certain circumstances the organisation would want the freedom of technique (feasibility study, reengineering) with guidelines for consideration, but in other cases it would prefer clear cut techniques. This applied to the more technical issues, such as standards, communication methods and software evaluation.

Other issues were difficult to evaluate objectively and subjective perceptions were offered as a number of project implementations would have to be performed across industry and

application boundaries to obtain more objective results. These areas include criteria such as industry independence, application independence, adaptability and modifiability. Shortcomings of the methodology are slightly contradictory to the specified criteria as under certain circumstances more specifics on techniques were requested (VAN vs. point-to-point evaluation). More worksheets were felt to be of use, such as the trading partner survey worksheet. As these additions would be volatile by nature, the agreement was reached that they may form an addendum to the methodology rather than an actual part of it.

The average rating at the different respondent levels is reflected in Figure 5.13.

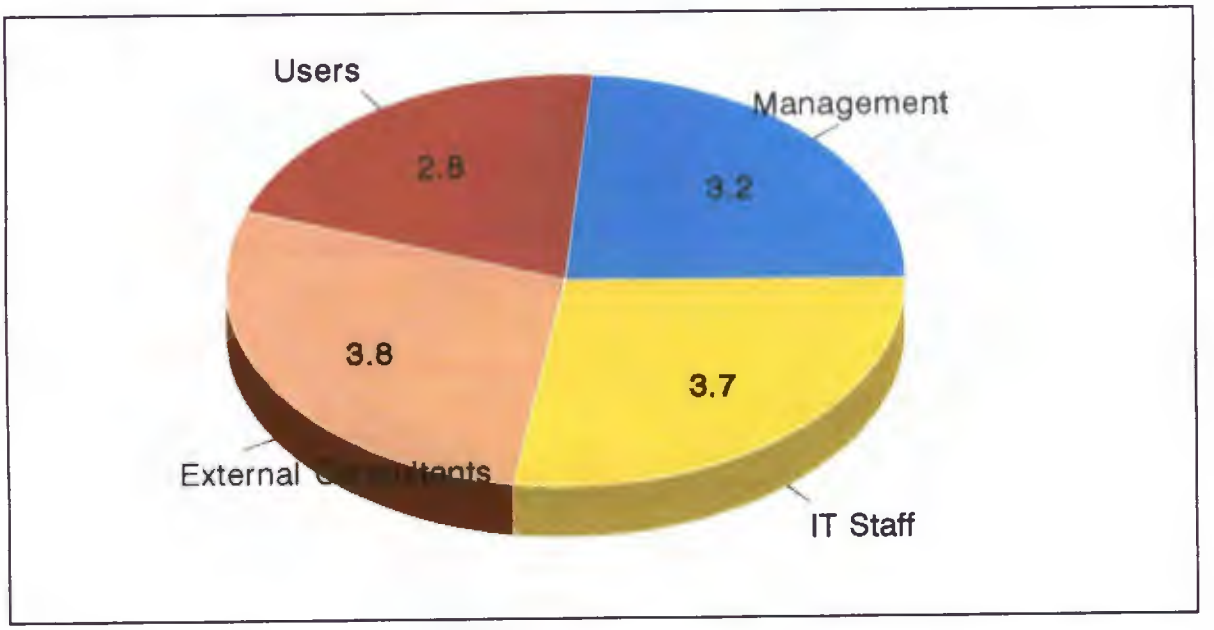

Figure 5.13 Overall rating per respondent level

5.5 SUMMARY

The chapter summarised a case study on the implementation of EDI between two trading partners for delivery instructions. The application of the proposed methodology was evaluated and found to be efficient for implementing EDI, and acceptable to all the role players involved. A number of criteria was found to be difficult to evaluate objectively and these were attempted subjectively. A number of improvements and addenda to the methodology were identified. It was found to address areas such as environmental issues particularly well.

CHAPTER 6 : SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

A summary of the research results is presented in this chapter. The hypothesis presented in Chapter 1 is validated in the light of these results and the resultant conclusions and recommendations are made.

6.2 SUMMARY

The research is based on the hypothesis that the spiral model can be adopted to define an implementation methodology for the EDI application domain, that will (i) facilitate the integration of EDI into the organisation, and (ii) optimise the benefits accruable from EDI utilisation.

In support of this hypothesis the research commenced with a literature survey, which had two objectives. Firstly to gain an understanding of EDI and its benefits and secondly to gain an understanding of software development methodologies in general. This enabled the development of an EDI implementation methodology and the specification of criteria to evaluate an EDI implementation methodology, satisfying the **third objective of the research**. The methodology was further enhanced by practical experience and criticism by other EDI experts. Finally a case study was embarked on to test the methodology in full in a live environment, to achieve the fourth objective of the research. The implementation was successful and is still being continued to integrate more trading partners and documents.

The case study enabled the development of a number of tools, such as trading partner surveys and communications worksheets, which can be incorporated as part of a further refined implementation methodology. The criteria defined for evaluating EDI

implementation methodologies enabled the assessment of such methodologies to identify their strengths and weaknesses in order to gain a perspective of the effectiveness of such a methodology.

6.3 CONCLUSIONS

In a survey conducted with the participants of the case study utilising the proposed methodology, the methodology was found to be acceptable according to the criteria specified. Methodologies will vary in many respects, such as with respect to their ability to support the full implementation life cycle versus the Feasibility Cycle or perhaps only the Implementation Cycle. They could also differ in that they could be generic by nature versus industry specific. The more generic the methodology the wider its application domain and higher its technique independence at the atomic level. Thus the methodology would be more suitable to organisations strong in software development with techniques in place for performing atomic level operations such as cost-benefit analysis and reengineering. The concern must be raised that the methodology may be difficult to utilise by organisations that do not perform these atomic level processes in their day to day IT environment and who also do not utilise external consultants familiar with such techniques. Certain issues were highlighted by the implementation and are briefly discussed below.

Organisations (encountered informally at EDI seminars) that had successful pilot projects were far more confident in continuing the implementation process than those not following a formal implementation methodology. EDI implementations are still few and far between, implying that perceived benefits will not be reaped in the immediate future. Experience gained through this investigation indicated that organisations using external consultants to implement EDI, without the benefit of a management control and risk-driven approach, such as the methodology developed here, open themselves up to being bullied into the directions advocated by the consultants. This may not necessarily be the most beneficial route to follow.

6.3.1 Management Issues

There are more opportunities for improving productivity and quality in the area of

management than anywhere else. The difference between software project successes and failures has most often been traced to good or poor practices in software management. The biggest software management problems have generally been the following:

Poor Planning: Generally, this leads to large amounts of wasted effort and unproductive time because of tasks being unnecessarily performed, overdone, poorly synchronised, or poorly interfaced.

Poor Control. Even a good plan is useless when it is not kept up-to-date and used to manage the project.

Poor Resource Estimation. Without a firm idea of how much time and effort a task should take, the manager is in a poor position to exercise control.

Unsuitable Management Personnel. As a very general statement, information technology personnel tend to respond to problem situations as designers rather than as managers.

Poor Accountability Structure. Projects are generally organised and run with very diffuse delineation of responsibilities, this exacerbating all the above problems.

The emphasis placed by the proposed methodology on the project charter and continuous re-evaluation of actual activities to the charter, assisted in eliminating the above mentioned problems. It was found that the methodology placed strong emphasis on management and controls.

6.3.2 Future Research Projects

Following on this research, future projects could embark on rigorous field testing of the methodology with the view of further refinement. Closely related issues for research are audit, security and legal issues in the South African context. An automated EDI methodology for EDI implementation would be ideal for organisations to manage and control EDI implementation. Further work on criteria for evaluating EDI implementation methodologies could result in a set of more objective criteria being defined.

Further refinement of techniques at the atomic level, which need not be used should the implementor have their own techniques in place (cost-benefit analysis and reengineering). The issue of business process reengineering with the emphasis on software reengineering can also receive further attention.

EDI as a standard groupware product that becomes part of an off-the-shelf operating system such as Windows and Internet will certainly alleviate some of the problems experienced by smaller organisations in setting up an EDI-ready environment. These systems currently cater for other groupware products such as E-mail and electronic faxing.

6.4 RECOMMENDATIONS

Pilot projects should be embarked on with low impact trading partners or messages as frustrations will be encountered and teething problems need to be ironed out.

Emphasis should be placed on proper cost-benefit studies being performed to ensure cost control and the effective selling of the EDI concept both within an organisation and to its trading partners.

The strategic importance of EDI to organisations implies the following of a formal methodology with strict management control to ensure success. If staff are not EDI aware it is crucial to embark on a training program to avoid internal objections.

Appendix A : INTERCHANGE AGREEMENT

A.1 INTRODUCTION

This model Interchange Agreement and commentary was drafted under the auspices of SITPROSA and the SABS by Prof GTS Eiselen of the Potchefstroom University for CHE. The draft was closely modelled on the United Nations Economic Council for Europe's Draft Model and Commentary. The Model has however been adapted to make provision for the specific requirements and quirks of South African law.

To be able to exchange EDI messages, traders and businesses must agree on the operational and technical matters which will allow them to determine the kind of messages, the message standards, the protocols of communication, the network standards and other issues that are necessary to operate EDI and to effect trade transactions. Because of differences which are involved with the use of EDI in comparison with the use of paper, the legal aspects of the new environment of trading need to be addressed by trading partners in order to reduce the legal uncertainty that electronic trading might raise and to enhance the confidence with which the technology was employed. From early in the use of EDI, these types of legally focused agreements have been employed. Both kinds of agreements, the technical and the legal, are often referred to as Interchange Agreements, although the technical ones are also called "user manuals" or "technical annexes" or "EDI handbooks" and the legal ones called "EDI Agreements". This Draft Interchange Agreement emphasizes the legal topics; it is designed to permit trading companies to define, specify and establish the legal context in which they will be using EDI.

The Agreement specifically contemplates the attachment of a Technical Annex giving attention to the remaining operational and technical matters. The Technical Annex is not included due to its bulkiness.

A.2 SITPROSA MODEL CONTRACT DRAFT INTERCHANGE AGREEMENT

THIS INTERCHANGE AGREEMENT (the "Agreement") is concluded between ABC (Pty) Ltd (hereinafter called ABC)

and XYZ (Pty) Ltd (hereinafter called XYZ)

(hereinafter referred to as "the parties") as of

....., 19 .....

The parties:

(a) have entered or propose to enter into one or more trading agreements for the supply of goods (services/...);

(b) has deemed that such trade will be facilitated by the use of electronic data interchange as a means of communication between the parties in substitution of conventional methods of communications; and

(c) have agreed that the use of such electronic data interchange should be regulated by the provisions of this Agreement;

(d) intending to be legally bound, hereby agree as follows:

1. SCOPE AND STRUCTURE

1.1 Scope.

1.1.1 This Agreement governs any electronic transfers between the parties. Except as expressly provided, this Agreement does not govern any other relationships, contractual or not, in the context of which messages are communicated. A 'Message' means data to be communicated in accordance with the UN/EDIFACT Standards, as provided in Section 2.

1.1.2 In the event of a conflict between the Interchange Agreement and any commercial agreement between the parties, the Interchange Agreement shall take precedence.

1.2 Technical Annex.

The attached Technical Annex sets forth the specifications agreed upon by the parties for certain technical and procedural requirements. In the event of a conflict between the terms of this Agreement and the Technical Annex, the terms of this Agreement shall prevail.

2. COMMUNICATIONS AND OPERATIONS

The parties shall communicate Messages in accordance with the following:

2.1 Standards.

2.1.1 The "UN/EDIFACT Standards" are those standards established for Electronic Data Interchange (together with related recommendations), as approved and published in the United Nations Trade Data Interchange Directory (UN/TDID). The parties shall use those versions of the UN/EDIFACT Standards identified in the Technical Annex.

2.1.2 No party shall change to a newer version of any message without the prior written permission of the other party, which permission shall not be unreasonably withheld.

2.2 System Operations.

Each party shall obtain, test, maintain and upgrade their respective equipment, software and services necessary to effectively and reliably transmit and receive Messages.

2.3 System Changes.

No party shall make any changes in systems operations which may impair the mutual capabilities of the parties to communicate as contemplated by this Agreement without providing prior notice of the intended change.

2.4 Communications.

The parties shall specify in the Technical Annex the selected methods of communication, including the requirements for telecommunication or the use of third party providers.

2.5 Security Procedures and Services.

Each party shall implement and maintain security procedures and services, including any specified in the Technical Annex, to protect Messages and their records against untoward events or misuse including improper access, alteration or loss.

2.6 Record Storage.

The parties shall store and retain records of the Messages communicated under this Agreement according to their own requirements, in compliance with applicable law and as may be specified in the Technical Annex.

3. MESSAGE PROCESSING

3.1 Receipt.

Any Message transmitted in compliance with this Agreement shall be deemed received when accessible to the receiving party on his computer system or in the manner designated in Technical Annex. Until so received, any transmitted Message shall have no legal effect, unless applicable law mandates legal effect to such Message upon transmission, whether or not received.

3.2 Acknowledgement

3.2.1 Unless otherwise designated in the Technical Annex, the receipt of Message, need not be acknowledged by the receiving party. A requirement of acknowledgement in the Technical Annex shall include the methods and types of acknowledgement (including any Messages or procedures) and the time periods, if any, in which acknowledgement must be received.

3.2.2 An acknowledgement will be prima facie evidence that the related Message was received. A party receiving a Message requiring acknowledgement shall not act upon that Message until the acknowledgement is sent. If a receiving party is not able to send the acknowledgement, he shall not act upon the Message without further instructions from the originator of the Message. The failure of a receiving party to acknowledge a Message will not deprive the Message of its legal effect, except when the originating party is not identifiable from the Message.

3.2.3 In the event that the originating party has not received, for a properly transmitted Message, a required acknowledgement and no further instructions have been provided, the originating party may declare the Message to be null and void by so notifying the receiving party.

3.3 Processing of messages

Each party shall deal with any Message within the time stipulated in the commercial agreement or the time stipulated in the Technical Annex whichever occurs first.

3.4 Technical Errors.

3.4.1 Each party accepts the integrity of all Messages and attaches the same

value to them as would be the case with any other form of communication unless such a Message is reasonably suspected to be incorrect or to have been corrupted during transmission or not intended for the receiving party.

3.4.2 A receiving party must give notice to the originating party of circumstances, including technical errors in any received transmission exist which prevent the further processing of a Message.

3.4.3 The originating party must either confirm the contents of the original Message or retransmit the correct Message within a reasonable time. The receiving party is not entitled to act upon the original Message until the originating party has confirmed or retransmitted the Message.

4. VALIDITY AND ENFORCEABILITY

4.1 Validity.

The parties agree that valid and enforceable obligations may be created by the communication of Messages in compliance with this Agreement. The parties expressly waive any rights to object to the validity of a transaction solely on the ground that communication between the parties occurred through the use of Electronic Data Interchange.

4.2 Evidence.

4.2.1 Without regard to the absence of any writings or written signatures and to the extent permitted by law, the records of Messages maintained by the parties or any printout thereof shall be admissible and may be used as evidence of the information contained therein.

4.2.2 Each party shall maintain a Message Log and procedures as specified in the Technical Annex.

4.2.3 The parties agree that a copy of the Message Log certified in terms of the Technical Annex or provided by the third party service provider shall be admissible in evidence in any dispute or litigation between them and shall be prima facie evidence of the facts contained therein.

4.3 Contract Formation.

A contract concluded through the use of Electronic Data Interchange under this Agreement shall be deemed to be formed when the Message sent as acceptance of an offer has been received in terms of section 3.1.

4.4 Guaranteed validity

Each party guarantees that every Message originating from the EDI system under its control will be binding upon it.

5. DATA CONTENT REQUIREMENTS

5.1 Confidential Status.

No information contained in any Message communicated under this Agreement shall be considered confidential unless such information would be treated as confidential in the normal course of business or by operation of law or by designation in the Technical Annex or the Message.

5.2 Legal Compliance

5.2.1 Each party shall ensure that the content of any Message is transmitted, received or stored in compliance with all legal requirements to such party and such message.

5.2.2 In the event that the receipt of or the storage of any element of a Message would constitute a contravention of the applicable law, the receiver shall without undue delay give notice of such

non-compliance.

5.2.3 Until the receiver is aware of non-compliance of the Message, its rights and obligations under this Agreement shall not be affected.

5.2.4 Upon giving notice of non-compliance to the sender, the receiver shall be under no obligation to respond to any further non-complying Message.

6. LIABILITY

6.1 Force Majeure.

6.1.1 No party shall be liable for any delay or other failure in performing its obligations under this Agreement where such delay or failure is caused by an event beyond the party's control (a) which could not reasonably expected to have been taken into account at the time this Agreement was signed or (b) the consequences of which could not be avoided or overcome.

6.1.2 On discovery of any failure in the communications system, the discovering party shall notify the other party within a reasonable time by any means suitable.

6.1.3 Both parties shall take reasonable steps to rectify the problem as soon as possible and to utilize other forms of business communication until such problem has been rectified.

6.2 Excluded Damages.

No party shall be liable for any special, consequential, indirect or exemplary damages arising from any breach of this Agreement.

6.3 Provider liability.

6.3.1 A party using the services of a third party provider in the communication or processing of Messages shall be responsible under this Agreement for any acts, failures or omissions of that provider in the provision of said services.

6.3.2 Any party instructing any other party to use a specified third party shall be responsible for any acts, failures or omissions of the provider.

6.3.3 Each party shall be responsible for the costs of the third party service provider in terms of its own contract with the provider.

6.4 Liability for faulty messages

6.4.1 The risk and liability for any faulty transmission and the resulting damages rests with the originating party subject to the exceptions described in clause 6.4.2

6.4.2 Although the originator is responsible and liable for the completeness and accuracy of the Message, the originating party will not be liable for the consequences arising from reliance on a Message where the error is reasonably obvious and should have been detected by the Recipient; or the agreed procedures for authentication or verification have not been complied with.

7. GENERAL PROVISIONS

7.1 Governing Law.

This Agreement shall be governed by the national laws of ..... In the event of a conflict in law between the laws governing a transaction and the laws governing this Agreement, the laws governing this Agreement shall prevail.

7.2 Severability.

Should any provision of this Agreement be invalid or unenforceable for any reason, all other provisions of the Agreement shall remain in full force and effect.

7.3 Termination.

Any party may terminate this Agreement upon not less than 30 days prior notice of the termination. No termination shall affect any communications occurring prior to the termination, or the performance of any related transactions. The provisions of sections 2.5, 2.6, 5.1, 6, and 7.5 shall expressly survive any termination and remain binding upon the parties.

7.4 Entire Agreement.

This Agreement, including the Technical Annex, constitutes the complete agreement of the parties on the subject matters of this Agreement and becomes effective when signed by the parties and no subsequent variation or waiver will be valid unless in writing and signed by both parties.

7.5 Interpretation

7.5.1 The headings and sub-headings of this Agreement shall be read as part of the clause or sub-clause in which it appears.

7.5.2 If in the interpretation of this Agreement, including the Technical Annex, any clause is found to be ambiguous or uncertain, the Official Commentary provided with the SITPROSA Standard Interchange Agreement may be used as an aid to the interpretation of the Agreement.

7.6 Notice.

7.6.1 Except in regard to Section 3 every notice required to be given under this Agreement or under the Technical Annex shall be treated as properly given if provided to the other party in writing and signed by an authorised person for the party giving notice or an electronic equivalent of which a record can be produced. Each notice shall have effect from the day following that upon which it is received or deemed to be received at the address below of the party.

7.6.2 Notices shall be deemed to have been received five days after having been mailed by registered mail to the address in section 8 , or in the case of telex or telefax on the next business day after successful transmission to the number provided in section 8.

7.7 Addresses

7.7.1 The parties hereby choose their respective domicilii citandi et executandi as follows:

ABC (Pty) Ltd	XYZ (Pty) Ltd
.....	.....
.....	.....
.....	.....
.....	.....

7.7.2 The parties choose the following numbers as numbers to which notices may be sent in terms of section 7.6:

ABC (Pty) Ltd	XYZ Pty Ltd
Fax no:	Fax no:.....
Telex no:	Telex no:.....
Telephone no:	Telephone no:.....

7.7.3 The addresses and telephone, fax and telex numbers stated in section 7.7.1 and 7.7.2 may only be changed with not less than fourteen days' prior written notice to the other party.

7.8 Dispute Resolution

7.8.1 In the event of any dispute arising between the parties as to any matter arising from this Agreement, any party may refer the dispute to arbitration. The aggrieved party shall give two weeks notice to the other party of his intention to refer the dispute to arbitration.

7.8.2 The dispute will be arbitrated in accordance with the provisions of the Arbitration Act 42 of 1965 by an independent arbitrator appointed by the Chairman of the SITPROSA Board and who shall be an electronic data interchange technology expert.

7.9 Jurisdiction Clause

Any dispute arising out of or in conjunction with this Agreement that cannot be resolved by arbitration shall be referred to the Witwatersrand Local Division of the Supreme Court of South Africa which shall have sole and exclusive jurisdiction.

Signed on this ..... day of ..... 19....
Name of Party:
Authorised Officer:
Signature:

Signed on this ..... day of ..... 19....
Name of Party:
Authorised Officer:
Signature:

TECHNICAL ANNEX

The Interchange Agreement specifically identifies a number of matters which must or may be addressed in the Technical Annex. For the convenience of review, those matters are summarised below.

1. Related agreements

List the related Commercial Agreements between the parties to which the use of EDI will relate.

2. Standards

2.1 Specify the UN/EDIFACT standards that will be relied on.
2.2 Designate the version that will be used.
2.3 Designate which messages in the UN/TDID may be used.
2.4 Specify other applicable standards such as communications protocols (see also Communications below).

3. System Operations

3.1 Describe the testing methods to be employed by the trading partners for initial configurations, the duration of testing, the benchmarks to be attained etc.

3.2 Specify the arrangements for the allocation of costs for testing.

4. System changes

Specify any relevant arrangements in the event of system changes not covered by Section 2.3 Specific attention should be given to the period of notice and whether the permission of the other party is required before such changes may be implemented.

5. Communications

5.1 List the third party providers that will be used by each party as well as addresses, telephone numbers and other relevant contact information.

5.2 Describe applicable communication protocols other than the EDI standards with which the parties must comply (such as X.25 or X.400)

6. Security Procedures and Services

6.1 Describe the security procedures the parties specifically agree on in regard to:

6.1.1 authentication, including the use of codes, passwords, smartcards, etc.;

6.1.2 encryption;

6.1.3 third party storage, authentication and verification.

6.2 Describe the security services that the parties are required to maintain or employ.

6.3 Describe the security measures that should be taken in regard to confidential messages.

7. Confidentiality

Describe the circumstances under which messages or data should be handled as confidential.

7.1 List the messages which shall be confidential in all circumstances.

7.2 Describe the procedures and requirements that must be met if a party wishes a messages to be treated confidentially.

7.3 Describe any restrictions in regard to a party unilaterally designating messages as confidential.

8. Record storage and evidence

8.1 Specify the record storage requirements on which the parties mutually agree, including any data logs that must be kept.

8.2 Describe the applicable message log to be kept and procedures to be followed by either party.

8.3 Designate the way in which logs must be certified to make them acceptable as evidence in any dispute between the parties.

9. Acknowledgement

9.1 Designate under what circumstances acknowledgement may be required or for which specific messages it is required.

9.2 Stipulate the methods, types of acknowledgement and procedures to be followed in the case of acknowledgement not yet covered in section 3.2.

9.3 Stipulate the relevant time periods within which acknowledgement must take place.

10. Receipt

Describe the manner in which and the time when a message is deemed accessible to party, i.e. when stored by the VANS, or when forwarded by the VANS, or when received on the computer of the receiving party, or at the time when the VANS records a successful transmission to the receiving party.

11. Processing of messages

Stipulate the time periods within which messages must be processed by the other party, as well as defining what is meant by processing i.e. 'processing an order' will mean notification of the packing and dispatching department, or of the manufacturing plant.

Appendix B : DELIVERY INSTRUCTION MESSAGE LAYOUT

CEB NETWORKS / MARKSEC
Delivery Instruction Message
(ODETTE DELINS Version 3)
Description of used message-segments

B.1 INTRODUCTION

Document Purpose

This specification provides the definition of the ODETTE (Organisation for Data Exchange by Tele Transmission in Europe) DELINS (Delivery Instruction) message to be used in Electronic Data Interchange (EDI) between trading partners.

Message Definition

A message by means of which a buyer provides information regarding details for both short term delivery instructions and medium to long term requirements for planning purposes according to conditions set out in an order.

Principles

A delivery instruction covers one seller and one buyer and can relate to:

different articles, packed in different type of packages
different time periods, with different quantities.

B.2 CEB NETWORKS SPECIFIC USAGE AND DEFINITION OF SEGMENTS

Segment Code UNB
Segment Name Interchange Header
Segment Status Man / 1 x per message

TAG	Name	St.	Format	Remarks
0001	Syntax Identifier	M	an..4	Translator value = "UNOA".
0002	Syntax Version Number	M	n..1	Translator value = "1" or "2".
0004	Sender Identification	M	an..35	The sender's ODX code. CEB Network's ODX code = "ODX91000268"
0010	Receiver Identification	M	an..35	The receiver's ODX code.
0014	Routing Address	M	an..14	The routing address is qualified by the supplier where required. This field can be used to identify the final routing message.
0017	Date	M	n..6	Translator Date for message been sent.
0019	Time	M	n..4	Translator Time for message been sent.
0020	Interchange Control Reference	M	an..14	System allocated reference number allocated by sender to identify the message uniquely.
0035	Test Indicator	M	n..1	Indicate if the message is for test or must be used in the production environment. Production message = "0" Test Message = "1"

Segment Code UNH
Segment Name Message Header
Segment Status Man / 1 x per message

TAG	Name	St.	Format	Remarks
0062	Message Reference	M	an..14	An unique number to identify each transmission.
0065	Message Type	M	an..6	Value always = "DELINS".
0052	Message Version Number	M	n..3	Value always = "003".

Segment Code MID
Segment Name Message Identification
Segment Status Man / 1 x per message

TAG	Name	St.	Format	Remarks
1004	Document Number	M	an..17	For CEB Networks to uniquely identify this document the document number is the same as the release number of the first item. For Marksec (UK) value = "ARD". To indicate the release number is at item level. (Field Tag 1004 in AD1 segment)
2007	Document Date	M	n..6	The date of the above document as it appears on any paper document. Format always = YYMMDD.
2002	Document Time	M	n..4	The time when the above document was compiled. Format always = HHMM. **(not used by CEB Networks)**

Segment Code FTX
Segment Name Free Text
Segment Status Con / n x per ARD

TAG	Name	St.	Format	Remarks
4440	Free Text Action Code	M	an..70	The release comments 1-3 lines on each line item. First line only is "M" if segment is used.

Segment Code SDT
Segment Name Seller Details
Segment Status Man / 1 x per message

TAG	Name	St.	Format	Remarks
3347	Seller Code	C	an..20	The International supplier code given to the supplier.
3036	Seller Name	C	an..35	The name of the supplier in a free text format.
3124	Address Line	C	an..35	The supplier's address in 1-4 lines in a free text format.
3296	Trading Partner Code	M	an..17	The supplier code given to the supplier by CEB Networks. The code is a 6 numeric number.
3207	Country Code	C	a2	Identify the country of origin of the release. Value for South Africa = "ZA".

Segment Code BDT
Segment Name Buyer Details
Segment Status Man / 1 x per message

TAG	Name	St.	Format	Remarks
3003	Buyer Code	C	an..20	For CEB Networks same code as in Field 3296.
3036	Buyer Name	C	an..35	The name of the buyer in a free text format. Value = "CEB Networks".
3124	Address Line	C	an..35	The buyer's address in 1-4 lines in a free text format.
3296	Trading Partner Code	M	an..17	The code the supplier should use in returned message for CEB Networks. Value = "575663".
3412	Contact Person	C	an..35	The name of a contact person or department. For CEB Networks this person will be the sourcing manager responsible for the supplier.
3928	Telephone Number	C	an..17	The telephone number for CEB Networks.
3929	Telephone Extension	C	an..17	The telephone extension of the contact person mentioned above.
3926	Fax Number	C	an..17	The fax number of the contact person mentioned above.

Segment Code ARI
Segment Name Additional Release Information
Segment Status Con / 1 x per message

TAG	Name	St.	Format	Remarks
7903	Release Type Code	M	n1	This indicator to identify the action to be taken on the date of the schedule. (Field Tag 2803 in DEL segment) Ship by Date = "1" Receive by Date = "2" In Manufacturing by Date = "3" At Distribution Centre by Date = "4"
2069	Effective From Date	M	n6	The date from when this release is valid. Format always = YYMMDD.
2073	Effective To Date	C	n6	The date to when this release is valid. Format always = YYMMDD.

Segment Code PDI
Segment Name Previous Delivery Instruction
Segment Status Con / 1 x per ARD

TAG	Name	St.	Format	Remarks
1004	Document Number	M	an..17	The previous item release reference number.
2007	Document Date	C	n6	The date of the previous item release. Format always = YYMMDD.
2002	Document Time	C	n4	The time of the previous item release. Format always = HHMM. **(not used by CEB Networks)**

Segment Code CSG
Segment Name Consignee Details
Segment Status Man / 1 x per item/order/final destination

TAG	Name	St.	Format	Remarks
3113	Consignee Code	C	an..20	The International code given to the consignee. For CEB Networks same code as in Field 3296. For Marksec (UK) on the OLS releases this is a 3-digit code of the plant location group in UK. * See page 13 for the OLS Plant codes in UK
3036	Consignee Code	C	an..35	The name of the consignee in a free text format. Value = "CEB Networks".
3124	Address Line	C	an..35	The address in 1-4 lines in a free text format.
3296	Trading Partner Code	M	an..17	The code the supplier uses for CEB Networks. Value = "575663".
3921	Final Delivery Code	C	an..17	The final destination code given by CEB Networks to the supplier for where to supply. For Local OE release = format 8 alpha numeric and the code can be e.g. "57566311" On Export release = format 10 alpha numeric and the code can be e.g. "CEBWAG0022". * See page 13 for the OLS Plan codes in UK.
3920	Final Delivery Point	C	an..35	The physical address of the final destination in a free text format.
3412	Contact Person	C	an..35	The name of the contact person and department. For CEB Networks this person will be the material planner responsible for this item.
3928	Telephone Number	C	an..17	The telephone number for CEB Networks.
3929	Telephone Extension	C	an..17	The telephone extension of the contact person mentioned above.
3926	Fax Number	c	an..17	The fax number of the contact person mentioned above.

Segment Code ARD
Segment Name Article Details
Segment Status Man / n x per CSG

TAG	Name	St.	Format	Remarks
7304	Buyer's Article Number	M	an..35	Used by CEB Networks to uniquely identify the item number. The number is 7 numeric.
7194	Seller's Article Number	C	an..35	Used by CEB Networks if it is available for the supplier to uniquely identify the same item number.
7008	Article Description	C	an..35	Description of the item, only 1 line in free text.
6410	Measure Unit Specifier	C	an..3	The unit of measure used by CEB Networks. Value per price = "PCE".
1022	Order Number	M	an..17	The order which CEB Networks raised on the supplier for this item release. The number is 9 numeric.
2001	Order Date	C	n6	The date the order was printed. Format always YYMMDD.
4440	Free Text	C	an..70	This field is for additional item information.
7860	Design Revision Number	C	an..35	This number is used by CEB Networks for the change level of the item.
1376	Engineering Change Number	C	an..17	The engineering change number (NRCL no.) of the item.

Segment Code UNT
Segment Name Message Trailer
Segment Status Man / 1 x per message

TAG	Name	St.	Format	Remarks
0074	Segment Count	M	n6	System defined segment count.
0062	Message Reference number	M	an..14	The same message reference as for the UNH segment (Message Header).

Segment Code SAD
Segment Name Supplementary Article Details
Segment Status Con / 1 x per ARD

TAG	Name	St.	Format	Remarks
7807	Instruction Update Action Code	M	n1	This indicator identifies the action to be taken with this release. Replace previous release = "1".
3413	** Employee Code Mandatory within Marksec (UK)	C	an..17	For Marksec (UK) on the OLS releases this is a 4-digit code of the responsible person at UK.
7153	Article Status Code	C	n2	This code indicates the status of the item. New item to run in = "01" Obsolete item running out = "02" Current production item = "03" Current P&A item = "06" Run out item not current = "08"
2013	Frequency Code	C	an..2	This code indicates the delivery frequency. Weekly delivery = "3".

Segment Code DST
Segment Name Delivery Status **(Mandatory within CEB Networks)**
Segment Status Con / 1 x per ARD

TAG	Name	St.	Format	Remarks
2253	Calculation Date	M	n6	The run date when this release was compiled. Format always = YYMMDD.
6802	Actual Cumulative Quantity Scheduled	C	n..10	The cum quantity on call-off from the beginning of the current year.
6804	Actual Cumulative Quantity Received	C	n..10	The cum quantity received from the beginning of the current year.
6806	Delivery Quantity Balance	C	n..10	The cum quantity to indicate an ahead delivery (- sign) or a behind delivery (+ sign). (Scheduled - Received = Balance)
2121	Quantities Accumulation Start Date	C	n6	The base line date from where calculations were started.
6812	Quantity Balance	C	n..10	The opening balance at the base line date as mentioned in field tag 2121.
6905	Cumulative Quantity Scheduled up to	C	n..10	The cum release quantity for the previous period.
6909	Quantity in Stock	C	n..10	This quantity is used by CEB Networks for the Run-out cum.

Segment Code PDN
Segment Name Previous Despatch Notes
Segment Status Con / n x per ARD **(up to three times for CEB Networks)**

TAG	Name	St.	Format	Remarks
1128	Despatch Note Number	M	an..17	The Despatch Note number created by the supplier.
2219	Despatch Note Date	C	n6	The date the despatch note was compiled at the supplier. Format always = YYMMDD.
6270	Quantity Delivered	C	n..10	The despatch note line item quantity.
6872	Actual Quantity Received	C	n..10	The actual quantity CEB Networks received on the line item.
2441	Goods Receipt Date Balance	C	n6	The date the despatch was received. Format always YYMMDD.

Segment Code SID
Segment Name Schedule Indicator Details
Segment Status Con / n x per ARD

TAG	Name	St.	Format	Remarks
6811	Schedule Status Indicator	M	n1	An indicator to show the supplier commitment. Firm Order (may deliver) = "1" Manufacturing (may start production) = "2" Material (may buy raw materials) = "3"
2151	**Type of Period Coded Mandatory with Marksec (UK)	C	an..3	For Marksec (UK) on the OLS releases this is a fix code = "M".
2152	**Number of Periods Mandatory with Marksec (UK)	C	n..3	For Marksec (UK) on the OLS releases this is a fix code = "2" i.e. 2 months firm order plus 2 months raw materials only excluded the actual month.
6906	Latest Cumulative Quantity Scheduled	C	n..10	The last commitment cum.
6907	Highest Quantity Previously Scheduled	C	n..10	The previous highest commitment cum.
1430 2152	Reference to Highest Quantity Previously Scheduled	C	an..17	The release reference of previous highest commitment cum.

Segment Code DEL
Segment Name Delivery Details
Segment Status Con / n x per ARD

TAG	Name	St.	Format	Remarks
2803	First Date	M	n6	The actual date of the required delivery. Format always = YYMMDD.
2805	Last Date	C	n6	The last date of the required delivery. Format always = YYMMDD.
2836	**Time Period Coded Mandatory within Marksec (UK)	C	n8	For Marksec (UK) on the OLS releases this is the delivery-time period for one or several weeks. Format always = YYWWYYWW.
6060	Quantity	M	n..15	The quantity required to be delivered on the actual date.
7803	Delivery Instruction Reason Code	C	n1	Specify the reason code for the delivery. Normal requirement = no value Back order = "3" Urgent delivery = "4" Cancel order = "5" (quantity = zero) For Marksec (UK) on the OLS releases this field could be used to identify a behind condition. The value = "3" and the behind quantity is in field tag 6060.
6811	Schedule Status Indicator	C	n1	An indicator to show the supplier commitment. Firm Order (may deliver) = "1" Manufacturing (may start production) = "2" Material (may buy raw materials) = "3"
6903	Cumulative Quantity Scheduled	C	n..10	The cumulative quantity for the scheduled release used by CEB Networks.

Segment Code TCO
Segment Name Type of Packages
Segment Status Con / n x per ARD

TAG	Name	St.	Format	Remarks
7064	Type of Package	C	an..35	A description of the type of package the item is to be packed into.
1906	Package Reference Number. Mandatory within CEB Networks	C	an..35	The code of the package being used to pack the item in for CEB Networks.
6853	Quantity of Article in Package	C	n..10	The actual quantity of the items to be packed into the package.

Segment Code ADI
Segment Name Article Delivery Instruction Number
Segment Status Con / 1 x per ARD

TAG	Name	St.	Format	Remarks
1004	Document Number	M	an..17	The current release number reference for this line item and this number must correspond to any paper documents the supplier receives.
2007	Document Date	C	n6	The actual date the release for this line item was compiled at CEB Networks. Format always = YYMMDD
2002	Document Time	C	n4	The actual time the release for this line item was compiled at CEB Networks. Format always = HHMM **(not used by CEB Networks)**

Segment Code UNZ
Segment Name Interchange Trailer
Segment Status Man / 1 x per message

TAG	Name	St.	Format	Remarks
0036	Interchange Control Count	M	n6	Automatic interchange count.
0020	Interchange Control Reference	M	an..14	The reference for this interchange message.

Important Remarks:

This definition is according to CEB Network's requirements and is in line with the Odette message definition. In some cases in this definition a field is marked as being Mandatory (St. = M); this means that for CEB Networks it is mandatory, although according to the Odette standard it may be a conditional field.

This definition also caters for the OLS releases received from Marksec (UK) and therefore also includes the requirements of the VDA 4905/2 standards. Where these fields deviate from the recommendation of this message, they are marked with "**".

The Local OE releases compiled from CEB Networks get calculated at Sandton data processing centre. The complete release run is every second week while the supplementary releases are processed as required. The EDI transmission run is started directly after the release run and the messages will be available from 8 o'clock the next morning.

The Export OLS releases compiled from Marksec (UK) get calculated at London data processing centre every night when the responsible material control staff revise the release. The EDI release data gets downloaded to CEB Networks and EDI transmission starts after the data has been received. The messages will be available from 8 o'clock the next morning.

B.3 CODES DEFINITION

OLS Plants in UK and Germany

Plant Locations	UK Plants		Locations Group CSG Segment, Field Tag 3133	Plant Codes CSG Segment, Field Tag 3921
München			010	
	Heidemann str.	Plant 0.1		MARKSEC0001
	Petuelring.	Plant 1.0		MARKSEC0010
	Lerchenauer str.	Plant 1.1		MARKSEC0011
Dingolfing			020	
	Landshuter str.	Plant 2.2		MARKSEC0022
	Landshuter str.	Plant 2.4		MARKSEC0024
Berlin			030	
	Sparte Motorrad.	Plant 3.1		MARKSEC0031
Birmingham			040	
	Ohm str.	Plant 4.1		MARKSEC0041
Manchester			060	
	Dawson str.	Plant 6.1		MARKSEC0061
	Long str.	Plant 6.2		MARKSEC0062

Message Example

Example of a Local OE release

UNB+UNOA:2+ODX91000268+"ODETTE-ID of Supplier"+YYMMDD:HHMM
+"Transmission number"++++++0'

UNH+MESSAGE01+DELINS:003'

MID+"Document number"+YYMMDD'

SDT+"International Code":"Supplier Name":Address Line"::::"Supplier
Code"++++ZA'

BDT+575663:CEB Networks South Africa:"Address Line 1"::::575663++++
+"Contact Person":0125292911:"Extension"::"Fax number" '

ARI+1+YYMMDD:YYMMDD'

CSG+575663:CEB Networks South Africa:"Address Line 1"::::575663+
57566311:"Delivery Address"+++"Contact Person":90125292911:
"Extension"::"Fax number" '

ARD+CEB Networks item number":"Supplier Item number":"Item
Description"+:PCE+"Order number":YYMMDD++"Free Text"+Change
Level":"Engineering Change number" '

PDI+"Document number"+YYMMDD'

SAD+1++01++3'

FTX+"Free Text Line 1"::'

DST+YYMMDD+0000021215:0000012125:+0000009090:YYMMDD+0000000000+
0000001122+0000000250'

PDN+"Despatch Note number":YYMMDD+0000000234:0000000230+YYMMDD'

SID+2+:0000021215:0000021210:"Release Reference number" '

DEL+YYMMDD::YYMMDD+000000000000155:: :1:0000000122'

TCO+"Package Type Description" : CEB Networks Package Code"++
"Package Quantity" '

ADI+"Document number"+YYMMDD'

UNT+000017+MESSAGE01'

UNZ+000001+"Interchange Reference" '

Appendix C : FEATURES, BENEFITS AND PREREQUISITES OF ODEX

C.1 INTRODUCTION

ODEX is a software package that performs the tasks of a communications management system in an EDI environment. It establishes the communications link, manages the transmission of data, handles error recovery and the termination of a session. It allows for direct communication via X.25 (X.400) networks and can link to any value added network supporting the ODETTE File Transfer Protocol and the X.400 standard. ODEX runs on a variety of mainframe, mini and Personal Computers. It can send or receive both EDI and non-EDI data.

C.2 FEATURES OF ODEX

- **ODEX** handles both EDI and non EDI data files.
- Has full recovery and restart facilities.
- Supports the United Nations Guidelines for Trade Data Interchange (UNGTDI) and Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) syntax rules as well as ANSI X.12.
- Supports both national and international connections.
- Full password support for total integrity.
- Designed to run unattended without operator intervention.
- Produces reports on the files it has in process or has processed.
- Able to run under menu control or in automatic mode.
- **ODEX** maintains a comprehensive audit trail of all sessions established together with details of files transmitted and received.
- Supports a LAN environment with concurrent processing.
- **ODEX** supports multiple simultaneous communication sessions (up to twenty). Some of these may be outgoing calls, some may be incoming, some may be direct to a trading partner, some may be indirect to a VAN.
- All of these simultaneous connections are established over a single connection to the X.25 (X.400) network.
- Data compression is supported, and if enabled will compress all transmitted data.

- Should a communications problem be encountered, an online multi-level tracing capability exists for easy problem diagnosis.
- In the event of a session not being established, due to network failure, **ODEX** will automatically retry for a user specified number of retry attempts and intervals.
- When a file is scheduled for transmission, it is queued immediately, and, unless the user defines a specific date and time before which the file should not be sent, **ODEX** will automatically establish an outgoing call.
- In the event that a communication session is interrupted, **ODEX** is able to automatically restart the transmission or reception of an EDI file at the point the session was interrupted.
- **ODEX** will automatically accept all incoming calls. If the incoming user is not known to **ODEX,** or if he does not pass the security check, **ODEX** will reject the incoming call. Once the session has been established, messages may be received from or sent to the end user.
- **ODEX** has a very comprehensive reporting capability, but if the user wants more than the predefined reports he may customise his own reports.
- End to End Response (EERP) support is incorporated within **ODEX.** This feature of the ODETTE protocol allows the user to determine if his file has reached its ultimate destination.
- **ODEX** will automatically split a file into a number of mini files on a customer destination basis and automatically queue the mini files ready for transmission. Using the customer destination codes in the message, **ODEX** will know not only to whom the message should be sent, but also when it is to be sent.
- **ODEX** will perform all the management functions of a clearing centre.

C.3 BENEFITS OF ODEX

- If the user begins his EDI communications on a point to point basis and later decides to use a Value Added Network (VAN), **ODEX** will allow him this option. This eliminates software changes and protects his original investment.
- Data compression reduces transmission costs.
- Automation allows for the system to run unattended, reducing human intervention and saving time.

- Online multi-level tracing facilities problem solving thereby reducing down-time.
- EERP will show the user if his file has reached its destination; this is of particular importance in a "just in time" manufacturing environment.
- Merge functions will collect together all of the individual delivery instruction messages received and combine them into one file, thereby streamlining the up-loading of information into existing applications.
- The split function is one of the automatic features that reduces human error and human intervention.
- Reporting facilities and audit trails allow for complete control over EDI operation.
- High level security controls prevent illegal or unauthorised access to the organisation's EDI systems.

C.4 PRE-REQUISITES FOR INSTALLATION

ODEX requires that at least one of the parties communicating must have a dedicated line to an X.25 network.

Listed below are the hardware and software requirements for installing **ODEX** on all the different platforms:

PC's, OS/2, LAN:

Hardware: Either a modem for dial-up or an Eicon communications card for dedicated line users.
Subscription to X.25
Minimum of 300 KB RAM
One fixed drive and one floppy drive
A matrix printer 80 columns

Software: PC DOS 3.1 or above
X.25 Communications Support Software

Appendix D : TRADING PARTNER SURVEY WORKSHEET

Trading Partner: **EDI Contact:**

Address: **Title:**

Phone:

Fax:

Last 12 months business:

Sales value: Purchase value:

Sales units: Purchase units:

Sales orders: Purchase orders:

CURRENT USE OF EDI (Repeat per application)
Business application/s:
EDI Standard/s:
Transaction set:
Number of EDI trading partners exchanging transaction with:
Value-added network/s:

PLANS FOR EDI
Requirements/Expectations
Next 6 months - Transaction sets under evaluation
Next 12 months - Transaction sets under evaluation

ATTITUDE TOWARDS EDI
Business application:
Specific business information needs:
Perceived benefits:
Perceived constraints:

Appendix E : DATA COMMUNICATIONS WORKSHEET

1. Assign Data Communications to a project team member: _____

2. Note data communications requirements of trading partner(s) or a VAN:

   a. Communications protocol: _____

   b. Asynchronous or Bisynchronous communications method: _____

   c. Transmission line speed of modem: _____

Notes:

3. Estimate the data communications hardware/software costs:

   a. Estimate cost of modem: _____

   b. Estimate cost of communications software: _____

   c. Estimate cost of dial-up or leased data quality telephone line: _____

Notes:

TOTAL COST: _____

4. Date equipment is to be installed/tested: _____

Appendix F : LOW COST VAN OPTION

F.1 OVERVIEW

EasyServ is the name of the entire value added services which are provided by EDIserv (PTY) LTD. EasyServ is a value added message switching service, providing EDI and non-EDI message transfer between trading entities.

The EasyServ Service is available to users on a 24 x 7 x 365 basis, with the exception of a short period of downtime at published intervals overnight to ensure system integrity is maintained.

F.2 HARDWARE

The EasyServ Service runs from EDIserv's Head Office in Sandton. EasyServ is implemented on a SCO UNIX machine with mirrored external disks for integrity and is designed for applications which require the highest levels of system availability. An alternate site has been allocated as a disaster recovery site with full X.25 capability.

F.3 PROTOCOLS

EasyServ supports both the OFTP (Odette File Transfer Protocol) and X.400 (1988 MTA P2) over X.25. Users will also be able to access EasyServ using ISDN.

F.4 SPEEDS

EasyServ allows access to users with modem capabilities from 2400 to 9600 baud over X.25 and supports 64Kb over ISDN.

F.5 ADVANTAGES

The EasyServ concept is to provide extremely low cost alternatives to the more traditional VANS and to permit discrete trading communities to be established with minimal impact.

In line with this policy, the following features will be applied:

- No Connection Charge
- No Annual Usage Charge
- Free Enabling Software
- Sender Pays Transmission Fees

In order to reduce the cost barriers associated with electronic trading, EasyServ provides virtually free EDI enabling for those companies wishing to receive data. The only charge will be the local telephone call charges for the period of transmission.

F.6 FREE SOFTWARE

The customer will receive a version of the standard ODEX communications product, which will communicate only with EasyServ Services. Should the users wish to bypass the EasyServ Services for specific customers, or use any of the other VANS directly, a discounted upgrade to the standard product can be made available for all of these requirements.

The customer will also receive DISP, the central control facility for report generation and data entry. The basic expansion modules for each industry sector will be provided free of charge. Trading partner specific message groups can be purchased for a nominal fee as and when required or can be commissioned by the manufacturer for a single negotiable fee.

F.7 REQUIREMENTS

In order to become EDI enabled to EasyServ a customer must have access to:-

- An IBM or 100% compatible Personal Computer
- PC DOS 3.3 or higher
- A V.22 bis modem

F.8 EASY ACCESS

The EasyServ Services provide access to users via native X.25 and TELKOM's Easy Access Service. Those users wishing to access EasyServ using the Easy Access option do not require an Easy Access subscription. Those users wishing to access EasyServ via X.25 will need to subscribe to the X.25 service provider, Telkom.

F.9 SERVICE FEATURES

In addition to automatic message switching the EasyServ Services offer full end to end auditing and accountability via the OFTP's integral (EERP) End to End RESPONSE. This means that users are always able to ascertain the current status of any transaction.

EasyServ can also provide a service message to corporate clients wishing to have their data analysed by the service prior to forwarding. This can be tailored to work on a transactional, or an exception basis. A variety of validation routines can be applied to the customers data upon request.

EASYSERV
Tariff Sheet

1 Costs

Networking	No cost
Connection to EasyServ	No cost
EasyServ Enabling Software (Includes 3 DISP Modules)	No cost
Annual Charge	No cost
Receiving Data	No cost
Receiving Data from Other Vans (per K)	R 0.11c
Transmission costs (Sending data per K)	R 0.11c
Minimum charge per session (5K)	R 0.55c
Mailbox polling first two unproductive connects to EasyServ per 24 hour period	No cost
Mailbox polling on third and subsequent unproductive connects (per 24 hour period)	R 0.55c

2 Invoicing

Minimum invoice value is R57.00, if and only if an invoice needs to be raised.
All payment will be Direct Debit.
The minimum charge will apply to any user exceeding the permitted maximum unsuccessful polling interval.

3 Support, Maintenance, Installation & Training (optional)

Support and a Product Maintenance Agreement for the EasyServ software is available at a cost of R720.00 per annum.
Support is availabe from 8:00 to 17:00 daily, Monday - Friday.
Installation & Training R 1 140.00

4 Costs for additional facilities

Hardcopy of User Guide and Binder	R 150.00
Internal card modem (9600 baud) (USA Sportser)	R 906.30
External modem (9600 baud) (USA Sportster)	R 963.30
Other DISP Module Packs	R 855.00
ODEX/PC stand-alone (Multi Networking Version)	£ 1 237.00
XLATE/PC stand-alone (for full integration)	£ 1 237.00

ODEX and XLATE are available for a wide range of platforms.
Migrational discounts available on request.

5 Standard Support and Maintenance Contract (optional)

Support is available for the entire product range at an annual cost of 15% of the retail price per annum.

6 Other Platforms

ODEX & XLATE are available for a wide range of platforms including:

- MVS MAINFRAME
- DEC/VAX
- AS/400
- TANDEM UNIX
- AIX UNIX
- HP UNIX
- SCO UNIX
- INTERACTIVE UNIX
- OS2
- DOS

7 Method of Payment

Direct Debit
An administration fee will be levied for any other financial arrangement. R 57.00

Appendix G : VAN REQUIREMENTS DOCUMENT

This document was developed by SITPROSA for its members to assist them in evaluating a VAN facility. It is broken up into 4 sections, namely the central data facility, networks, end user software and service levels.

G.1 CENTRAL DATA FACILITY

- Support of EDIFACT and other internationally accepted standards;
- Central mailbox functionality of a Store and Call Forward or (Retrieve) application;
  - Send message(s);
  - Retrieve message(s);
  - Selective message retrieval;
  - Message deletion, selective and automatic;
  - Archiving facilities;
  - Status enquiries;
  - Audit trails;
  - Date and Time stamping.
- Usage and billing analysis;
- Validation of EDI file addressing detail;
- Data resident on the service cannot be modified by Sender or Receiver (changes/updates to be a new message/file);
- Multiple transmissions in a single session;
- Multiple addressing options;
- Control and allocation of unique mailbox addresses;
- User controlled access passwords;
- User controlled mailbox access;
- User defined and controlled Trading Partner Relationships;
- Backups of Software Systems;
- Backups of User Data;
- Hardware backup;
- 24 Hour/365 Days per year - Minimum scheduled maintenance;
- Enhancements to service to cater for new technology as and when economically viable.

G.2 NETWORK

- All access methods supported:
  - Dial up;
  - Leased line;
  - PDN;
  - Digital.
- Local access points;
- International access points;
- Access via Public Data Network(s) (PDN);
- Network redundancy;
- Various transmission speeds supported;
- Protocol conversion for commonly used proprietary protocols;
- Error free transmission (dependant on user software/hardware);
- Access security - passwords, inactivity timeouts;
- 24 Hour/365 Days per year - Minimum scheduled maintenance.

G.3 END USER SOFTWARE

- UN/EDIFACT support, ie. the formatting and deformatting of EDIFACT messages. Software updates supporting EDIFACT evolutionary development;
- Software functionality:
  - Single or multiple message transmission capability;
  - Reconnection capability;
  - Password encryption;
  - Interface to inhouse applications;
  - Support of commonly used machine environments.
- User friendly;
- User generated service commands;
- Security;
- Password protected end user software.

G.4 SERVICE LEVELS

- 24 hour Help Desk service:
  - Central Data Facility;
  - Network access;
  - End user software.
- Escalation procedures;
- Education and training available;
- Consulting services available;
  - Technical;
  - Standards;
  - Commercial.
- User Group Support;
- Liaison with Standards Organisations;
- Local and International support;
- Certification and/or endorsement of service by industry bodies;
- Testing and certification of user connect software by Value Added Services.

Appendix H : PROJECT EVALUATION QUESTIONNAIRE

The information requested in this questionnaire will be used in an evaluation of the EDI implementation methodology utilised by CEB in implementing EDI with Marksec.

All information provided will be used in confidence and I thank you for your cooperation. If you have any questions concerning this questionnaire or the study of which it forms a basis, then please contact Ettienne Meyer on (012) 663-1895. Due to the subjective nature of the questionnaire, comments on each individual rating would be appreciated.

Section 1. Organisation Details

Please complete in block capitals

Name of company: .....

Address: .....

.....

.....

Your name: .....

Position: .....

Telephone: .....

Fax: .....

Role in project:

Level:	Management	User Department	External Consultant	IT Dept

Section 2. Methodology Evaluation

Evaluation Criteria:

1. Reliability / Consistency

With reliability and consistency, it is meant that if faced with the same circumstances, repetitive application of the methodology must produce the same results. Thus the user of the methodology must be able to clearly interpret each step of the methodology without fear of inconsistent results.

Rating:

	0	1	2	3	4	5
N/A	Poor		Fair		Good	

Opinion:

Subjective	Objective

Comment on rating:

2. Completeness / Life cycle framework

The methodology should be complete so that there is no need for the user to have to apply any other set of steps to implement EDI. Due to the non-existence of previously defined life cycle frameworks for EDI implementation methodologies, modification to this framework is natural.

Rating:

	0	1	2	3	4	5
N/A	Poor		Fair		Good	

Opinion:

Subjective	Objective

Comment on rating:

3. Application independence

The methodology should be suitable to any application where EDI is being implemented, e.g. a methodology that is so specific that it could only be applied to financial documents would not be of much use to an organisation when it wishes to implement non-financial documents.

Rating:

	0	1	2	3	4	5
N/A	Poor		Fair		Good	

Opinion:

Subjective	Objective

Comment on rating:

4. Industry independence

It must be usable in any industry. A methodology that is only applicable to the manufacturing industry causes problems when a manufacturing company wishes to trade electronically with its bank for example. Thus even organisations in a specific industry will do EDI with organisations outside of that industry.

Rating:

	0	1	2	3	4	5
N/A	Poor		Fair		Good	

Opinion:

Subjective	Objective

Comment on rating:

5. Technology independence

It must not prescribe any technical solutions, e.g. a VAN or point-to-point implementation.

Rating:

	0	1	2	3	4	5
N/A	Poor		Fair		Good	

Opinion:

Subjective	Objective

Comment on rating:

6. Technique independence

At the atomic level, the methodology should not prescribe specific techniques for performing individual activities. This will allow users to apply existing techniques for those steps that they already perform in the organisation. Examples are the method with which a cost-benefit analysis is performed or the methods used to plan for EDI integration to existing applications.

Rating:

	0	1	2	3	4	5
N/A	Poor		Fair		Good	

Opinion:

Subjective	Objective

Comment on rating:

7. Adaptability

It should be adaptable to suit the specific needs of the user, e.g. should organisations already have pilot projects in place they would wish to use only subsequent phases of the proposed methodology.

Rating:

	0	1	2	3	4	5
N/A	Poor		Fair		Good	

Opinion:

Subjective	Objective

Comment on rating:

8. Modifiability

It must be modifiable to cater for life cycle evolution and changes in EDI technology.

Rating:

	0	1	2	3	4	5
N/A	Poor		Fair		Good	

Opinion:

Subjective	Objective

Comment on rating:

9. Alternative evaluation

The methodology should facilitate early error detection as well as early eradication of unattractive alternatives.

Rating:

	0	1	2	3	4	5
N/A	Poor		Fair		Good	

Opinion:

Subjective	Objective

Comment on rating:

10. Environment Issues

The fit of a methodology to an organisation's needs and the demands it places on the organisation are important. The resources required by the implementation process must be considered. Methodologies requiring a great deal of technological support may not be feasible for the small shop. Similarly, small- to medium-sized shops may not be able to afford consultive efforts aimed at customizing a particular methodology to fit their needs. Other issues such as those of educational requirements are also of importance.

Rating:

	0	1	2	3	4	5
N/A	Poor		Fair		Good	

Opinion:

Subjective	Objective

Comment on rating:

BIBLIOGRAPHY

Arnold, R.S., *SOFTWARE REENGINEERING*, IEEE Computer Society Press, Los Alamitos, 1993.

Babb II, R.G., Kieburtz, R., Orr, K., Mili, A., Gearhart, S. & Martin, N., *Workshop on Models and Languages for Software Specification and Design, Current Issues of Requirements Engineering*, Computer, March 1985, pp. 103-108.

Banerjee, A. & Banerjee. S, *Coordinated, orderless inventory replenishment for a single supplier and multiple buyers through electronic data interchange*, International Journal of Technology Management, 1992, Volume 7, Number 4/5, P 328.

Bentley, T., *Paperless Trading*, Management Accounting, 1989, Vol. 67, No. 7, p. 16.

Black, U.D., *Data Communications and Distributed Networks*, Prentice-Hall International, Inc, New Yersey, 1987.

Blum, B.I., *Software Engineering A Holistic View*, Oxford University Press, Oxford, 1992.

Boehm, B.W., *A Spiral Model of Software Development and Enhancement*, Computer, May 1988, pp 61-72.

Burke, D.P., *Gearing Up for EDI*, Financial Executive, 1993, Volume 9, Number 3, P 25.

Cannon, E., *EDI GUIDE: A Step by Step Approach*, Van Nostrand Reinhold, New York, 1993.

Collier, P. & Spaul, B., *An Introduction to EDI*, Accountants Digest, 1991/92, pp 18-21.

Connor, D., *Information System Specification and Design Road Map*, Prentice-Hall Inc., New Yersey, 1985.

Cummings, J., *Cost savings not a factor for firms moving to EDI; users sites strategic gains as most important*, Network World, February 1, 1993, p. 37.

Davis, L., *Retailers go shopping for EDI*, Datamation, March 1, 1989, p. 53.

Du Plessis, A.L., *A Method for CASE Tool Evaluation*, Information & Management, Vol 25, 1993, pp 93-102.

Du Plessis, A.L. & van der Walt, E., *Modelling The Software Development Process, IFIP WG8.1 Working Conference on "Information System Concepts: Improving the Understanding"*, Alexandria, Egypt 13 - 15 April 1992.

Dumaine, B., *What the Leaders of tomorrow see*, Fortune 500, July 1989, pp. 48-57.

Eckerson, W., *IS executives say top priority is responsiveness to users' requests*, Network World, July 6, 1992, 9(27):33.

EDI'92, *(August 1992: Sandton)*, 1992.

Eiselen, G.T.S., *Legal aspects of the change to EDI*, Potchefstroom University for Christian Higher Education, 1988, (Unpublished report).

Ellis, C.A., Gibbs, S.J. & Rein, G.L., *The Groupware Project: An Overview*, MCC Technical Report Number STP-033-88, January 1988.

Emmelhainz, M.A., *EDI a Total Management Guide*, 1993, Van Nostrand Reinhold, New York.

Feldman, J., *The bytes that bind- Electronic Data Interchange*, Handling and Shipping Management, 1987, Vol 25, No. 5, pp. 62-66.

Gant, D.R., *How to plan an EDI implementation*, Networking Management, March 1993,

Gareiss, R., *R.J. Reynolds backs EDI purchasing 100 percent*, Communications Week, April 26, 1993, p. 4.

Gifkins, M., *EDI technology*, Blenheim Online Publications, Middlesex, 1989.

Greenberg, S., *Computer-supported cooperative work and groupware: an introduction to the special issues*, Int. J. Man-Machine Studies (1991) 34, pp 133-141.

Harrington, G., *EDI in South Africa: An Assessment of the Costs and Benefits*, South African Computer Journal, Number 11, May 1994, pp. 26-38.

Haverson, D.S., *EDI offers promise despite flaws*, Midrange Systems, November 24, 1992, p. 35.

Hill, N.C. & Ferguson, D.M., *EDI and payment terms: Negotiating a positive-sum game*, Journal of Cash Management, 1987, Vol. 7, No. 5, pp. 21-26.

Hinge, K.C., *Electronic Data Interchange from Understanding to Implementation*, New York:American Membership Publication, 1988.

Kekre, S. & Mukhopadhyay, T., *Impact of electronic data interchange technology on quality improvement and inventory reduction programs: A field study* , International Journal of Production Economics, 1992, Volume 28, Number 3, P 265.

Kimberley, P. *Electronic Data Interchange*, McGraw-Hill, New York, 1991.

Leedy, D.L. *Practical Research Planning and Design*, Macmillan Publishing Company, New York, Third Edition, 1985.

Macpherson, S., *What are VADS?*, The National Computing Centre Limited, Manchester, 1987.

Main, J., *The Winning Organisation*, Fortune 500, September 1988, pp. 50-60.

Manganelli, R.L. & Klein, M.M., *The Reengineering Handbook*, AMACOM, New York, 1994.

Marcella, A.J. Jr. & Chan, S., *EDI Security, Control, and Audit*, Artech House, Inc, 1993.

McCusker, T., *How to get from 80 percent to a 100 percent in EDI*, Datamation, February 1, 1993, p. 45.

McFarlan, W., *Information Technology changes the way we compete*, Harvard Business Review, 1984, pp. 98-102.

McLeod, R. Jr, *Management Information Systems*, 2nd Edition, Science Research Associates, Sydney, 1983.

McNurlin, B.C. (Editor), *The rise of the Cooperative System*, EDP Analyzer, 1987, Vol. 25, No. 6, p. 35.

Metzgen, F., *Killing the paper dragon: EDI in business*, Oxford Heinemann Newnes, 1990.

Newton, *H. Newton's Telecom Dictionary*, 1992.

Night, R.M., *Firms must do upfront EDI planning; successful implementation demands cooperation amongst corporations, departments, personnel*, Computer World, October 19, 1992, p. 82.

Olle, T.W.,...[et al.], *Information systems methodologies: a framework for understanding*, Addison-Wesly, Cornwall, 2nd Edition, 1991.

Olson, P. & Nathan Mitchell, W., *Financial EDI: A Case Study at Lowe's Companies, Inc.*, Journal of Cash Management, 1993, Volume 13, Number 5.

Parfelt, M., *What is EDI: a guide to Electronic Data Interchange*, Oxford Bladwell, 1992.

Payne, A.L., Pub., *EDI Yellow Pages*, August 1992.

Payne, R.A., *With EDI, emphasis is on implementation*, Transportation and Distribution, 1988, Vol.29, p. 66.

Petrozzo, D.P. & Stepper, J.C., *Successful Reengineering*, Van Nostrand Reinhold, New York, 1994.

Picot, A., Neuburger, R. & Niggl, J., *Management Perspectives of Electronic Data Interchange Systems*, International Journal of Information Management, 1993, Volume 13, Number 4, P 243.

Plattner, B., Lanz, C., Lubich, H., Müller, M. & Walter, T., *X.400 Message Handling, Standards, Interworking, Applications*, Addison-Wesley, Kent, 1991.

Preston, M., *What is EDI?*, The National Computing Centre Limited, Manchester, 1988.

Raney, M. & Walter, C.K., *Electronic Data Interchange: The Warehouse and Supplier Interface*, International Journal of Physical Distribution and Logistics Management, 1992, Volume 22, Number 8, P 21.

Rogers, D.S., Daugherty, P.J. & Stank, T.P., *Enhancing Service Responsiveness: The Strategic Potential of EDI*, Logistics Information Management, Vol. 6, No. 3, 1993, pp. 27-32.

Royce, W.W., *Managing the development of large software systems*, In Proc, WESTCON, San Fransisco, 1970.

Schach, S.R., *Software Engineering*, 2nd Edition, Irwin Inc., 1993.

Scala, S. & McGrath, R., *Advantages and Disadvantages of electronic data interchange; An industry perspective*, Information and Management, 1993, Volume 25, Number 2, P 85

Schatz, W., *EDI: Putting the muscle in commerce and industry*, Datamation, March 15, 1988, p. 59.

Snyder, B., *EDI: The paper chase*, Cooperate Computing, March 1993, p. 33.

Sokol, P., *EDI: The competitive edge*, New York: McGraw & Hill, 1989.

Stuparich, M., *Security Issues in EFT/EDI*, Journal of Cash Management, 1993, Volume 13, Number 1, P 22.

Thayer, R.H., *SOFTWARE ENGINEERING PROJECT MANAGEMENT*, IEEE Computer Society Press, Washington, 1988.

Thierauf, R.J., *Electronic Data Interchange in finance & accounting*, New York Quorum Books, 1990.

Thomsen, H.B. & Wheble, B.S., *Trading with EDI, The Legal Issues*, IBC Financial Books, 1989.

Turnbull, P., *The impact of EDI upon the business organisation*, The EDI Handbook, 1988, pp. 11-13.

Tyndall, G.R., *Supply-Chain Management spurs long-term strategic retail alliances*, Marketing News, Vol. 22, p. 10.

Van der Walt, E., *SOFTWARE PROJECT MANAGEMENT FOR OBJECT-ORIENTED DEVELOPMENT*, MSc topic module, UNISA, 1993.

Van Drussell, C., *EDI: Implementation remains an obstacle*, Computing Canada, November 23, 1992, p. 1.

Vervest, P.H.M., *Innovation in Electronic Mail*, Elsevier Science Publishers, Amsterdam, 1986.

Viljoen, Z., *The CSCW Paradigm for Software Development*, MSc topic module, UNISA, 1994.

Wilson, P., *Computer Supported Cooperative Work (CSCW): origins, concepts and research initiatives*, Computer Networks and ISDN Systems 23 (1991), pp 91-95.

Wright, B.J.D., *EDI and American Law, A Practical Guide*, Electronic Data Interchange Association, 1989.

Wriston, W.B., *Technology and Direct Marketing*, Vital Speeches of the Day, 1989, pp. 678-680.

Yamamoto, Y., *An Approach to the Generation of Software Life Cycle Support Systems*, University Microfilms International, Michigan, 1981.