Lappeenranta University of Technology
Department of Industrial Engineering and Management

Electronic Data Interchange in Logistics Processes

The subject of this thesis was approved by the council of the department of industrial engineering and management in the meeting on October 13, 1999.

Supervisor: Professor Anita Lukka
Instructor: Mikael Rydström Datex-Ohmeda Global Infrastructure Manager

Helsinki November 9, 1999

Esa Katajamäki
Hämeentie 38 C 75
FIN-00500 Helsinki
Tel. (040) 5100072

ABSTRACT

Author: Esa Katajamäki

Title: Electronic Data Interchange in Logistics Processes

Department: Industrial Engineering and Management

Year: 1999 | **Place**: Helsinki

Master's Thesis. Lappeenranta University of Technology.

74 pages, 13 pictures, 2 tables and 1 appendix

Supervisor Professor Anita Lukka

Keywords: Electronic Data Interchange EDI , Enterprise Resources Planning ERP, logistics process, purchasing

Hakusanat: EDI organisaatioiden välinen tiedonsiirto OVT, logistinen prosessi, osto, toiminnanohjaus

The purposes of this thesis was to make a survey of influences, needs and benefits connected with EDI, and to prepare for taking the EDI Gateway module of the ERP system of Oracle Applications into production use. The information of the survey was gathered from discussions. Some new commercially derivative initiatives that are developed for the business-to-business environment and for the use of the internet technology, were discussed from the EDI perspective for future scenarios. Up-to-date information for the thesis was found also from Internet.

After these phases it was possible to implement one suitably wide and limited EDI pilot project for creating an EDI concept. This thesis concentrates mainly on the influences of EDI on purchasing. EDI was decided to be implemented first in purchase orders.

Benefits of EDI were difficult to be measured in figures. A large amount of money or items must be handled with an EDI partner often enough. In the phase of taking EDI into use the main problems are usually the problems connected with information technology of the applications.

The information gathered from surveys and from the EDI project can be used as a basis for further development. Further efforts have to be made to create a comprehensive, fully functional system.

TIIVISTELMÄ

Tekijä: Esa Katajamäki

Työn nimi: Organisaatioden välinen tiedonsiirto logistisissa prosesseissa

Osasto: Tuotantotalous

Vuosi: 1999	**Paikka**: Helsinki

Diplomityö. Lappeenrannan teknillinen korkeakoulu.
74 sivua, 13 kuvaa, 2 taulukkoa ja 1 liite
Tarkastajana professori Anita Lukka

Hakusanat: EDI organisaatioiden välinen tiedonsiirto OVT, logistinen prosessi, osto, toiminnanohjaus

Keywords: Electronic Data Interchange EDI, Enterprise Resources Planning ERP, logistics process, purchasing

Tämän diplomityön tarkoituksena oli tehdä selvitys EDI:in liittyvistä vaikutuksista, tarpeista ja eduista sekä valmistella Oracle Applications- toiminnanohjausjärjestelmän EDI Gateway- modulin ottamista tuotantokäyttöön. Tietoa tarvekartoitukseen saatiin keskustelujen avulla. Uusia kaupallisista lähtökohdista johdettuja, yritysten väliseen kaupankäyntiin ja internet-teknologian hyödyntämiseen kehitettyjä aloitteita käsiteltiin EDI-näkökulmasta tulevaisuutta varten. Ajankohtaisinta tietoa tätä diplomityötä varten löydettiin myös internetistä.

Tämän jälkeen oli mahdollista toteuttaa sopivan laaja mutta rajattu EDI pilottiprojekti EDI-konseptin luomista varten. EDI:n vaikutuksiin ostossa keskityttiin tässä diplomityössä enemmän ja EDI:ä päätettiin soveltaa aluksi ostotilauksissa.

EDI:n hyötyjä on vaikea mitata numeerisesti. Suurta määrää rahaa tai tuoteyksiköitä on käsiteltävä EDI-partnerin kanssa riittävän usein. EDI:n käyttöönottovaiheessa pääongelmat ovat sovelluksiin liittyviä tietotekniikkaongelmia.

Selvityksistä ja EDI-projektista saatu tieto on mahdollista hyödyntää jatkokehityksessä. Lisätoimenpiteitä tarvitaan kokonaan toimivan järjestelmän luomiseksi.

PREFACE

This thesis was done as a part of the studies for the degree of Master of Science (Tech.) in Lappeenranta University of Technology. The thesis has been conducted during 1999 for Instrumentarium Corp. Datex-Ohmeda Division, in Helsinki, Finland.

I would like to express my thanks to each and every person who has contributed to this work. Thanks to Professor Anita Lukka who has supervised the preparation of this thesis, to Mr. Mikael Rydström who, as my instructor, has supported me during the preparation of this thesis, and to Mr. Heikki Isotalo who has helped me by giving good advice for the thesis. Special thanks to the whole LISA support team.

Table of Contents

ABBREVIATIONS

ANSI	American National Standards Institute
API	Application Program Interface
ASC	ANSI Accredited Standards Committee
ASCII	American Standard Code for Information Interchange
ATO	Assemble to Order
ATP	Available to Promise
BOM	Bills of Material
BPR	Business Process Re-engineering
CFAR	Collaborative Forecasting and Replenishment
CPFR	Collaborative Planning, Forecasting and Replenishment
CRP	Continuous Replenishment Program
D-O	Instrumentarium Corp. Datex–Ohmeda Division Nordic Operations
DTD	Document Type Definition
DTR	Device Track Recording
EAN	European Article Numbering
EC	Electronic Commerce
ECR	Efficient Consumer Response
EDI	Electronic Data Interchange
EDIFACT	EDI for Administration, Commerce and Transport
EDIFICE	EDI Forum for Companies Interested in Computing and Electronics
EDIINT	EDI Internet Integration
EOQ	Economic Order Quantity
ERP	Enterprise Resources Planning
FPOS	Front Point of sale
FTP	File Transfer Protocol
GEIS	General Electronic Information Services
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transfer Protocol
IETF	Internet Engineering Task Force
ISO	International Standard Organization

ISP	Internet Service Provider
JIT	Just in Time
LISA	Logistical Information Systems Application
MPS	Master Production Schedule
MRP	Materials Requirements Planning
NCA	Network Computing Architecture
OBI	Open Buying on the Internet
OEM	Original Equipment Manufacturer
OTP	Open Trading Protocol
POS	Point of sale
PPTP	Point-to-Point Tunneling Protocol
QR	Quick Response
RDBMS	Relational Database Management System
RFQ	Request for Quotation
RPOS	Rear Point of sale
SETELI	The Federation of Finnish Electrical and Electronics Industry
SET-EDI	EDI implementation guide of SETELI
SGML	Standard Generalized Markup Language
SKU	Stock-keeping Unit
SMTP	Simple Mail Transfer Protocol
TCP/IP	Transmission Control Protocol / Internet Protocol
TIEKE	The Finnish Information Technology Development Center
TPO	Trading Protocol Options
UN	United Nations
UPC	Uniform Product Code
URL	Uniform Resource Locator
VAN	Value Added Network
VAS	Value Added Services
VPN	Virtual Private Network
WWW	World Wide Web
XML	Extensible Markup Language
XSL	Extensible Stylesheet Language

1. INTRODUCTION

The background of this thesis was in October 1998 when Datex-Ohmeda Nordic Operations introduced LISA in Finland. Later in this thesis Datex-Ohmeda or D-O means mainly Datex-Ohmeda Nordic.

Logistical Information Systems Application LISA is an Enterprise Resource Planning ERP system used by Datex-Ohmeda Nordic Operations to manage the logistics processes in Finland and Sweden. The system is based on Oracle Applications version 10.7.

The LISA system covers the following modules: Order Entry, Master Scheduling/ Material Requirements Planning MRP, Bills of Material BOM, Engineering, Purchasing, Inventory, Work in Process, Capacity, Business reporting with Discoverer, General Ledger, Accounts Receivables, Accounts Payables, Fixed Assets, Cost Management, Alert and Workflow (LISA Support, 1999).

The project 'LISA98' was officially closed 26.5.1999 when the documentation was completed. Current focus has been to stabilize the existing environment (LISA Support, 1999).

1.1 Purpose and scope

When a new ERP system is introduced, it causes at first costs and starting problems. It takes time before everything operates as well as before the introduction of a new ERP system. Then expected results of the introduction of the ERP system will be reached in a few years. During the introduction of the ERP system in Datex-Ohmeda there were not enough resources to prepare for both the new ERP system and Electronic Data Interchange EDI at the same time. On the other hand it is more important to make the ERP system to operate well enough before it is possible to start to operate with outside enterprises using EDI.

At present, EDI is not in use in Datex-Ohmeda. However, some tasks, which can be performed using EDI, are performed manually using double keying up, faxing and

printing. Today a receiver of an order from D-O must manually key up the information of the order in its own system from a printed fax sent by D-O. On the other hand, D-O must manually key up the data of the order response in its own system from a printed fax sent by an outside organization. The fact is that for example some suppliers of Datex-Ohmeda would very much want Datex-Ohmeda to operate with them using EDI.

The subject of the thesis can be called as “Electronic Data Interchange in logistics processes”. One aim of this thesis was to make a survey of the needs and benefits of EDI. Other purpose of the thesis was to prepare for taking the EDI Gateway module of Oracle Applications into production use. After these phases it was possible to implement one suitably wide and limited EDI pilot project to create an EDI concept. An additional purpose was to get a wider scope or perspective for the concept, and for the future scenarios by introducing new technologies.

The following tools were used for the thesis. At first the information of the survey was gathered from discussions at Datex-Ohmeda. The survey lists the benefits of EDI, disadvantages when there is no EDI system in use, and problems in which EDI can assist in or develop the present situation. Discussions were also concluded with representatives of selected outside enterprises to find out their EDI operation models or best practices. Up-to-date information for surveys was also gathered from internet. Also the operation of the Oracle EDI Gateway module was studied. During the preparation phase, one task was also co-ordination, i.e. there was a need for a link between the future EDI users and the ERP support to help the preparation for EDI to progress.

One limitation of this thesis was that it concentrated in the area of Datex-Ohmeda Nordic, especially Datex-Ohmeda in Finland. Already in the beginning it was quite obvious that the work would mainly concentrate on using EDI in purchasing and only shortly discuss EDI in order fulfillment.

1.2 Structure of the thesis

The structure of this thesis is presented in the following. Chapters 1 and 2 introduce the main topics related to the thesis and the company. Chapter 3 defines the central terms of this thesis: Enterprise Resources Planning ERP and Electronic Data Interchange EDI. Chapter 4 discusses EDI connected information technologies: bar coding, point-of –sale and value-added network

Chapters 5 and 6 introduce new internet and extranet technologies including the new XML based XML/EDI and the existing philosophies and the new commercially derivative initiatives for the future scenarios. These new initiatives have been chosen so that they have a connection to EDI, supply chain management and purchasing.

Chapter 7 presents the benefits of EDI and the operating model of EDI both found out from the reference material, and compared to the previous, chapter 8 treats the operation models or the best practices of the case example enterprises and the benefits of EDI, which they have reached. Chapter 9 describes what has been done with the issues of this thesis before at Datex-Ohmeda, introduces the tools provided by the enterprise resources planning system for the EDI traffic for the present situation and for the possible future situation. This chapter covers also in the general level the benefits of EDI, which have been found before at Datex-Ohmeda but are still valid. These benefits are alike the benefits mentioned in chapter 7.

Chapter 10 covers influences of EDI in the present situation including the needs, the implementing possibilities and more detailed benefits connected with EDI that were gathered from the discussions at Datex-Ohmeda and this chapter covers also conclusions of these discussions. Then chapter 11 discusses the actions and phases of the EDI project and finally chapter 12 includes conclusions, wider perspective for the thesis and also visions for the future.

In this thesis chapters 3 - 7 give a theoretical background to the subject of the thesis. Chapters 8, 10, 11 and 12 are the empiric part of the thesis which shows how it is possible to implement the issues of chapters 3-7 in practice and how well these issues are connected to the real operations of the enterprises.

2. INSTRUMENTARIUM CORP DATEX-OHMEDA DIVISION[1]

Instrumentarium Corp is a health care area group, which produce and market the technology products of the health care to international markets and have the retail trade of optics in Finland and its near areas. It was founded in 1900. In 1998 the net sales of Instrumentarium was 3,9 billion FIM and it had personnel over 5000. Datex-Ohmeda is a division of Instrumentarium Corp., which represents the core business of the company, anesthesia and intensive care. In 1998 its net sales was 2,3 billion FIM and it had personnel over 2800. Datex-Ohmeda has the production in Finland in Helsinki, in Oulu and in Kuopio, in Sweden in Bromma near Stockholm and in Gällivare and also in the USA in Madison in the state of Wisconsin and in Louisville in the state of Colorado. It has a sales company in 12 countries and independent local retail dealers over 100 countries. North America and West Europe form 80 % of sales.

Datex-Ohmeda has specialized to design, produce and market products that help the hospital anesthesiologist to take good care of the patients. The final aim is the well-being of the patient. However the patient is a passive customer whereas the anesthesiologist is the one to operate with the products. Monitoring products for the anesthesiologist has been the basis of the business for many years. Among the most important end customer requirements has been such as the user friendliness of the products and the amount and the quality of the product features.

The latest years have enlarged the scope from the strict focusing to anesthesiologist's needs towards offering solutions for the management of the total anesthesia process. This means that products and services will be developed also for the use of intensive care units in the hospitals. The marketing message must reach new persons in the hospitals and address different kind of purchasing criteria.

The latest trend especially in the United States and in the most developed countries in the European Community is that hospitals are laying up purchasing policies that prefer the networking and compatibility issues among the separate medical devices. If

[1] Sources: Christopher, 1992, p. 145. Fogarty et.al., 1991, p.3. Instrumentarium Corp., 1999, p. 2, 14. Isotalo, 1997, pp. 5-7, pp. 9-11.

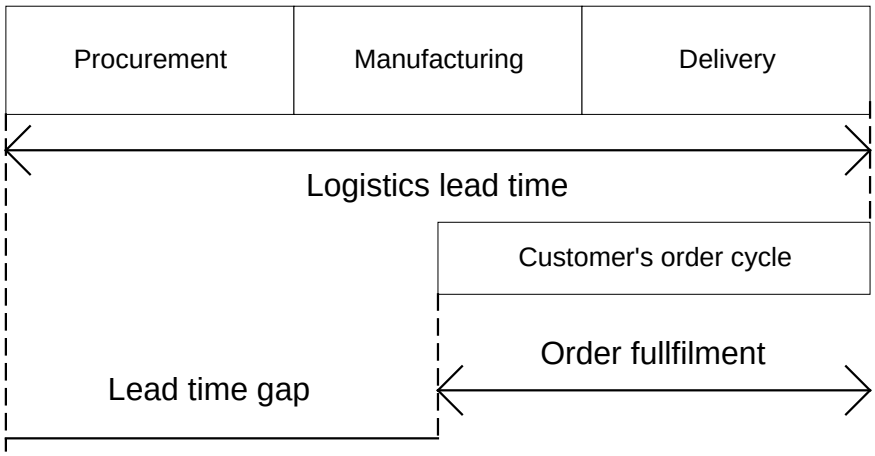
this trend spreads gradually in other markets, the smallest vendors with only a limited product palette are likely to disappear. At the same time the threshold for the newcomers to be able to arrive into the market is getting higher. The networking of the products and interfacing to competitors' products require large investments in the business processes, including product development, market communications and logistics.

Datex-Ohmeda has chosen to be one of the big players in the markets. Some acquisitions have been made, for instance Engström Ab in Sweden, Clinisoft in Finland and Tonometrics Inc. in the USA and Ohmeda in the USA. These acquisitions have brought in new people, new skills, new ways of doing business, new products and new technologies. Exceptionally large share of the turnover is allocated for product development and this will be continued. Heavy investments are going to be made to train the people to master the new products and also to harmonize the ways of doing business to speed up the adoption of the new strategy.

2.1 Assemble-to-order production

The positioning strategy of assemble-to-order is to supply a large variety of high quality, competitively priced, final products from standard components and subassemblies within a short assembly lead time. The customer and the competition determine what is meant by a short assembly lead-time. In assemble-to-order environments, options, subassemblies and components are either produced or purchased to stock. By stocking a small supply of components and subassemblies, the manufacturer can quickly assemble any one of an almost limitless number of possible configurations. The customer enjoys the benefit of some customization, yet has a short wait for delivery (Fogarty et.al., 1991, p.3).

However most organizations face a fundamental problem: the time it takes to procure, make and deliver the finished product to customer is longer than the customer is prepared to wait for it (Christopher, 1992, p. 145). Picture 1 describes this problem, lead time gap.



Picture 1 The lead-time gap (Christopher, 1992, p.145)

Datex-Ohmeda operates mainly using assemble-to-order-model in production. There are certain dependencies and constraints how modules can be combined each other in production. Quick lead-times require also ATO model.

2.2 Products

The devices for patient monitoring have been the primary products in Datex Division since it was founded in 1969. The monitoring devices include typically a variable set of features for gas measurement and the measurement of physiological parameters of the patient. New product innovations within monitoring devices typically fall into some of the categories below:

- completely new parameters
- old parameters measured in a way that is more accurate and/or faster than the older methods
- parameter measurement technology manufactured more compactly to achieve smaller module sizes. This includes e.g. combo-modules.
- parameter measurement technology sourced more effectively to achieve lower costs.

The strategy formulations have meant enlarging the focus to a whole clinical process, larger amount of persons to communicate with and also developing products for the areas of patient transporting, post-anesthesia care and intensive care.

The product lines of Datex-Ohmeda include stand-alone monitors, monitoring systems, information systems, ventilators and also accessories and supplies.

The customer satisfaction is often as dependent of the by-products as of the "core" products. The by-products are usually accessories and manuals. Also the logistics documents regarding the delivery must be seen as by-products since they form an important part of customer perceived service level. The logistics documents include invoice copies, packing lists, check lists, package labels etc. The logistics documents should help to streamline the logistics processes in the customer end, from goods receival to final installations and invoicing. This is where Electronic Data Interchange EDI brings in a number of benefits.

2.3 Distribution

Distribution channel is a chain of organizations that are involved in transferring, producing and refining the services to the end-customer. This channel has to be able to offer the value-adding service level elements that are crucial for the business in the market segment.

The Sales Organization is a general term for an organization that is responsible for providing pre-sales, sales and after sales services for the end-customer. An external distributor is a typical sales organization in any distribution path for Datex-Ohmeda. The other alternatives that have been commonly utilized in Datex-Ohmeda distribution arrangements are subsidiaries and Original Equipment Manufacturer OEM partners.

The sales organizations form the interface between Datex-Ohmeda and the hospitals. Like the customers on different market areas the sales organizations bring along needs that affect heavily on the business of respective market areas. The emphasis is on the periodic contracts that has to cover many details from distribution to marketing and after sales services.

3. ENTERPRISE RESOURCES PLANNING AND ELECTRONIC DATA INTERCHANGE

3.1 Enterprise Resources Planning [2]

Enterprise Resources Planning ERP is in simplest terms, enterprise systems use database technology and a single interface to control all the information related to a company's business including customer, product, employee, and financial data.

Enterprise Resources Planning is the current generation of the manufacturing resources planning systems installed in many manufacturing plants. The term "enterprise resources planning" was coined to reflect the fact that these computerized systems have evolved well beyond their origins as inventory transaction and cost accounting systems. The software has become the means to support and speed the entire order-fulfillment process and to automate and integrate both business and production process management. By recording transactions, i.e., the computerized record of events such as the receipt of inventory or the issue of a work order, the ERP system tracks resources, such as materials and labor, used in financial, manufacturing, and distribution management.

The systems' planning methodology uses material requirements planning MRP and master production schedule MPS to calculate requirements for materials, make recommendations to release replenishment orders, and reschedule open orders when due dates and need dates are not in phase. Many of today's ERP systems also take into consideration capacity constraints when planning production. But, unless equipped with advanced planning functionality, they do so only serially. ERP is increasingly seen as a transaction backbone and data source for ancillary, decision-support systems.

In addition, functionality has more recently been introduced to support the specific needs of vertical industry segments, such as consumer packaged goods or automotive manufacturers, as well as special operations such as demand management, an essential feature for better management of supply chains. ERP systems have begun to incorporate functionality for customer interaction and managing relationships with

suppliers and vendors, making the system less inward-looking. Vendors are working hard to make ERP more palatable for small- to mid-sized manufacturers, particularly in the area of implementations, which can cost as much as five times as the software licenses. Other value-added aspects of the newest systems include product configuration, Electronic Data Interchange EDI, field service modules, and Internet capabilities that extend system access to more users.

Along with functionality for enterprise and supply chain management, ERP also is associated with the use of client/server, relational database technology, and the UNIX, Windows NT, or AS/400 operating systems, for greater flexibility in operation and modeling of the enterprise. Finally, ERP can be the means for business-process re-engineering BPR, increasing flexibility and responsiveness by breaking down barriers between functional departments and reducing duplication of efforts.

3.2 Electronic Data Interchange

Electronic Data Interchange is defined as:
"The electronic exchange of business documents such as purchase orders, invoices, application forms, etc. from one organization's computer to another organization's computer in standard data formats." (U.S. Department of the Treasury…, 1998)

In this thesis EDI is also understood widely in addition to traditional understanding of EDI. Some new network technologies and commercial derivative initiatives, which are developed for the business-to-business environment and for the internet, are treated from the EDI perspective. EDI is thought to belong to them.

3.2.1 Data contents

The recommendations of the data contents define the uniform information flows of the implementation area, in other words the messages and their realizations, which are made possible by the structures of the presentation grammar. (TIEKE, 1998)

A structural data interchange requires standardized messages in addition to the EDIFACT-grammar. There are over 150 international standard messages in

[2] Source: Manufacturing Systems Europe, 1999.

commerce, customs, banking, transport, forwarding and public sector. Many messages have been updated so that the structure of the message is dependent from the directory of the message. For example the invoice message INVOIC of the directory 91.1 differs structurally from the invoice message INVOIC of the directory D.96A. International standard messages notify very different situations and commerce habits and therefore the contents of the message has in many cases grown unnecessary large. The useful version of the message is made for every user group using the implementation instructions. In addition to the accepted messages there are also the messages, which are at the moment accepted only to the test usage. (TIEKE, 1998)

3.2.2 Presentation

Standards define the structure, format, and content of EDI documents, including the data fields that may be included in a document, the sequencing and format of fields, etc. These documents, known as transaction sets or messages, are used to exchange business information between organizations. EDI standards eliminate the need for human intervention in the interpretation of incoming and outgoing data. (U.S. Department of the Treasury…, 1998)

Today, there are primarily two sets of EDI standards used by organizations. ANSI ASC X12 is a set of EDI message standards developed and maintained by the American National Standards Institute, and is widely used within the U.S.A.

United Nations / Electronic Data Interchange for Administrations Commerce and Transport UN/EDIFACT is a set of EDI message standards developed and maintained by the United Nations, and is widely used internationally.

3.2.3 Data interchange

Data interchange recommendations base on internationally standardized data interchange procedures, like x.400 protocol, File Transfer Protocol FTP. EDI does not need any special EDI solutions to data interchange.

Organizations may also communicate EDI messages by providing direct connects to their systems for their trading partners. In this case, a trading partner would dial

directly into an organization's EDI gateway and transmit their EDI transaction sets. The advantage of this option is that the start up cost is low, provided that existing equipment can be used. However, if more than a few trading partners use direct connects, the cost of additional manpower, equipment, and technical expertise necessary to install, maintain, and support the trading partners would be significant. (U.S. Department of the Treasury…, 1998)

4. INFORMATION TECHNOLOGIES CONNECTED TO EDI[3]

In recent years, the heightened intensity of retail competition has drastically changed the way companies operate their systems. These changes include the application of the integrated logistics management concept to the analysis and design of their supply chains and what is most important, extensive use of information technology to gain a competitive edge. Following information technologies have become increasingly common in practice in addition to EDI.

4.1 Bar coding

A bar code which is often seen as a single word, barcode is the small image of lines, bars and spaces that is affixed to retail store items, identification cards, and postal mail to identify a particular product number, person, or location. The code uses a sequence of vertical bars and spaces to represent numbers and other symbols. A bar code reader is used to read the code. The reader uses a laser beam that is sensitive to the reflections from the line and space thickness and variation. The reader translates the reflected light into digital data that is transferred to a computer for immediate action or storage. Bar codes and readers are most often seen in supermarkets and retail stores, but a large number of different uses have been found for them. They are also used to take inventory in retail stores; to check out books from a library; to track manufacturing and shipping movement; to sign in on a job; to identify hospital patients; and to tabulate the results of direct mail marketing returns. Readers may be attached to a computer as they often are in retail store settings or separate and portable, in which case they store the data they read until it can be fed into a computer.

There is no one standard bar code; instead, there are several different bar code standards that serve different uses, industries, or geographic needs. Since 1973, the Uniform Product Code UPC, regulated by the Uniform Code Council, an industry organization, has provided a standard bar code used by most retail stores. The European Article Numbering system EAN, developed by Joe Woodland, the inventor of the first bar code system, allows for an extra pair of digits and is becoming widely

[3] Sources: Chiu, 1995. Whatis.com, 1999 May 18. U.S. Department of the Treasury…, 1998.

used. POSTNET is the standard bar code used in the United States for ZIP codes in bulk mailing.

Bar coding is a method of encoding data using bar code for fast and accurate readability.

4.2 Point-of-sale

Bar coding of products is the first step towards store automation. Store automation led by point- of- sale POS systems has become indispensable in the logistics management strategies of firms. The UPC data and price list are regularly provided by the mainframe in the corporate headquarters. In each store computer that monitors the POS terminals maintains the UPC database and price list. Almost all the sales information can be gathered by the front POS (FPOS) system in more timely and accurate way. The rear POS (RPOS) system analyses sales information from the FPOS system, prints out the UPC barcodes, manages goods by product and places electronic orders. In addition, the RPOS system handles merchandise receiving and inspection, inventory control, physical counting, accounting and vendor management.

4.3 Value added network

A third party network, also known as a value added network or VAN, serves as an intermediary between trading partners. A VAN is an electronic service provider that receives, stores, and transmits EDI and other electronic messages for trading partners. VAN s support multiple types of communications hardware and software configurations, thereby reducing an organization's burden to establish individual computer connections with each of its trading partners.

There are many advantages to using a VAN. First, an organization will only have to implement one connection to the VAN through which all messages will be sent and received. Second, VAN s are considered to be extremely reliable and secure for EDI transmissions, and are readily available through several large firms on a 24-hour basis. These firms offer a variety of protocols and speeds for connecting to their networks, and provide procedures and personnel to handle routine maintenance, problems, and user support.

The disadvantage of using a VAN is that even though the cost is relatively low, small trading partners may still find it to be financially burdensome.

Value Added Services VAS is similar to a VAN, except that a VAS provides additional services, such as consulting and training. VAS s varies widely both in terms of the services they provide and their fee structures. VAS s offer all the advantages of VAN s, as described above. Furthermore, the consulting and training offered by VAS s enable smaller organizations to implement EDI in a more timely manner. However, it should be noted that the cost of using a VAS is higher than that of a VAN. While all organizations may not need the level of assistance and service provided by a VAS, they would be required to pay for it regardless.

The following four-step approach is recommended for evaluating and selecting a communications network to transmit EDI documents:

1. Identify Communications Network Requirements and Evaluation Criteria
2. Select Network Option
3. Develop List of Network Service Providers
4. Compare Network Service Providers and Make Final Selection

The modern VAN has the ability to support the EDI standards e.g., ANSI ASC X12, EDIFACT, selected for the application and communications protocols. The modern VAN also is available 24 hours a day, 7 days a week for sending and receiving EDI messages.

VAN provides security features that meet the needs of the EDI application being implemented. If the data contained in the EDI messages being exchanged is subject to the Freedom of Information Act or the Privacy Act, people should ensure that VAN is capable of protecting the confidentiality of the data.

VAN has the ability to connect with other networks. If a large number of the agency's trading partners use a particular VAN, the user should consider selecting the same network, thus saving it the effort and cost of establishing connections between

networks. VAN provides adequate backup and recovery of EDI messages while they are in transit over the network or being stored for subsequent retrieval by trading partners. VAN provides users with reports and logs to assist them in resolving problems, tracing EDI messages, and tracking costs.

VAN provides translation services to allow smaller organizations to implement the EDI application without having to acquire their own EDI translation software packages. VAN allows the user to transmit messages to a trading partner's fax machine upon demand. VAN service provider maintains a help desk that has trained personnel who can assist in solving network related problems. The help desk should be accessible by telephone 24 hours a day, 7 days a week.

5. NEW EDI CONNECTED TECHNOLOGIES AND NETWORKS

5.1 Extensible Markup Language/ Electronic Data Interchange XML/EDI[4]

5.1.1 Extensible Markup Language XML

Extensible Markup Language XML is subset of the Standard Generalized Markup Language SGML defined in ISO standard 8879:1986 that is designed to make it easy to interchange structured documents over the Internet. XML files always clearly mark where the start and end of each of the logical parts called elements of an interchanged document occurs. XML restricts the use of SGML constructs to ensure that fall back options are available when access to certain components of the document is not currently possible over the Internet. It also defines how Internet Uniform Resource Locators can be used to identify component parts of XML data streams.

By defining the role of each element of text in a formal model, known as a Document Type Definition DTD, users of XML can check that each component of document occurs in a valid place within the interchanged data stream. An XML DTD allows computers to check, for example, that users do not accidentally enter a third level heading without first having entered a second-level heading. That cannot be checked using the Hyper Text Markup Language HTML previously used to code documents that form part of the World Wide Web (WWW) of documents accessible through the Internet.

However, unlike SGML, XML does not require the presence of a DTD. If no DTD is available, either because all or part of it is not accessible over the Internet or because the user failed to create it, an XML system can assign a default definition for undeclared components of the markup.

XML allows users to bring multiple files together to form compound documents, identify where illustrations are to be incorporated into text files and the format used to encode each illustration, provide processing control information to supporting programs, such as document validators and browsers and finally add editorial comments to a file.

[4] Sources: Bryan, 1998 Jan. 28 Bryan, 1998 Oct. 13.

It is important to note, however, that XML is not a predefined set of tags, of the type defined for HTML, that can be used to markup documents or a standardized template for producing particular types of documents.

XML was not designed to be a standardized way of coding text: in fact it is impossible to devise a single coding scheme that would be suit all languages and all applications. Instead XML is formal language that can be used to pass information about the component parts of a document to another computer system. XML is flexible enough to be able to describe any logical text structure, whether it be a form, memo, letter, report, book, encyclopedia, dictionary or database.

5.1.2 The components of XML

XML is based on the concept of documents composed of a series of entities. Each entity can contain one or more logical elements. Each of these elements can have certain attributes (properties) that describe the way in which it is to be processed. XML provides a formal syntax for describing the relationships between the entities, elements and attributes that make up an XML document, which can be used to tell the computer how it can recognize the component parts of each document.

XML differs from other markup languages in that it does not simply indicate where a change of appearance occurs, or where a new element starts. XML sets out to clearly identify the boundaries of every part of a document, whether it is a new chapter, a piece of boilerplate text, or a reference to another publication.

To allow the computer to check the structure of a document users must provide it with a document type definition that declares each of the permitted entities, elements and attributes, and the relationships between them.

XML allows message type creators to clearly identify the role and syntax of each piece of interchanged data using a definition that is both machine-processable and human interpretable. XML allows message type creators to identify the source of each shared structure using an Internet Uniform Resource Locator, URL. It also allows

message type creators to optionally identify, which pieces of information should occur in each interchanged set of data and, where relevant, the order in which individual fields should occur in a particular message stream.

XML documents can be given metadata fields that can be used to identify who is responsible for creating, transmitting, receiving and processing each message, and can have built-in facilities for identifying the storage points of programs that should be used to control processes. XML can make use of facilities provided by the latest version of the Internet Hyper Text Transfer Protocol HTTP, which can identify when a message should be moved from one stage of the interchange process to another, and to check that the relevant forms of interchange have taken place.

5.1.3 XML/EDI concept

XML/EDI is a synthesis of many concepts. XML/EDI uses the XML protocol as its "data interchange modeling" layer and the XSL protocol as its "presentation" layer. XML/EDI can be integrated with traditional methods of Electronic Data Interchange EDI and can be used with all standard Internet transport mechanisms such as IP routing, HTTP, FTP and SMTP.

XML/EDI allows for document-centric views and processing methodologies. It also uses modern programming tools such as Java and ActiveX to allow data to be shared between programs and agent technologies for data manipulation, parsing, mapping and searching.

XML/EDI can be seen as the fusion of five existing technologies:

1.Web data interchange based on the new XML specification
2.Existing EDI business methods and message structures
3.Knowledge templates that provide process control logic
4.Data manipulation agents (Data Bots) that perform specialist functions
5.Data repositories that allow relationships to be maintained.

5.1.4 Integrating XML with EDI

XML can be integrated with existing EDI systems by providing application-specific forms that users can complete to generate EDI messages, generating EDI message formats for transmission between computers over the Internet or through existing value-added networks (VAN s) and allowing data received in EDI format to be interpreted according to sets of predefined rules for display by the receiver on standardized browsers using a user-defined template, rather than having to rely on specially customized display packages.

XML can extend existing EDI applications by allowing message creators to add application-specific data to standardized message sets where required or to display the contents of each field in conjunction with explanatory material which is specific to the application and the language preferences of the user. XML can also extend existing EDI applications by allowing system developers to customize the help information associated with the data for each field and by allowing field value checking to be integrated with checks on the validity of the data with respect to information stored on local databases.

5.2 Internet

Today, the Internet is a public, co-operative, and self-sustaining facility accessible to hundreds of millions of people worldwide. Physically, the Internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is its use of a set of protocols called TCP/IP (Transmission Control Protocol / Internet Protocol). (Whatis.com, Oct. 14, 1998)

The Internet supports a wide range of applications such as electronic mail, bulletin boards, file transfer, database searches, and the World Wide Web WWW. The individual networks are owned and managed by educational and commercial institutions for the most part, but there is no supervision of the Internet as a whole. (U.S. Department of the Treasury…, 1998)

VAN services have typically used proprietary network or a network gatewayed with a specific set of other proprietary networks. In contrast an Internet Service Provider (ISP) offers generic network access (i.e. not specific to EDI) for all computers connected to the internet. A direct internet connection permits real time computer-computer communication for client-server applications. Internet email can be configured for a dedicated connection with real-time transfers, or a store and forward method like traditional VAN s, or a combination of the two, e.g. where a direct delivery to a trading partners system is used when a link is operational, and a store and forward from an ISP is used as a backup. (Houser, 1997)

A large organization can connect their network to the Internet at an internet exchange point, however, most use a commercial ISP, either a major backbone provider, or local resellers of service off one or more backbones. The ISP provides technical assistance and access to local telecommunications links. (Houser, 1997)

The advantages of using the Internet are that the cost of transmitting messages over the Internet is relatively low, and that the Internet has a wide outreach. In addition, there are many third party service providers who enable users to connect to the Internet. These services can be accessed through a variety of protocols and typically require only a simple communications software package. (U.S. Department of the Treasury…, 1998)

The Internet does not enforce any uniform standard of security across participating networks, and data that is transmitted over the Internet can be accessed by unauthorized parties. Special security measures, such as firewalls and encryption, are needed for transmitting EDI messages over the Internet. Moreover, as there is no single entity that manages and operates the Internet, the reliability of transmissions tends to be low, and there is no accountability for dropped or misdirected messages. (U.S. Department of the Treasury…, 1998)

5.2.1 Open network versus closed network

In following table are presented pros and cons of the two rival network concepts. Originally the comparison was made in context of using the Internet to transmit EDI but it applies to the networks in general as well. (McAteer, 1996, p. 3)

Internet	Value - Added Network
Common and open standards, proven interoperable systems	Proprietary standards
Distributed, common, non-localized directory service enabling contact with any other organization in the world	Requires building a network connection with trading partners
Commitment by participating organizations to route traffic co-operatively, work to resolve addresses, and meet required standards	Standards set and maintained by service providers, message standards set by participating organizations, addresses assigned
Ubiquitous network access through choice of service providers	Narrow coverage over proprietary networks by a small number of service providers
Layering of application such as EDI over existing proven applications such as Internet mail and Web browser software.	Stand - alone application
A standard process to which all vendors have equal access	A politicized standards process skewed in favor of users' paying for EDI: large service providers and their multinational clients
Widely available public domain software including applications, protocols, and platform development tools	Narrow supply base of software; difficult to separate the software from the service provider
Varying network availability and speed, depending on the distance to the backbone and the bandwidth of the local connection	Consistent and guaranteed availability and speed
Cryptography necessary to secure data	Inherently secure network

Table 1 Value-added network versus the Internet (McAteer, 1996, p.3)

5.2.2 EDI versus Internet technologies

Since EDI has been in use for years it is one of the most mature electronic commerce applications. There are clear standards and the technology is widely accepted. However, although EDI brings significant advantages compared to paper document based business process, it still is quite a rigid method. EDI is still document based and works according to the same schema as the traditional processes bringing only incremental improvements by automating certain procedures. The current trend is towards integration of EC to the core business processes. The focus of EC is one the ways to use EDI in conjunction with other electronic tools to streamline all aspects of commerce between companies, not just replace existing paper documents. (Benesko, 1994)

In order to make EDI easier and less expensive to implement there are made efforts to move EDI transactions to the Internet. Internet Engineering Task Force IETF has a working group for EDI Internet Integration EDIINT. EDIINT is supposed to establish standards for secure Internet-Based EDI. Preliminary standards were available in 1996. Another specification published in June 1997 is Open Buying on the Internet (OBI) by Internet Purchasing Roundtable. Building on existing standards like ANSI X12 EDI 850 purchase order transaction specification OBI aims to ensure interoperability among Internet-based EC systems. (Niilo-Rämä, 1998, p. 19)

5.2.3 Open Buying on the Internet [5]

The Open Buying on the Internet OBI standard consists of a common set of business requirements, and a supporting architecture, technical specifications and guidelines. OBI solutions should complement, not replace, existing EDI infrastructures. OBI was created for the purchase of non-strategic, indirect materials by large, distributed requisitioner populations. The design of the OBI architecture and OBI business process reflect the nature of this type of transaction.

[5] Source: The OBI Consortium, 1999.

Objectives of the standard include:

- open, vendor- and platform-neutral architecture for internet purchasing to allow companies to fit these solutions into their information technology infrastructure
- customer choice to allow companies to create partnerships for buying and selling high-volume, low-dollar commodity goods and services independent of technology providers
- interoperability among purchasing systems to allow companies to conduct business-to-business electronic purchasing independent of technology providers
- healthy competition to allow buying organizations to select suppliers and technology providers based on their own criteria, not proprietary technology
- standard solutions which meet the common needs of organizations to conduct business-to-business electronic commerce
- public documents like OBI requirements, architecture, specifications, and guidelines that evolved from the Roundtable to allow all interested parties to implement OBI-based solution

5.2.4 Open Trading Protocol [6]

The Open Trading Protocol OTP complements today's electronic payment protocols by addressing trading - the process of doing business. They provide:

- a means to negotiate trade
- a means to buy and sell by invoking underlying payment protocols
- a means to resolve problems.

By reducing operating costs, OTP aims to bring to the Internet ways of trading that have been economically nonviable to date. OTP also expects to enable the framework to accommodate new models of trade not possible except on the Internet. EDI also can integrate with OTP.

A fundamental premise is that low cost trade is typically a two party operation and our model reflects this. This protocol has however been specifically designed to be flexible enough to support a three party payment mechanism in a two party trade and

[6] Open Trading Protocol Consortium, 1998.

also provides for other parties to be included as needed for payment settlement or delivery.

The protocol is designed to be open, flexible, extensible, robust, and vendor neutral:

- flexibility allows unique service offerings to be created, providing service providers and other stakeholders such as solution providers the ability to differentiate their products and services in the market
- extensibility means that it must be possible to add new trading models or enhance old ones without disrupting current models in use
- robust means the protocol is sufficiently accommodating of errors that products and services break infrequently and only under extraordinary circumstances and failures are almost always soft
- vendor neutral means that the protocol will not incorporate proprietary elements except to the extent where there has been industry-wide acceptance of de-facto proprietary solutions.

Three key features of OTP are worth emphasizing:

- OTP provides Trading Protocol Options which control how the trade occurs
- OTP provides a record of a Trade
- OTP supports real and virtual world delivery of goods and services

Trading Protocol Options TPO provide:

- a means by which merchants can inform consumers of the way in which they propose to trade to which consumers can then agree
- a method by which the payment brand and payment protocol can be selected,
- an approach which uses this information so that the details of the purchase can be adjusted, for example by allowing an additional discount if a store card is used.

OTP supports a standard, yet flexible, method of providing offers and receipts which bind the payment to the reason why the payment occurred. This information can then be used for problem resolution purposes. Since the information is in a standard format, it facilitates the provision of automated, lower cost customer care.

OTP supports the delivery of goods both physically and electronically. In addition it provides a means for linking the delivery to the offer and the payment. In this way OTP spans the whole life cycle of a business trade from terms and conditions to payment to acknowledged delivery of goods.

OTP provides a method of encapsulating different payment protocols. This means that it should be easier for payment schemes to be offered by the same basic set of software no matter which electronic commerce software vendor developed that software. Without interoperability the protocol cannot satisfy any of its principal business requirements.

Two recent adaptations of Internet technology, the intranet and the extended intranet extranet, also make use of the TCP/IP protocol.

5.3 Intranet[7]

An intranet is a network of networks that is contained within an enterprise. It may consist of many interlinked local area networks and also use leased lines in the wide area network. Typically, an intranet includes connections through one or more gateway computers to the outside Internet. The main purpose of an intranet is to share company information and computing resources among employees. An intranet can also be used to facilitate working in groups and for teleconferences.

An intranet uses TCP/IP, HTTP, and other Internet protocols and in general looks like a private version of the Internet. With tunneling, companies can send private messages through the public network, using the public network with special encryption/decryption and other security safeguards to connect one part of their intranet to another.

Typically, larger enterprises allow users within their intranet to access the public internet through firewall servers that have the ability to screen messages in both directions so that company security is maintained. When part of an intranet is made

[7] Source: Whatis.com, 1998 Oct. 8.

accessible to customers, partners, suppliers, or others outside the company, that part is called an extranet.

5.4 Extranet

An extranet is a private network that uses the Internet protocols and the public telecommunication system to securely share part of a business's information or operations with suppliers, vendors, partners, customers, or other businesses. An extranet can be viewed as part of a company's intranet that is extended to users outside the company. It has also been described as a "state of mind" in which the Internet is perceived as a way to do business with other companies as well as to sell products to customers. The same benefits that HTML, HTTP, SMTP, and other Internet technologies have brought to the Internet and to corporate intranets now seem designed to accelerate business between businesses. (Whatis.com Oct 13, 1998)

An extranet requires security and privacy. These require firewall server management, the issuance and use of digital certificates or similar means of user authentication, encryption of messages, and the use of virtual private networks (VPN s) that tunnel through the public network. Companies can use an extranet to: (Whatis.com Oct 13, 1998)

- Exchange large volumes of data using Electronic Data Interchange (EDI)
- Share product catalogs exclusively with wholesalers or those "in the trade"
- Collaborate with other companies on joint development efforts.
- Jointly develop and use training programs with other companies
- Provide or access services provided by one company to a group of other companies, such as an online banking application managed by one company on behalf of affiliated banks
- Share news of common interest exclusively with partner companies.

5.5 Virtual Private Network

A virtual private network (VPN) is a private data network that makes use of the public telecommunication infrastructure, maintaining privacy through the use of a tunneling protocol and security procedures. A virtual private network can be contrasted with a

system of owned or leased lines that can only be used by one company. The idea of the VPN is to give the company the same capabilities at much lower cost by using the shared public infrastructure rather than a private one. Phone companies have provided secure shared resources for voice messages. A virtual private network makes it possible to have the same secure sharing of public resources for data. Companies today are looking at using a private virtual network for both extranets and wide-area intranets.(Whatis.com May 12, 1999)

Using a virtual private network involves encrypting data before sending it through the public network and decrypting it at the receiving end. An additional level of security involves encrypting not only the data but also the originating and receiving network addresses. Microsoft, 3Com, and several other companies have proposed a standard protocol, the Point-to-Point Tunneling Protocol (PPTP) and Microsoft has built the protocol into its Windows NT server. VPN software such as Microsoft's PPTP support as well as security software would usually be installed on a company's firewall server. (Whatis.com, May 12, 1999)

6. PHILOSOPHIES AND DERIVATIVE INITIATIVES CONNECTED EDI

There are several philosophies and initiatives, which require a tool according to the principles of electronic data interchange in order to be realized. The following presentations cover a few one.

6.1 Just-In-Time[8]

The move toward Just-In-Time JIT manufacturing schedules requires product to be delivered just in time to be included in the next manufacturing process. Just as customers that support JIT manufacturing scheduling are requiring very fast product turnaround from their vendors, they are requiring even faster information turn around so that they are informed that the product is available on time. Vendors will find it difficult to provide JIT information via paper so they are turning to EDI, EDI allows them to respond pressure from customers, to accept orders electronically from them provide an intention to ship to their customers via an electronic advanced shipping notice.

Often manufacturing companies combine vendor management activities, (thus reducing the number of vendors from whom they buy and developing closer ties with those remaining) with requests for implementing EDI. Those vendors who are EDI - ready will not only keep the business but they will get more than their current share of the pie.

This is an example of what Porter terms a linkage between two value chains, the linkage between a vendors value chain and a firms value chain provides opportunities for the firm to enhance its competitive advantage, both the vendor and firm are benefiting by improving the coordination between a firms and a vendors chains.

6.2 Quick Response[9]

Quick response logistics is a derivative of the JIT philosophy. By definition quick response is a co-operative effort between retailer and supplier to improve inventory

[8] Source: McHale, 1996.

velocity while providing merchandise supply closely matched to consumer buying patterns.

In other words the objectives are to increase flexibility and efficiency in supply chain to better respond to changing customer demand and to reduce investments in inventory. This is done by gathering and sharing information throughout the supply chain with tools like bar coding and scanning, EDI etc. The idea is to capture demand as close to real-time as possible and as near to final customer as possible. Logistics response is then made directly as response of this information.

The Quick Response process begins with a transmission from the retailer to the trading partner via Electronic Data Interchange. The EDI 852 Product Activity data file (ANSI ASC X12 EDI 852) consists of point of sale warehouse shipment activity and inventory status data from the vendor's trading partner. The vendor then creates a file inclusive of this data that Quick Response uses to update its continuous replenishment files.

The system generates a weekly forecast of future demand, by product category levels, to assist in inventory decision making. The forecast may be user adjusted based on most recent selling patterns, promotional events and marketing plans. Quick Response offers a choice of several established replenishment techniques to compute order quantity, safety stock and reorder points that take into account the forecast and its accuracy, order constraints, desired service levels and lead times.

When available inventory dips below the reorder point, an order is generated for the item's replenishment order quantity. Economic and practical shipping combinations such as fill truck loads, full pallet or tier loads dictate how item level replenishment order quantities are adjusted by the system.

After a replenishment update is performed, the quantities may be adjusted by the user. Once finalized, a file is generated and downloaded to the vendor's EDI translator which physically creates a Purchase Order Acknowledgement (ANSI ASC X12 EDI

---

[9] Sources: Bowersox et. al., 1996, p. 492. Niilo-Rämä, 1998. Prescient Systems, 1999 March 19.

855) or an Advanced Shipping Notice (ANSI ASC X12 EDI 856 / EDIFACT DESADV). The system also provides a Purchase Order (ANSI ASC X12 EDI 850 / EDIFACT ORDERS) or (ANSI ASC X12 EDI 875). These communications are in turn sent to an order processing system.

6.3 Efficient Consumer Response

A quick response concept is Efficient Consumer Response ECR developed in food and beverage industry. It is created with the support of two major US organizations in that industry, the Grocery Manufactures of America and the Food Marketing Institute. (Bowersox et. al., 1996, p. 103)

ECR uses series of technologies to streamline the logistic process. These include enterprise-wide, integrated, client/server manufacturing and distribution systems, EDI for electronic purchasing, bar coding for collecting retail sales data; relational database management systems for collecting inventory, sales, shipping and customer information, and building data warehouses. (Gill, 1996)

In nutshell the process works according to following scheme: Bar-coding is used to collect retail sales data, the consumption records are analyzed, sorted by supplier and sent to appropriate supplier via EDI. The supplier uses EDI transaction as a replenishment signal, transmits to the customer an EDI Advanced Shipment and Billing Notice which identifies the merchandise, the carrier and the arrival date and time. The customer receives the shipment, scans in the bar-coded merchandise and reconciles the shipment electronically with the previously received shipment notice. (Benesko, 1994)

Because ECR has originally been developed for business- to-consumer environment, there are not very much experience of its implementations in business-to-business environment. However, it is quite possible to conclude one thing connected with the business-to-business environment and even the D-O purchasing. The principles of ECR can help to make better the situation in which there are wrong components in inventories and at the same time there are shortages of some components.

Three initiatives, which are presented next, are especially useful in order to achieve more accurate control, forecasting and replenishment orders. They have more the properties of the tool than three other initiatives, which was presented earlier in this chapter and which can be said to be more general logistical philosophies and principles.

6.4 Collaborative Forecasting and Replenishment

Collaborative Forecasting and Replenishment CFAR is a standardized way for manufacturers and merchants to work together on forecasts across the internet. It is developed within Voluntary Inter-industry Commerce Standards organization by Benchmarking Partners, Inc., an American consultant firm, in association with Wall Mart, Inc., Warner Lambert Co., IBM, SAP AG and Manugistics Group, Inc. (Verity, 1996)

CFAR Internet Protocol provides a standardized way for manufacturers and retailers to share information back and forth. With the CFAR software the parties exchange written comments and supporting data. The exchanges are organized on an electronic bulletin board, which allows viewing related messages and appending new ones. The goal is to agree on forecast and thus eliminate uncertainty as everybody is working on bases of the same figures. As the “see-far” acronym implies, intention is to provide more reliable longer-term forecasts.(Verity, 1996)

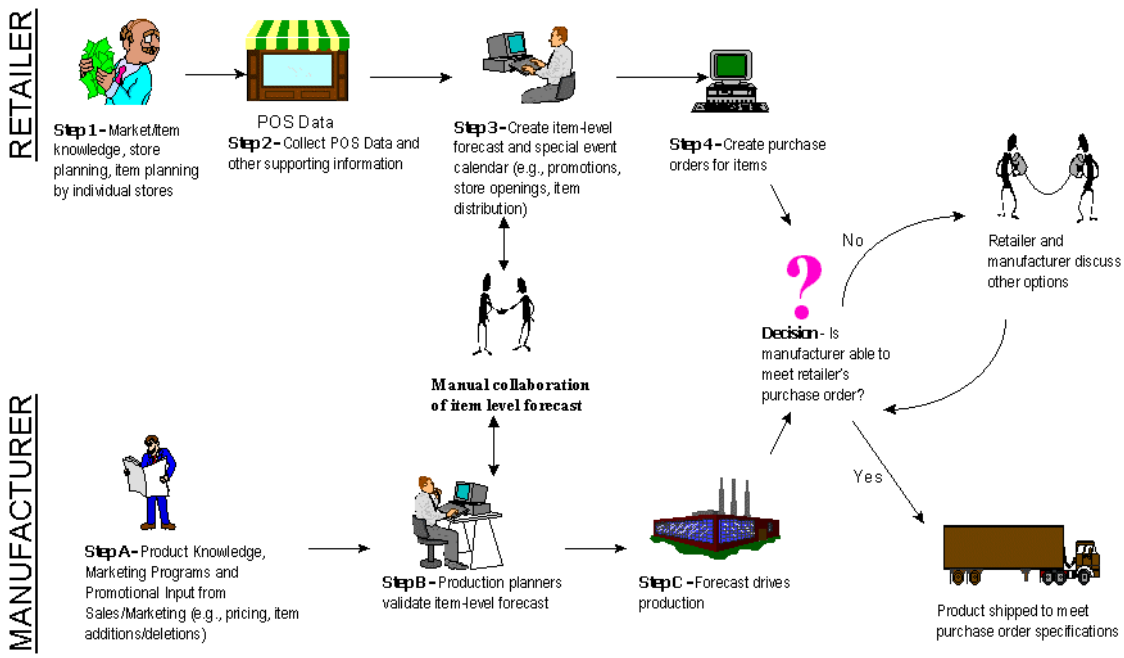
CFAR is quite a recent initiative; Wall Mart and Warner Lambert have been running the pilot of one product in 1996. The results were encouraging: 2 weeks have been eliminated from the supply chain of the test product, order cycle time has been halved and incidents of the product being out of stock have been eliminated. (King, 1996)

In the pilot Wal-Mart extracted relevant data from its data warehouse on Warner-Lambert product sales. The data was structured according to CFAR standard and stored in Wal-Mart CFAR server. To create the first forecast Wal-Mart buyer used CFAR workbench to attach comments to the data. Copy of the forecast was transferred to Warner-Lambert CFAR server. Warner-Lambert planner added comments and passed the result to Wal-Mart. Through iterations figures that satisfy

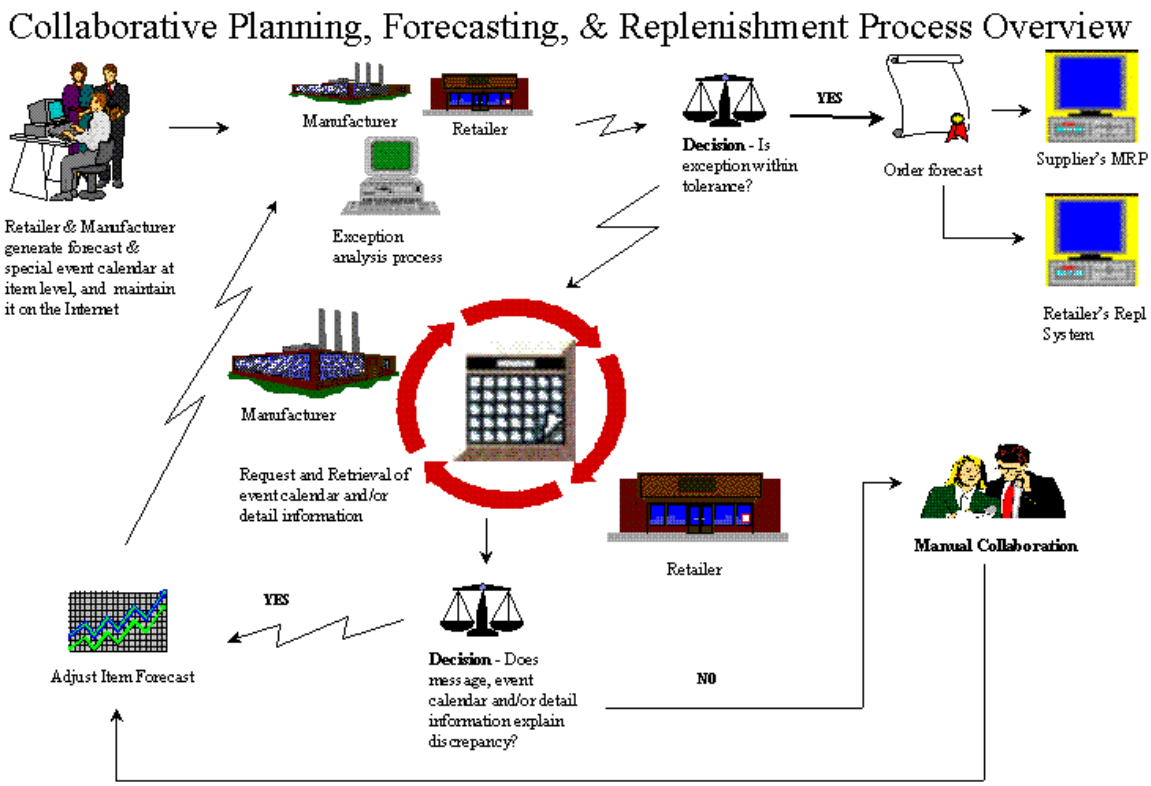
both parties were found and the final forecast was formed. It became a production plan as the data was transferred to Warner-Lambert's manufacturing-planning system. (Darling et. al., 1996)

6.5 Collaborative, Planning, Forecasting, and Replenishment

The initial Collaborative, Planning, Forecasting, and Replenishment (CPFR) process for which a prototype will be built consists of an initial ANSI ASC X12 EDI 830 forecast transmission from the retailer to the supplier. On an item basis, the vendor compares forecasts based on predefined retailer or vendor specific item tolerances to identify exceptions. This will be an automated process that results in the identification and communication of exception items. Once the exceptions are available, item event calendars are accessed selectively by either party to resolve inconsistencies. If event calendar does not explain exception, the vendor initiates communication with the retailer to resolve the exception. Once exceptions are resolved the forecast of retailer or vendor is altered and other backend processes for order fulfillment are initiated. (The Collaborative Planning, Forecasting and Replenishment Committee, 1997)



Picture 2 Current State Process Overview (The Collaborative Planning, Forecasting and Replenishment Committee, 1997)



Picture 3 Future State Process Overview (The Collaborative Planning, Forecasting and Replenishment Committee, 1997)

6.6 Continuous Replenishment Program[10]

Continuous Replenishment Program CRP is a logistical solution for making replenishment orders between enterprises and suppliers according to Efficient Consumer Response ECR – concept. The idea of the CRP- system is that the user sends the daily information of the sales and inventories into CRP-system, which makes orders optimizing inventories and transport equipment and then sends the orders to supplier for final acceptance or editing. With CRP the orders base to the real demand, which offers for enterprises a possibility to reduce significantly the costs of the distribution chain and also possibility to make the availability of the products better.

CRP has two different principles. The service can be bought outside of the enterprise when expertise to the usage of the tool is lower. Another possibility is to acquire CRP to the ownership of enterprise itself. Then it is possible to get more comprehensive

[10]Maximizing value in supply chain, 1996. Prescient Systems, 1998 Jul 1.

results. If there are same kind of the other tools like CRP in use, the efficiency of CRP is lower.

6.6.1 Replenishment Ordering System

Once EDI is in place and operating smoothly the implementation of a replenishment ordering system should be undertaken. Naturally, a state-of-the-art system should have the capability to interface with EDI. Forecasting functionality should provide reliable projections of demand and allow user input of market intelligence for events. The system's inventor replenishment model will be used to drive the generation of replenishment orders and provide a simple, efficient transportation algorithm.

If there is one truism to forecasts it is that they are always wrong. However, forecasting is a necessary and worthwhile ingredient of successful Continuous Replenishment. A replenishment system that allows user addition of market intelligence to statistically based projections can enhance forecast value. As trading partner volume grows, exception-based forecast models assist with task management. Accurate forecasts are advantageous for more than their use in driving the generation of replenishment orders. Make-to-stock manufacturers place high value on a trading partner that furnishes reliable estimates of short-term demand. Customers appreciate having enough inventory to see them through a promotional event or heavy seasonal period while maintaining service level and inventory turns goals. Accurate, intelligent forecasts can benefit many components of the ECR initiative by helping to reduce inventory costs throughout the supply chain.

An ideal Continuous Replenishment system would create replenishment orders based on a valid inventory model. This system would also allow the creation of orders on demand. The customer's EDI transaction does not always come at the same time every day, or even every day. The issue becomes further complicated when multiple trading partners are being replenished. Finally, the CRP system must provide a simple transportation routine that can meet the shipping (bracket pricing) requirements of those environments utilizing full containers. Less-Than-Truckload orders must also be possible under this system.

6.6.2 Electronic Data Interchange proficiency

A broker that has embraced this technology to become EDI capable, proficient and flexible can successfully implement CRP. Brokers must be able to receive the ANSI ASC X12 EDI 852 – Product Activity Data from the customer. This basic transaction provides inventory data by stock-keeping unit SKU at the customer distribution center. It also furnishes the broker with key information that, when input into a replenishment system, can be used to effectively manage inventory-related events– even while they are occurring. For example, there may be a current promotion running predicted to have incremental volume of 1000 cases. The replenishment analyst tracking the progress of the event notices that there is a possibility to move additional 2000 cases. The analyst can notify the manufacturer who has the opportunity to fill the increased volume. The importance of the situation is that the product movement information is even more critical for similar, future events. Analysis of the ANSI ASC X12 EDI 852 data can lead to increasingly intelligent projections. A reliable estimate of future demand in the help of the forecasts can help both manufacturer and customer.

The turnaround transaction created from the replenishment system's suggested order is the ANSI ASC X12 EDI 855 – Purchase Order Acknowledgment. The "855" informs the customer when to expect delivery of particular SKU quantities.

Further, the manufacturer must be notified to send product to the customer. The ANSI ASC X12 EDI 875 Purchase Order may be the transaction of choice. Likewise, the broker's order entry system needs updating to facilitate customer invoicing, more likely than not, via EDI. There is a variety of in-use and awaiting transaction sets for the broker who has designed flexibility into their EDI approach. Sales, marketing and product knowledge are transmittable via the ANSI ASC X12 EDI 879 Price Change, ANSI ASC X12 EDI 888 Item Maintenance and ANSI ASC X12 EDI 889 Promotion Announcement transactions. There are also functional acknowledgments for the EDI receipt of these transactions.

7. IMPLEMENTING EDI

7.1 Benefits of EDI[11]

EDI helps organizations and their trading partners become more efficient, reduce transaction costs, and improve client service. Some of the benefits of EDI include:

- Speed: Exchanging data electronically reduces or eliminates communication lag time between entities.
- Elimination of data entry: EDI is the computer-to-computer exchange of data and it eliminates or reduces the need for manual data entry.
- Reduction of errors: EDI eliminates the possibility of data entry errors or sending documents to the wrong party.
- Standardized data: By using EDI message formats, business entities can standardize the data that they exchange with each other.

Certain other consequential benefits can also be realized through an EDI implementation, such as:

- Reduction in costs: EDI will eliminate manual, labor-intensive activities associated with the creation, verification, reconciliation, and handling of paper documents. In addition, the cost of postage and storage will also be eliminated.
- Information availability and integrity: Organizations will be able to provide better customer service as a result of having access to information that is more accurate and up-to-date.
- Availability of resources: EDI will allow resources to be diverted from performing manual, labor-intensive activities to areas that may require additional personnel.
- An ability to maintain control over the movements of materials, thereby enchasing its ability to participate either directly or indirectly in Just-In-Time, JIT manufacturing or quick response distribution, otherwise known as Efficient Consumer Response, ECR
- An increase in cash flow due to the effective management of trade creditors

[11] Sources: Gattorna et. al., 1996 pp. 5. U.S. Department of the Treasury…, 1998

EDI can also have some disadvantages

- Problems may be created with staff who are resistant to change
- The need for cooperation within transaction and physical distribution channels may be difficult to obtain.

7.2 EDI Pilot Project

Prior to implementing an EDI application with its trading partners, it is recommended that an organization conduct a small pilot of the application. In addition to the technical knowledge and experience gained, the initial success from a pilot effort is an important step in building the credibility of the EDI project team and the confidence of the users. A pilot implementation is also an effective vehicle for demonstrating to management the benefits of an EDI program, which are often strategic and difficult to quantify. A typical pilot involves converting 5 to 10 trading partners to an EDI application consisting of 1 or 2 transaction sets for a period of 4 to 6 months. This section presents a detailed approach to implementing a pilot EDI application, using the steps listed below. (U.S. Department of the Treasury…, 1998)

1. Establish project team
2. Determine functions to be included
3. Redesign the process
4. Recruit pilot trading partners
5. Define pilot technical architecture
6. Acquire and install hardware and software
7. Arrange for network services
8. Build interfaces to in-house application systems
9. Train users and trading partners
10. Test pilot system
11. Implement pilot system
12. Evaluate pilot system

At the beginning of EDI usage of Datex-Ohmeda Nordic Operations it is difficult to see that there is a possibility for above mentioned redesign very much or the redesign of the process in which EDI is implemented cannot be very large. Processes were researched, designed and defined before new ERP system was introduced. At the

beginning the task is more to implement EDI into logistics processes than totally redesign processes because of EDI. It is more possible to realize redesign of processes, in other words business process re-engineering BPR, to achieve economical improvement and better logistics processes after the just beginning phase of EDI usage is over.

Costs are additional expenditures, cash outlays, or losses that arise as a result of changing the current process or program. Costs include both one-time and recurring expenditures. Some cost categories that should be considered when implementing EDI-based applications are: (U.S. Department of the Treasury…, 1998)

- Hardware for the EDI gateway
- Software like EDI translation software, communications software, etc.
- Cost of modifying current application systems
- Telecommunications (VAN) charges
- Trading partner outreach program costs
- Ongoing support and maintenance costs

8. BEST PRACTICES

This chapter covers the results of the discussions made with the representatives of the suppliers of Datex-Ohmeda based on the questions of the appendix I. The models of the EDI operations of four companies are introduced for the best practices. These companies are Vaisala Corp, Avnet Nortec Corp and Arrow-Finland Corp, which all has participated the SET-EDI project, and in addition to these three companies also Kyrel Corp. All these four companies represent the Finnish electrical and electronics industry. Avnet Nortec Corp and Arrow-Finland Corp are the large importers of the electronic components. Vaisala Corp and Kyrel Corp are the manufacturers of the products of the electronics trade.

The results show that these companies have achieved quite obvious and same benefits using EDI. These companies use EDI service providers for the EDIFACT conversions but do not necessarily have very many EDI messages in use or very many EDI partners.

8.1 SET-EDI

The SET-EDI concept has been defined by the federation of the Finnish electrical and electronics industry SETELI. The enterprises of the SET-EDI project are ABB Control, Arrow-Finland Corp, Aspocomp Corp, Avnet Nortec Corp, Elcoteq Corp, InCap Electronics, Juha-Elektro, Kone Elevators, Nokia Telecommunications, Ojala Yhtymä Corp, Scanfil Corp, Teräsjousi Corp, TH Elektroniikka Corp, Vaisala Corp, Yleiselektroniikka and also Elma Corp and Sonera Corp as service providers. In the SET-EDI concept the following business information are delivered: (SETELI, 1998)

- forecasts
- delivery schedules
- deliveries just in time
- purchase orders
- purchase order responses
- dispatch advice
- invoices

In the SET-EDI project the implementation guide of the common EDIFACT messages and the SET-EDI central system has been created for the electrical and electronics industry. In other words the SET-EDI concept is the part group of the EDI Forum for Companies Interested in Computing and Electronics EDIFICE Committee in the Finnish electronics trade. The EDIFICE Committee operates in the control of the United Nations. The SET-EDI concept includes the agreement, which defines the parts of the EDIFACT standards, which are used. (Salminen, 1999.SETELI, 1998.)

In EDI connections the costs of a single connection are often arisen high because of lot of customizations. In the SET-EDI concept all data connections are opened by the same interface and one join payment. The SET–EDI central system routes messages between the trading partners and if necessary harmonizes the versions of the messages of the partners. During the message work national and international message standards for the most important business transactions used by the interest groups of the branch have been notified. (SETELI, 1998)

Vaisala Corp and Avnet Nortec Corp use the EDI Center service. EDI Center is the transfer – and data interchange service provided by Sonera Corp. EDI Center is a total service including the definitions of the EDI connections and the control of the EDI connections. The service offers many different choices to join. When the needs increase and the EDI usage widens it is possible to change from the EDI Center service to the own EDISERVER system. In that situation it is possible to move the definitions made for the EDI Center service to the definitions of the own EDISERVER system. (SETELI, 1998)

Arrow-Finland Corp and Kyrel Corp use both the ElmaEDI service, but Kyrel Corp does not participate the SET-EDI project at the moment. In the ElmaEDI service Elma Corp provides the EDI services as totally as possible. ElmaEDI service has the client-server architecture and the joining to the ElmaEDI service is implemented using the customer joint software. (Luojumäki, 1999. SETELI, 1998) The role of the EDI service provider in the ElmaEDI service is a little bigger than EDI service provider’s role in the EDICenter service.

Datex-Ohmeda was active to participate to the SET-EDI-project at the beginning of this project. Then the introduction of the new ERP system took that time.

8.1.1 Vaisala Corp

Vaisala Corp is the enterprise of the same size class as Datex-Ohmeda. The ERP system of Vaisala has been implemented so that from the delivery just in time, sent by the EDI Partner, is created an in house file according to the SET-EDI concept instead of printing a purchase order. This in house file is then transferred to the SET-EDI service by the EDI Manager software. The EDI Manager and the needed definitions for the EDI traffic have also been bought from the EDI service provider. The EDI Manager controls that the EDI service gives either a receipt of a succeeded receiving of a message or an error message if a message had mistakes. The EDI Manager reports every mistake to the defined persons via email for the clearing and repair operations. Three persons are ready to solve mistakes.

Purchase orders, mainly deliveries just in time, and also forecasts are sent to the sub contractors using EDI. The types of the EDI messages are DELJIT and ORDERS and also DELFOR. If the supplier of Vaisala is not an EDI partner, a purchase order is sent by fax. Order changes are made in the telephone discussions between the buyer of Vaisala and the sales people of the supplier of Vaisala.

When EDI has been taken in use, its operation has been good and significantly better than the fax operating. When EDI is in use, orders are registered 2-3 days quicker to the system of the sub contractor and this registration is accurate. The sub contractor needs also significantly smaller resources. Faster times of deliveries, lower safety stocks and faster response times in the exception situations are achieved by using EDI with trading partners.

At the beginning of the EDI project it is not sensible to spend time with learning the operation of the converters, but the service providers should be utilized. Generally defined rules, for example the SET-EDI recommendation, should be complied and the implementations only between two companies should be avoided. This way the beginning with the new EDI partner is easier.

The most difficult parts in the EDI usage are the receiving of the messages and the flexible interchange of the messages to the own ERP system. While modifying an in house file it can also be difficult to understand the recommendations of the EDI messages right.

It takes a few weeks to take EDI in use. The appending of a new EDI partner requires time now only one hour. The EDI Manager enables also the sending of the test messages and therefore the abilities of the receiver are the only possible problem factor. The appending of a new type of a message requires changes to the ERP system. There is a technical model for the handling of the sending message and the problems exist more in system level. In contrast to previous the handling of the receiving message requires quite a lot of resources.

The delivery of the information between organizations requires either bilateral standards or general standards and therefore EDI is also one alternative. When the volume of the EDI traffic is low, EDI is not worth of considering and the direct, protected internet connections are provided for a replenishment by operators.

8.1.2 Avnet Nortec Corp

The older version of the directory of EDIFICE / EDIFACT is 92.1 and the newer and recommendable is D97. Avnet has its own implementation of EDIFICE; European Utilization of EDIFICE. The traffic of the EDI messages to Avnet from the customers of Avnet has been realized in Finland via EDI Center both to the General Electric Information Services GEIS in the USA and to the ERP system SAP R/3 in Europe. The basic structure of SAP R/3 has not enough supported a consignment stock and EDI. Avnet started its EDI operations with its suppliers. It took about two months at the beginning before the EDI usage had become enough stabilized in Avnet.

The EDI messages, which Avnet operates, are orders using ORDERS message, orders response using ORDRSP message, forecast using DELFOR message, delivery just in time using DELJIT message, invoice using INVOIC message and dispatch advice using DESADV message. Orders are changed in the help of sending of new orders using ORDERS messages. There is also a self-billing invoice, which the customer of

Avnet pays for the own material use from the stock of Avnet. In the use of INVOIC messages must be notified the situations in which the same order includes many different invoice lines. The changes of the prices must be defined to start from the date, which both sides have agreed.

If DELJIT message does not include mistakes, its information is delivered to the packing of the goods. It is enough for Avnet that the product code, the needed amount and the date of the delivery form the contents of DELJIT. The SAP R/3 system sends a message to the responsible person when there has been a mistake in the DELJIT message. On the other hand the delay from the receiving of ORDERS message to the sending of ORDRSP message does not cause problems to Avnet. In the forecast process and in the use of DELFOR message the change of the supplier must be realized during the predefined time. Then it is better possible to avoid the problems, which can be caused the situation in which there are the needs of a new trade without a new agreement.

8.1.3 Arrow-Finland Corp

In present EDI concept Arrow delivers an in house file to its EDI service provider which delivers then the data to the EDI partners of Arrow. Therefore the costs of data interchange are changing from the variable costs to the fixed costs, which are also better predictable for example for budgets. Problem of the data interchange on the Internet is the control of the fact if EDI message has successfully been delivered to its target.

Arrow has 10 EDI partners in Finland. The EDI partners of Arrow must have enough trade with Arrow. Faster lead times are the significant advantage of EDI for Arrow. For example when EDI is in use, the out-of-stock- situation can be started to solve earlier than without EDI when people have just noticed the mentioned problem.

The EDI messages, which Arrow operates, are DELFOR and either ORDERS-ORDRSP together or DELJIT or only DELFOR. Arrow does not find useful to use both ORDERS and ORDRSP together and in addition to them DELJIT. DELJIT is more useful, when the time between ORDERS and ORDRSP is short. Then people

should consider if ORDRSP is unnecessary. Arrow does not use DESADV in Nordic countries. It uses INVOIC with some EDI trading partners. Naturally it is not sensible to take the advanced EDI operation models in use at the beginning of the EDI operations. Arrow begins the EDI operations with a new EDI partner using only one EDI Message. Arrow estimates that it takes at least three months at the beginning before the EDI usage had become enough stabilized.

At all Arrow has estimated that the technology is 25 % of EDI and the development of the co-operation is 75 % of EDI. One example of the co-operation is the fact that the EDI partners must have the same amount of the segments in their EDI messages.

8.2 Kyrel Corp

Kyrel has EDI connections both to the customers and to the suppliers. In Kyrel for the development of EDI is part-time participated by the logistics manager and the materials manager. The IT- group of Kyrel and the provider of the ERP system help too. The largest customer sends orders and forecasts using ORDERS- or DELJIT- and DELFOR-messages. DELFOR messages for forecasts, in which a supplier interprets the first line as an order, are sent in purchasing. A delivery just in time can be delivered at the same time to the forwarder and they can allocate space from the transport equipment and make the paper routines of the forwarding.

The biggest benefits from using EDI have been the speed and the correctness of the data. When the customer changes its own orders and forecasts daily, the information about that can be delivered to the suppliers so that there is only one day delay because MRP is run by nights. Before the EDI usage a data interchange could take three weeks because of a large amount of item codes and suppliers. Also extranet is used for the suppliers, which it is not possible to have EDI. Therefore with all big suppliers, in other words 95 % of the item codes of Kyrel, are operated using the quick information interchange.

EDI has reduced the amount of the mistakes and the purchasers have more time for the more value-added purchasing. When EDI is in use, faster lead times and more flexible operation models can be provided for the EDI trading partners. On the other

hand the EDI trading partners give faster lead times and better flexibility. One problem of the EDI usage is to modify the purchasing processes and the sales processes so that these processes become enough well operated or simple.

It took 2- 3 months from the first sending of the EDI test data before the EDI usage had become enough stabilized in Kyrel. Then the time for every following connection was spent some days. Because of being a member of the EDIFICE, it is quite easy for Kyrel to increase the amount of the EDI messages used by Kyrel. Kyrel intends to operate using the simple standard data interchange as much as possible.

There are the process development at the first place, the extranet at the second place and EDI at the third place in the logistics development of Kyrel. Internet can be used as a gateway but EDI represents the standard data interchange format needed for the communications between different ERP systems. Internet replenish but does not replace EDI.

9. ELECTRONIC DATA INTERCHANGE IN DATEX-OHMEDA[12]

9.1 EDI system used before in Datex-Ohmeda

The first pilot project in Datex-Ohmeda was chosen a subsidiary in France. That particular subsidiary took care of sales, distribution and after sales operations of Datex-Ohmeda products within France and thus acted as a customer to the factory and export services based in Helsinki.

Partly the decision of the first pilot was inevident due to the ongoing development project in France where the whole operative data system was to be switched to a completely new integrated data system. The system was developed from scratch. One of the most important objectives of the new data system of the subsidiary was to integrate all of the logistics routines within the subsidiary and also to integrate the order fulfillment routines to the logistics of D-O Helsinki. Practically this meant that EDI routines had to be incorporated into the new system to be developed. The costs and benefits were examined also in the routines of purchasing of D-O Helsinki but the sales side was figured to be more urgent.

Information about delivery data and product prices was transmitted in non-EDIFACT format. The messages were transmitted in the in-house file format i.e. without conversion. This decision was due to the lack of resources in the office of Lyon. It is common for all of the EDIFACT converters that they are easy to use and practically transparent in daily routines but still they need separate computers and people have to be trained to use them.

Most of own resources were used in that EDI project in the design and implementation of the interface to the operative data system in contrast to the present situation, in which the Oracle Applications provides the Oracle EDI Gateway module as part of the EDI interfaces.

[12] Sources: Haapanen et.al., 1990, p.186. Isotalo, 1997, pp. 43-48. Maula, 1991, p.154. Mäkelin, 1987, p.186. Oracle Corp., 1998, pp. 1_2-1_4, Quarmby, 1999.

Between the French subsidiary and D-O the volume of the EDI traffic was quite a small but as a result of the pilot project the valuable experience of the EDI usage was achieved.

In other logistics processes there have not been utilities of EDI in Datex-Ohmeda. In purchasing EDI has also not been used before, although before the introduction of the new ERP system there was quite an advanced fax system in use. A purchase order, which did not have need for modifications, was sent automatically using fax to the supplier from system without manual printing and faxing. On the other hand EDI system used before in order fulfillment has not also been in used since new ERP system was introduced.

9.2 Oracle EDI Gateway

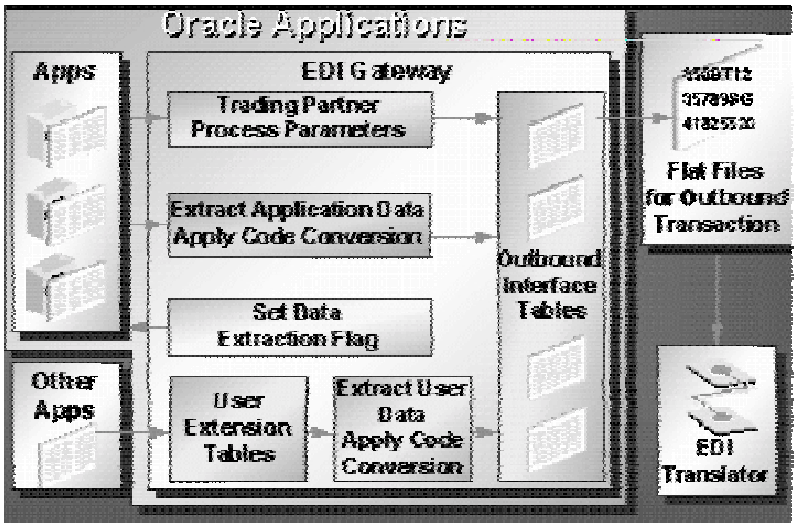
Oracle EDI Gateway performs the following functions:

- define trading partner groups and trading partner locations
- enable transactions for trading partners
- provide location code conversion between trading partner location codes and codes used in Oracle Applications
- provide general code conversion between trading partner codes or standard codes
- define interface data files so that application data can interface with EDI translators
- extract application data, format, and write to data files for outbound transactions
- import data or converted codes into application open interface tables so that application program interfaces API can validate and update Oracle application tables for inbound transactions

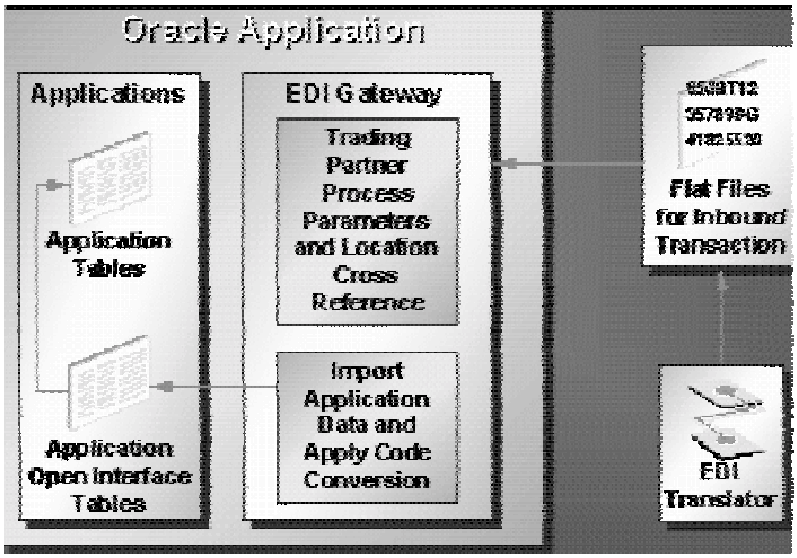
Oracle Applications are designed with an open architecture for integration with EDI translators and electronic transmission products to provide a seamless solution. Oracle Applications utilize the Oracle EDI Gateway to integrate with EDI translator software. EDI translation software packages integrate with an electronic transmission service to provide a closed-loop between Oracle Applications and the trading partner's application.

The Oracle Applications for Manufacturing, Distribution, and Financials are EDI-enabled using the Oracle EDI Gateway product. The Oracle EDI Gateway product augments the existing standard paper document capabilities of Oracle Applications, or adds functionality where no corresponding paper documents exist.

A common EDI implementation is via ASCII data files in a batch environment. Data from the sending application is extracted into an application data file. The application data file is received by the translation software, which translates it into the EDI standard agreed by both trading partners. Then the EDI data file is placed on a network for transmission to the receiving application. The receiving application's EDI translator receives the EDI data file from the network and begins the file processing in reverse sequence. The translator translates the EDI data file and creates an application data file meaningful to the receiving application. The receiving application receives the application data file for processing and imports the data into the application



Picture 4 The outbound EDI Gateway transaction flow (Oracle Corp., 1998, p. 1_3)



Picture 5 The inbound EDI Gateway transaction flow (Oracle Corp., 1998, p. 1_4)

9.3 Oracle Self Service Web Applications

Oracle Self Service Web Applications module is not bought yet bought to Datex-Ohmeda. Purpose of following introduction is to bring perspective for future scenarios and for the possible future usage.

Oracle Self Service Web Applications is a suite of function specific applications which empowers customers, suppliers and employees to perform simple tasks over the internet and intranet - e.g. order entry, supplier inquiries, requisitioning and expense claiming. Oracle Self Service Web Applications is an extension of standard Oracle Applications. It is not an alternative to Oracle Applications. In order to use it the related Oracle Applications must have been installed. Oracle Self Service Web Applications is a suite consisting of three modules; Oracle Web Employees, Oracle Web Customers and Oracle Web Suppliers. The technology that enables self-service is the World Wide Web. This universal access extends corporate information access to new audiences. It provides secure and reliable access across the Internet and corporate intranets. The modules have the following functional interactions with the standard modules in Oracle Applications:

Web Customers	Web Suppliers	Web Employees
Oracle Order Entry	Oracle Payables	Oracle Payables
Oracle Receivables	Oracle Purchasing	Oracle Purchasing
Oracle Service		Oracle Human Resources
Oracle MRP		Oracle Assets
Oracle Sales & Marketing		Oracle Engineering
		Oracle Workflow

Table 2 Modules in Oracle Self Service Applications vs. standard modules in Oracle Applications. (Quarmby, 1999)

Oracle Self Service Applications allow to transform business operations by making selected self-service transactions available to a broad audience of users, both inside and outside the enterprise, who can use the system via a browser. This makes Self-service stand apart. Screens are deliberately kept uncluttered and simple. No training courses are necessary to make use of the functionality. Complex transactions are not intended to be carried out over the web and it is a mistake to consider implementing self-service unless you are prepared to consider simplifying processes. Self-service is completely different from Standard Applications. It cannot be expected lots of fancy options, everything should be geared to simplicity and ease of use. When dealing with complex transactions the best solution is to continue to route them via departmental finance staff rather than to attempt to get every transaction entered via the Web. The simple approach is at the heart of the success of Self- Service in combination with workflow.

Self- Service has three components: Any web browser, a web application server and the relational database management system RDBMS server. The Oracle Web Application Server and the data server can exist on one machine or on different machines. The Web Application Server is required in order to process the requests coming in from the Browser.

9.3.1 Web Customers

Oracle Web Customers lets authorized business customers perform common business functions such as entering, configuring, and validating orders, tracking shipments,

verifying payments and submitting service requests. All service requests are integrated with Oracle Service and this is a particularly effective means of allowing customers to directly request service visits. Web Customers provides access to a wide range of key business information to an outside audience connected to the Web. It also helps to broaden reach by allowing consumers, business partners or sales representatives to enter orders in system through web-site. Finally customers can submit service requests, and track the progress of their requests. This all equates to higher service levels at lower cost.

Customer enters Web Store and builds up a shopping cart of items. As item lines are added to the order, pricing information is retrieved from the standard application using the relevant price list. These prices for the web store orderable items are based on rules established in Order Entry. It is quite possible to maintain a special price list for web store items. Once the user places the order data is stored in Oracle Web temporary tables, certain validations are performed, and if no errors are found, data is written into the order entry interface tables.

Initially customers were considering the Web Store for extras e.g. Manuals, Course materials and other sundry items. i.e. simple products. With the advent of Web Configurator in Release 11 it will be possible to place valid orders for complex products with many features and options. The Web Configurator automatically validates each order to prevent invalid orders from being introduced into your order processing system. Sales reps can enter orders on behalf of customers. They can enter orders restricted to their territory or they can enter orders for any customer. Even prospects can use Web Customers.

9.3.2 Web Suppliers

Web Suppliers lets authorized suppliers perform common business functions such as reviewing purchase orders, tracking inventory balances and verifying receipts. All functions are Inquiry only and are designed for organizations where there is a desire for closer integration with suppliers. Web Suppliers extends electronic commerce throughout the supply chain to the next level. It provides direct but secure access to systems. This allows suppliers to pro-actively learn about their service level in areas

such as progress against long term agreements, time critical delivery information, Purchase order changes, and Request for Quotations. Web Suppliers should provide better information to suppliers and improve relationships between customer and suppliers. Oracle Web Suppliers can offer the first step towards closer integration with suppliers in a managed environment.

Suppliers can view supplier agreements and release status, view PO's and drill down to invoices and receipts, view supplier items and drill down to inventory balances, view supplier on-time performance against schedules, view invoices and payments and drill down to invoice details, receipts, payment details and contact information, view delivery schedules and also view receipts and returns.

9.4 Benefits of EDI for Datex-Ohmeda

9.4.1 Faster lead times of different phases along the order - delivery chain

Utilization of EDI routines is one tool for an organization to speed up the processes in the area of order processing, invoicing and other customer service routines. Replacing paper documents with standardized electronic messages in these routines removes time consuming manual work. Keying up same data many times can be avoided. Also the accuracy of information increases.

9.4.2 Reduced business risk

In the near future a major deal of the orders of high-volume products like single-use products and other accessories may come through the channels of electronic commerce. This is a quite realistic vision at least in some European countries. This makes a large business risk if the distribution path for those markets is not ready for dealing with EDI routines. An investment for the pilot project is easily justifiable if it helps to reduce such large business risks in the future.

.

9.4.3 Better forecasting

There has been lots of studies that prove forecasting can never be a number one development subject for a manufacturing company. Random phenomena like end-

users' irrational buying decisions cannot be predicted. But there is a number of decisions concerning product demand along the distribution chain that can be predicted and prepared to. These decisions cause predictable trends and variations to the end-user sales and this should be reacted to in the purchasing as soon as possible. The reactivity of purchasing activities to the trends in end-user sales has a major impact on the internal logistic efficiency of the organization (Haapanen et.al., 1990, p.186).

Earlier the big problem has been to collect the forecasting data effectively enough. Today there are many options to put up a fast and reliable mobile data connection that data collection forms in paper format can be replaced with more effective tools. This calls for some kind of electronic form application.

9.4.4 The people can use their time for more value-adding operations

The dramatic benefits in Datex-Ohmeda can be achieved only when the people concerned with the order processing routines can be organized differently. This requires that eventually no human checkups are necessary to slow down the flow of data between the order release and the order confirmation if the input data has been correct.

Logistics processes need carefully planned data conversions. Commonly shared data should be coded in uniform way throughout the distribution chain. Especially this holds for the data regarding products, customers and tracking. Additional problems come up with the large amount of international and national standards e. g. for bar coding. (Maula, 1991, p.154)

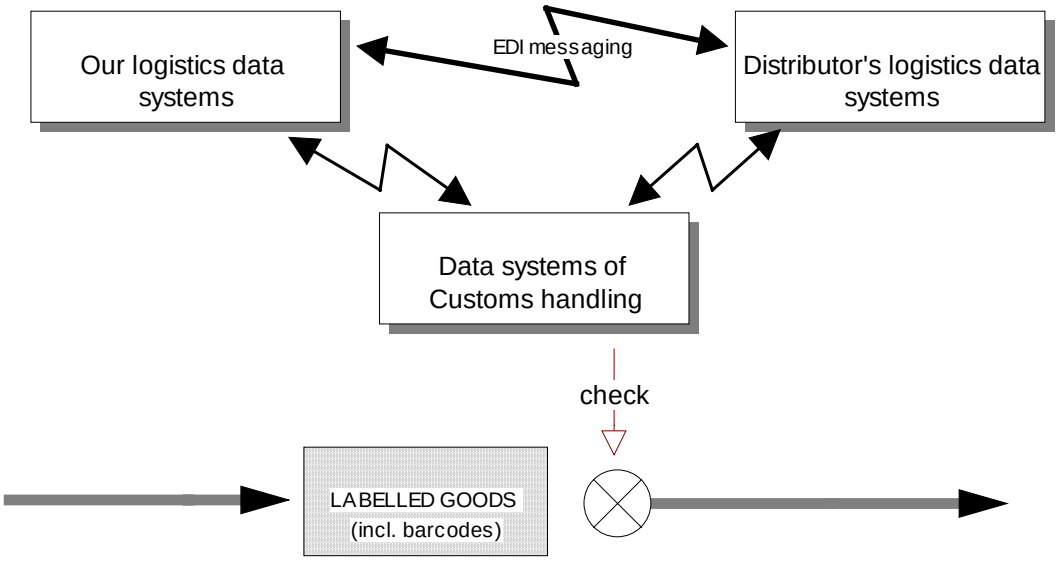
To achieve the cost and time savings it is important to keep things simple. In the EDI messages only the variable data should be transmitted. This means that the general terms must be agreed on regularly - for instance on annual basis during the contract negotiations.

Following two EDI benefits belong to order fulfillment in Datex-Ohmeda more although they can belong to all logistics processes.

9.4.5 Speed up customs clearing routines

The EDI-based customs clearing is nowadays supported in importing routines. The support of EDIFACT is coming also for exporting routines but the time schedule has been postponed many times already.

Remarkable improvements in speed are not gained until electronic communication is accepted also with other distributor and forwarder organizations. The architecture of this vision would look like in the picture below:



Picture 6 Information architecture for order fulfillment chain (Mäkelin., 1987, p.186)

9.4.6 No human resources required to produce the statistics for the customs

While the customs clearing routines are no longer performed for the deliveries inside the European Community, the responsibility of gathering the statistics of trading transactions is moved to the exporting and importing companies. These INTRASTAT statistics have to be announced to the customs authorities on regular basis. The customs authorities control the companies really fulfill these obligations.

10. INFLUENCES OF EDI IN DATEX-OHMEDA

The following chapter treats the influences and the switches between EDI and the selected Datex-Ohmeda logistics main processes and the selected logistics sub processes. This chapter covers the results of the discussions made at Datex-Ohmeda.

10.1 Purchasing

Nowadays the purchasing process in D-O includes following. After MRP has been run successfully, the purchaser's main purchase action is to make releases from the earlier defined purchase agreements in the help of the suggestions given by the MRP workbench. The releases are also made without the MRP workbench. Purchase orders are made even without the agreement. These purchase orders are called as standard purchase orders. After these phases the purchase orders are printed and faxed to a supplier.

At first in purchasing the targets of the EDI usage are quite clearly the logistics sub processes purchase orders and releases. Then EDI in order confirmations is needed and after that the EDI in forecasts is needed. The importance of EDI in purchase invoicing comes the next and EDI in purchase pricing with the Request for Quotation RFQ property of EDI comes after that. A request for a new acceptance for a once approved order should be considered. Also the forecasts in purchasing are switched to the planning process in production planning and these two have a connection to open tenders. The advance information for the sales people should be available.

If EDI is in use, it is possible for 1-2 purchasers in the orders making and 2-3 purchasers in the handling and the checking of the purchase invoices to use their time for the more value-added functions. Both mean about 250000 FIM of the employee cost in a year, totally 500000 FIM in a year. In addition to that it is also important to notice the reduction of the errors, the printing and the faxing. The savings of the purchasers' time can be 20% in the help of EDI and even 30 % if tenders and invitation of tenders can be delivered using EDI in the supply management. Also forecasts will be delivered directly to the system of the supplier using EDI and therefore the risk that forecasts will not every time be keyed up to the system will be eliminated. When forecasts will be delivered quickly, the delivery certainty can

become better. EDI is also a possibility to get the flexibility, when the volume of the production and the needs vary and the delivery must be ready earlier than agreed.

If EDI can reduce the total lead-time seen by the customer from 3 weeks to 2 weeks 3 days, the savings can be at least 1 % of the values of the inventories per year. On the other hand EDI can reduce 20 % of the cost of making an order and it is possible to order smaller economic order quantities EOQ. Some components are ordered today a need for one week. When EDI is in use, it is better possible to order some components also a need for a half of week or some monitors a need for a day. Smaller order changes can be made which is one way to the more accurate control and therefore one way to reduce the bounded capital. EDI makes also possible to interchange more order confirmations at once straight to the ERP system.

EDI can improve about 20 % of the problems in the purchasing logistics, in the inbound logistics. If more automatics to the purchasing routines are not got, there is the need to hire up several new purchasers, because amount of goods, which purchasers must purchase, is growing all the time. On the other hand EDI is not the only solution but other development actions must also be done. There is one question if the interfaces made so far for the foreign exchange engagements are enough for EDI.

10.2 Order fulfillment

In the order entry process there is a need for the more electronic transactions handling and therefore the need for EDI in the receiving of the orders and in the confirmations of the orders. EDI can reduce the delay of the manual keying up.

The available-to-promise is calculated to determine if an incoming order can be promised for delivery in a specific period. Promising delivery to customers should be based on what is or will be available (not committed). Available-to-promise (ATP) is defined by the APICS Dictionary (1987) as “The uncommitted portion of a company’s inventory or planned production. This figure is normally calculated from the master production schedule and is maintained as a tool for customer order promising.” (Fogarty et. al., 1991, p.139) The logistics sub process available to promise inquiry in the production planning should be in control before the ship

confirm process. Also the information about the new product introduction, the logistics sub process in the production planning, should be delivered to the sales channel, too.

In the ship confirm process the receipt of the fact that the ready product has been released from the factory can be delivered using EDI to the customer, the customs and to the forwarder. The receipts are needed both in the export customs routines and in the import customs routines. The delivered EDI information can include the information sorted by the customs code categories and the transaction categories to the customs and the forwarder and the information about the order, the product, the serial number etc. to the customer. When EDI is use, the customs clearings can begin although the product is not yet physically in the customs. One question to find out in the ship confirm process is the connection to the device tracking recording.

In the outbound invoicing process and in the outbound crediting and the outbound invoice amendment process EDI can provide a possibility to operate without paper prints especially between the D-O subsidiaries. In this case however the regulations of the legislation must be noticed. In these processes one question is also the connections to the forwarder.

In the EDI transactions the complex outbound logistics causes the fact that in the order handling people must notify the bills of material BOM. They must also check, if the configurations of the customers' EDI messages are right. More automatics and possibly the alerts to the ERP system are needed to find out the configuration errors of the orders. The problem of EDI in the order fulfillment can also be the fact the Request for Quotation dates of EDI are not exact with the real delivery times.

In the order fulfillment the D-O information systems and the D-O distributor information systems must be able communicate better than today in the help of the fact that the D-O distributor has been integrated better into the D-O configurations. In the future the straight connection to hospitals will become more important. When the customer's perspective is also taken to the survey, the priority of EDI is significant also in the order fulfillment although the basic processes of the order fulfillment must first be in the control and the response times must be reasonable.

10.3 The conclusions of the survey

There is the need for the ability to response in 24 hours notifying different time zones in the information interchange and in the fast delivery permanently and there is also need for the permanent global visibility of inventories and therefore the EDI based solution is needed. For example in the after-sales logistics the global visibility can save time, because it is possible to find out earlier if the needed spare part is available. The globally optimized control of the inventories and the faster react of the supply chain make possible to fulfill better customer's requirements for quicker lead-times. The EDI based solution is needed between D-O and some of its subsidiaries, between D-O and some of its distributors and its land warehouses and between D-O and some of its other logistics partners in addition to the need of the EDI based solution between D-O and some of its suppliers. EDI can give links to the breaking points of the logistics processes.

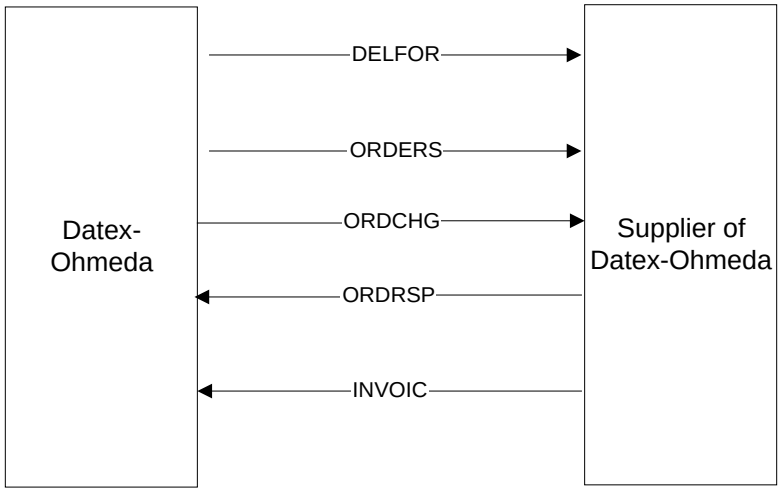
The need for the more electronic transactions handling in the logistics processes and therefore the need for the EDI based solution is obvious. The question is more about the schedules and the resources of the labor. In other words, which of logistics processes are preferred at the certain moment and where the ERP system operates so well that the implementation of EDI is possible. The EDI pilot project in the purchasing between the selected supplier and Datex-Ohmeda seems to be the most suitable alternative compared to the EDI pilot in the order fulfillment. Datex-Ohmeda must handle a large amount of money or items with the EDI trading partner and also order enough often from this supplier. It is also an advantage if the supplier has some experience of EDI.

In the order fulfillment there are the configuration conditions for different customers and for different countries unlike in the purchasing in which standardized products are handled without many configuration problems. Because the order fulfillment and the outbound logistics are complex, the other solutions for the IT-problems of the order fulfillment are more important than EDI at the moment. The performance of the order fulfillment process should be better. One important thing is also the fact that the D-O logistics system must look like one logistics system for the outside customer of the company more than it today look like.

11.THE EDI PROJECT

After the surveys the next phase was the start of the EDI project. After requesting the tenders from the EDI service providers Sonera EDI Center was chosen as the EDI service provider. One fact for the EDI project is clear. The strong participation to the EDI project from the D-O purchasing is needed. The purchasing of the D-O has the knowledge about the suppliers, which have enough trade with D-O for the EDI partnership with D-O. It is clear that the expertise the D-O purchasing will be needed, when the analogy between the SET-EDI data contents and the data contents got from the ERP system has been defined in D-O and after that the contents of the EDI messages will be defined with the EDI supplier. The latter definitions include the information needed in the EDI messages, for example if the item codes of D-O or the item codes of the EDI supplier will be used.

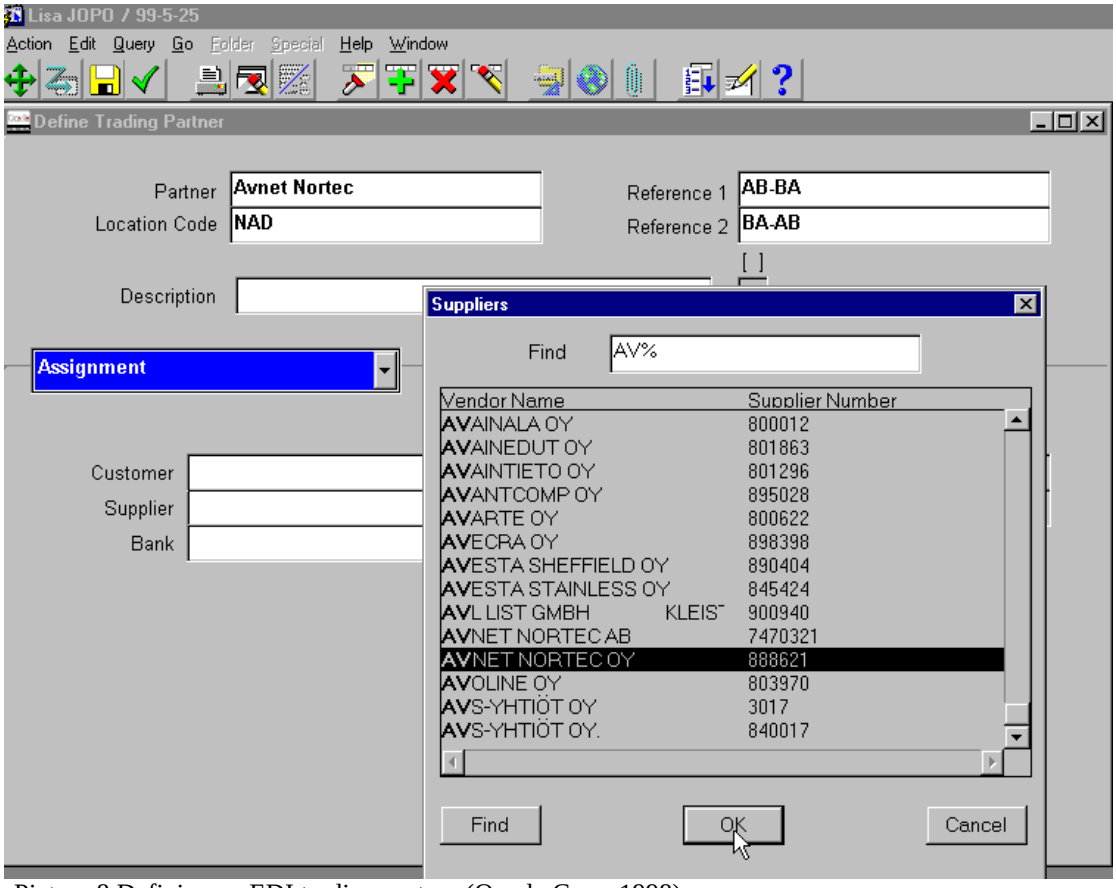
The EDI messages, which the purchasing of D-O want in the near future, are forecasts DELFOR, purchase orders ORDERS, and purchase order change ORDCHG to a supplier and on the other hand purchase order response ORDRSP and purchase invoice INVOIC from a supplier (Picture 7).



Picture 7 Data flow chart of EDI messages

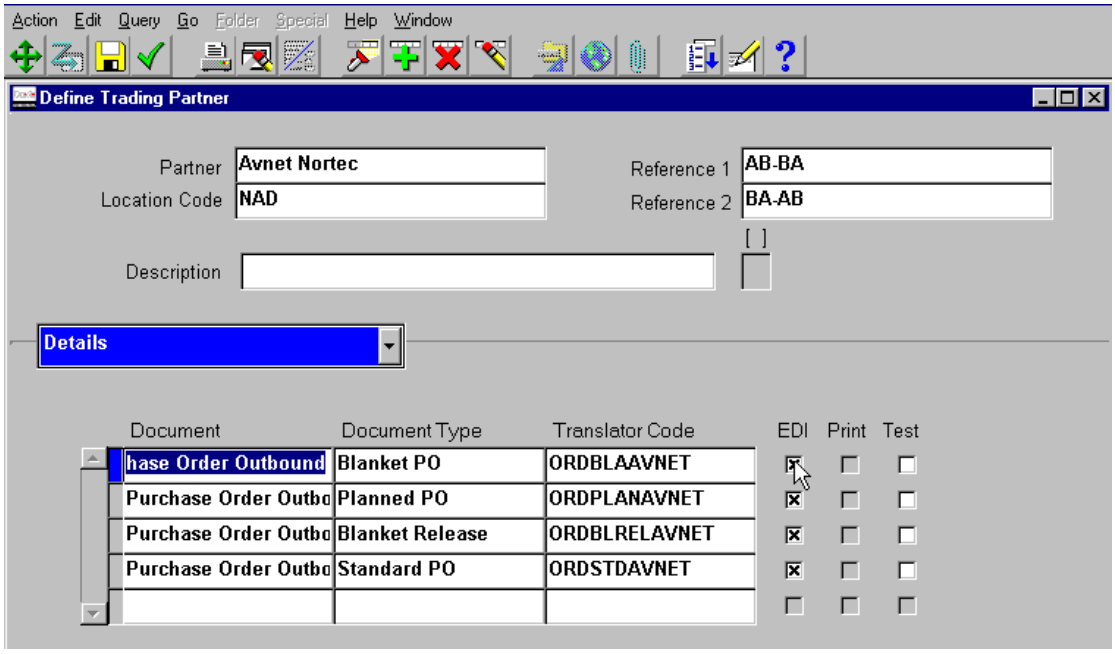
11.1 Defining EDI trading partner

Before it is possible to use the programs of the Oracle EDI Gateway for the EDI transactions, the definitions of the EDI trading partners must be done. The EDI trading partner is either a supplier or a customer. In the picture 8 Avnet Nortec has been defined as the supplier. If the same EDI trading partner is both the supplier and the customer the definitions must be done separately.



Picture 8 Defining an EDI trading partner (Oracle Corp. 1998)

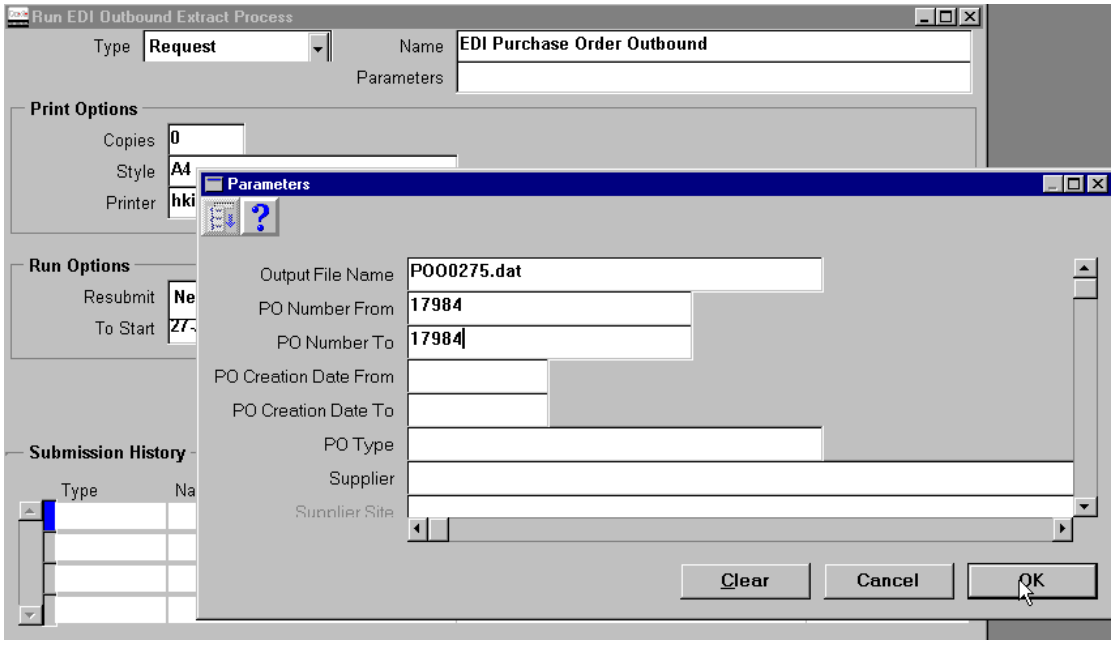
Every document type like a standard purchase order, a blanket release etc., used in EDI transfers, must be defined separately. The translator code links the trading partner definitions of the Oracle EDI Gateway to that in the EDI translator. Different EDI documents should also be selected to be sent using EDI (Picture 9).



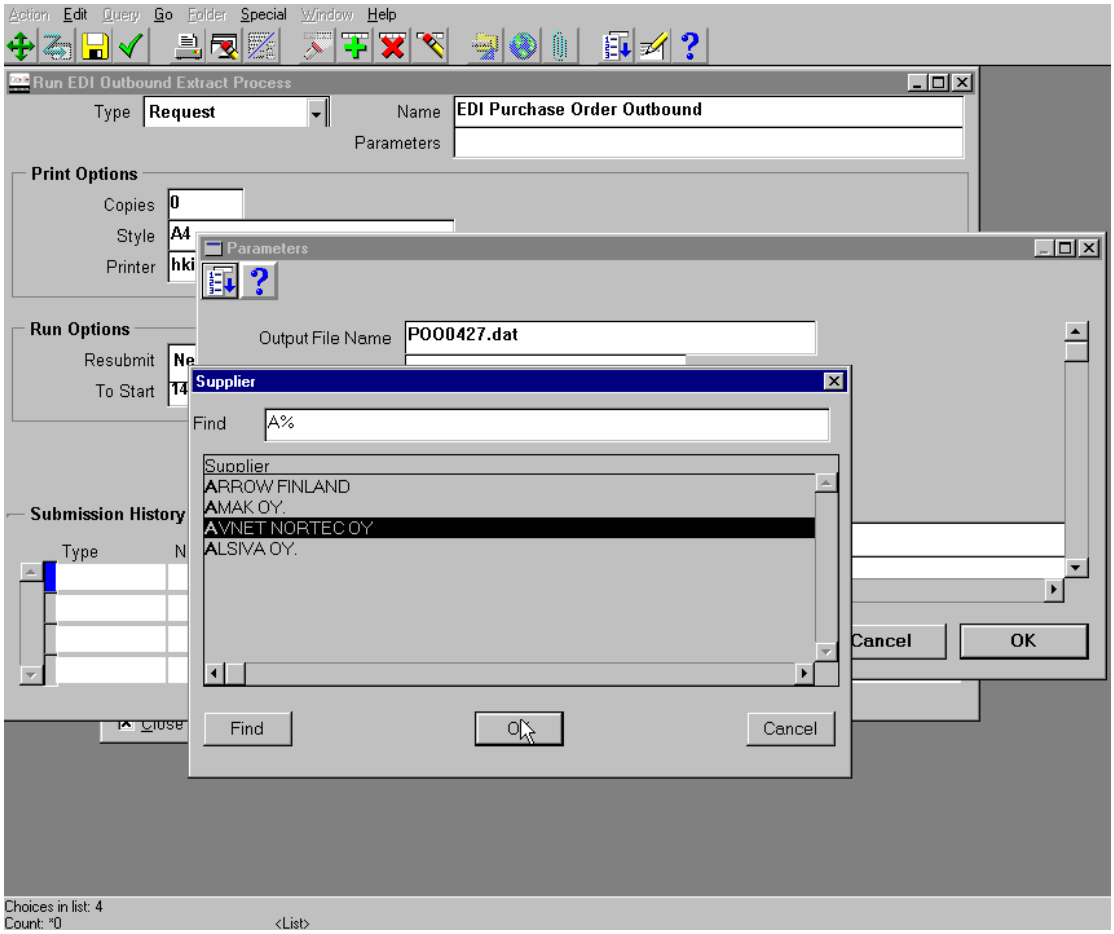
Picture 9 The definitions of the purchase order outbound document types (Oracle Corp. 1998)

11.2 EDI Purchase Order Outbound

The function of the EDI Purchase Order Outbound program is to create an in house file or in the Oracle terms “a flat file”. Oracle Applications gives automatically the name of this Output File (Picture 10). The usage of purchasing order numbers as parameters can be replaced later for example with the usage of a supplier name from the earlier defined list of the EDI trading partners, which are defined as the suppliers, and with the usage of a purchasing order type (Picture 10, Picture 11).

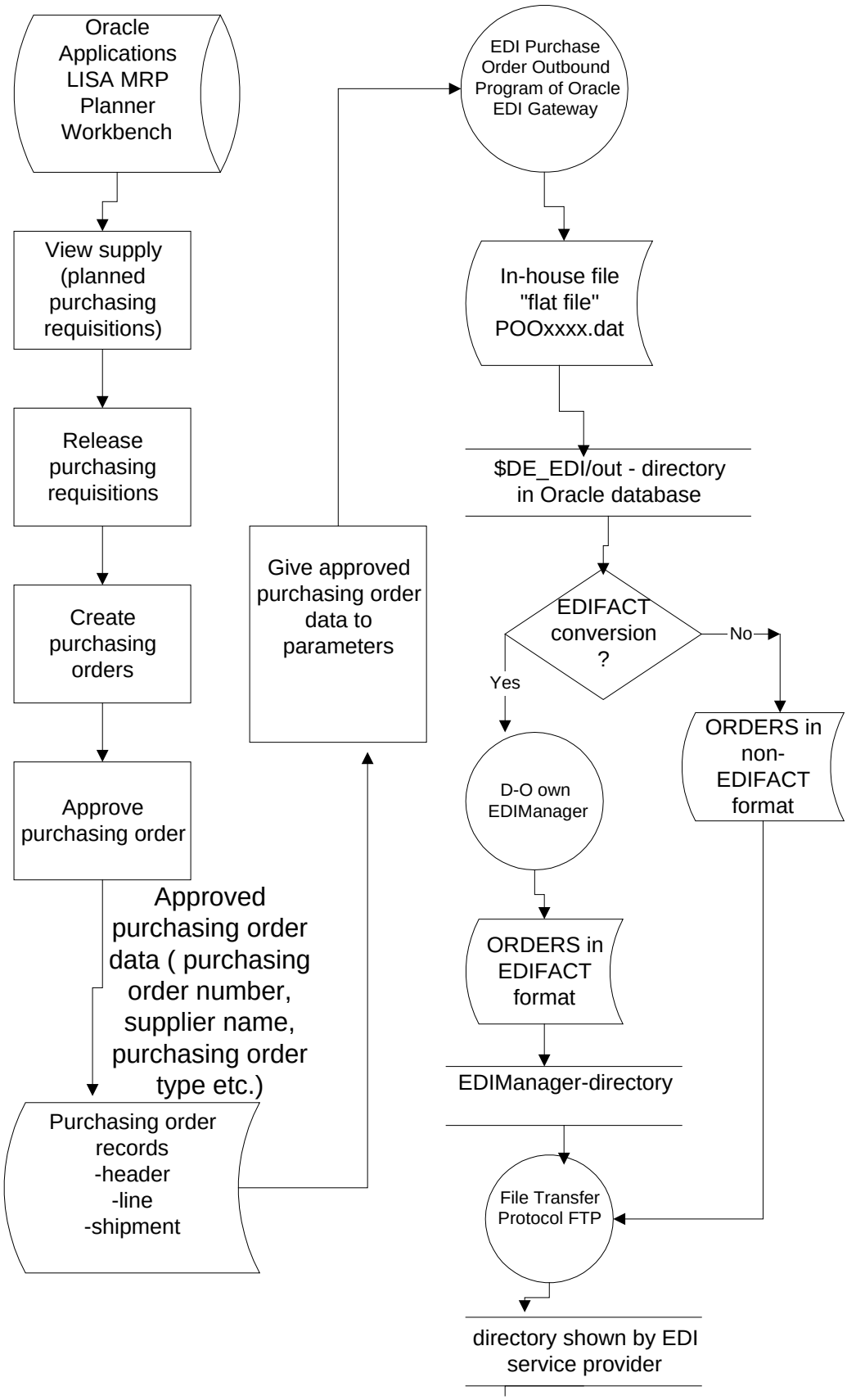


Picture 10 The EDI Purchase Order Outbound (Oracle Corp., 1998)



Picture 11 The EDI Purchase Order Outbound without purchasing order numbers (Oracle Corp., 1998)

The replacement of the usage of the purchasing order numbers as parameters is necessary, because purchasers have no time to search from the purchase order summary the purchase order numbers of the releases, which are made using MRP planner workbench. The picture 12 describes the whole process of making the EDI Purchase Order Outbound to a supplier as far as the data of the purchase order has left from D-O.

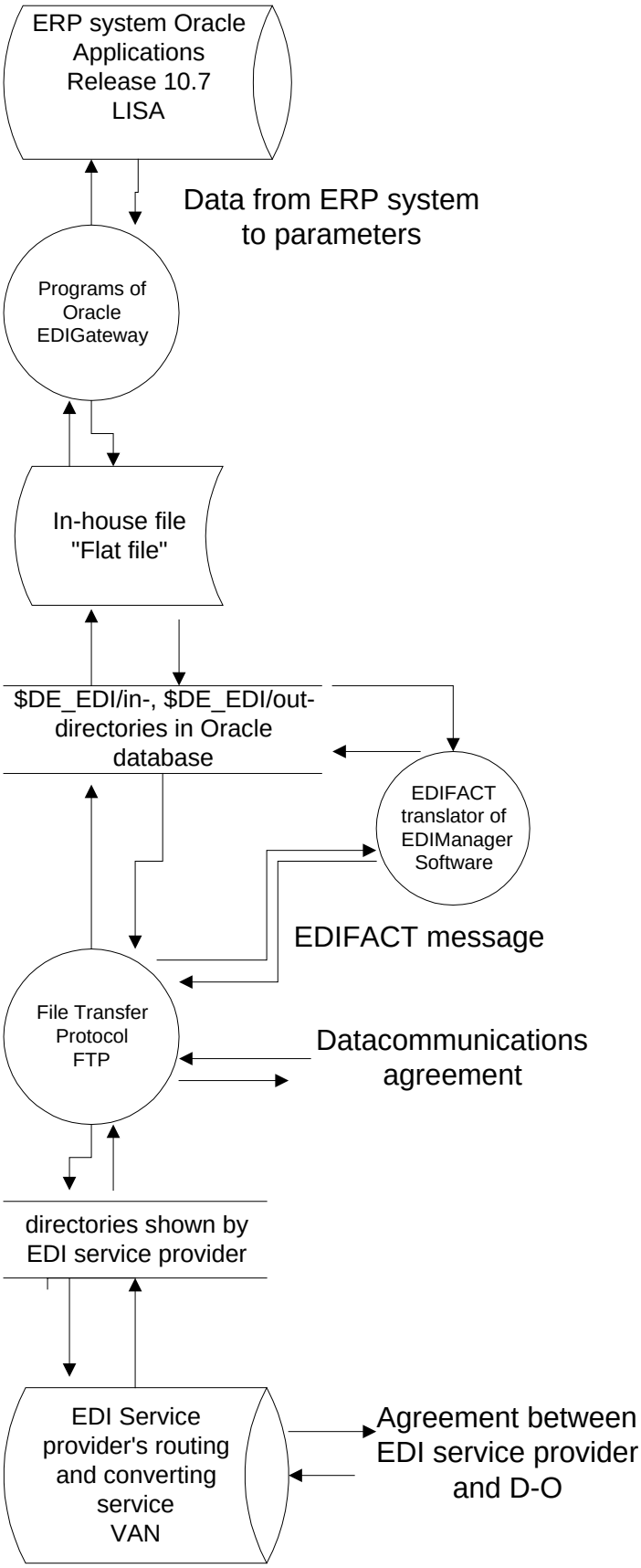


Picture 12. The EDI Data flow of the EDI Purchase Order Outbound as far as the purchase order data has left from Datex-Ohmeda

11.3 Continuation of the EDI project

This far in this EDI project time has been spent running the EDI Purchase Order Outbound program to create data to a flat file to the $DE_EDI/out-directory, which has been in the test database. The EDI Purchase Order Outbound program has not yet succeeded to create data to a flat file because of the problems in the Oracle software. Problems may also occur in the future, when date formats or units of measure formats of the Oracle Applications will be tried to integrate to the date formats or the units of measure format of EDI. People must remember that D-O is the first company in Finland starting the usage of the EDI Purchase Order Outbound program of the Oracle Applications EDI Gateway Module. So there is a lot of work to do to achieve the scenario, in which the EDI Purchase Order Outbound program is used right after MRP has been run or the situation, in which this program is used even background of the MRP-run.

In the continuation one question is the fact, if it is sensible to make the conversions from an in house file format to the EDIFACT format using own work during the present situation of the resources or should this service be bought from outside of the company. The answer is quite near the latter, although Datex-Ohmeda has license to the EDI Manager used in the former EDI system. Another question is the fact should D-O itself or the EDI service provider Sonera EDI Center poll the EDI directories. If the selection is the latter, the EDI service provider is the active part of the FTP transfers and controls if there is new data in the D-O EDI directories to transfer to the directories shown by Sonera EDI Center or on the contrary. The EDI service provider can also at the same time control if the service is up or down. So the EDI service provider’s way of mapping of an in house file must be defined. Also the needs for the CONTRL- or the Application error and acknowledgement APERAK-messages must be found out. The picture 13 describes the EDI traffic and the EDI data flows in general level referred to previous.



Picture 13 The EDI traffic of Datex-Ohmeda for outbound and inbound transactions

The first EDI message of D-O will be ORDERS to the supplier. The first EDI trading partner of D-O will be Avnet Nortec Corp, which is the large volume supplier of D-O. After that EDI operations will widen so that at one time one new EDI supplier or one new EDI message will be introduced. The version of the EDIFACT directory used by a new EDI supplier must be notified. The largest benefits of EDI for D-O is quite clearly achieved, when the ORDERS message connected EDI traffic has been made to operate enough well.

The problems will also occur with other EDI messages, which D-O purchasing wants. The Oracle EDI Gateway does not provide a program for the ORDRSP message. On the other hand there is not a willingness to make large modifications or customizations to the ERP system or to the Oracle EDI Gateway using own resources to make the ORDRSP message to operate. There are more intentions to expect better properties for the ORDRSP message in the future releases of the Oracle Applications. At the moment it is also difficult to see that it is possible to replace the usage of the ORDERS message with the usage of DELFOR message or the usage of the DELJIT message. That would require the large resources to change the types of actions of the D-O purchasing.

In the future D-O will also receive the EDI information from the suppliers and the EDI based operations will be also accrued to the customer service and the sales. The connections to two directions in the picture 13 show that.

12. CONCLUSIONS

There have also been questions if the new initiatives based on internet or extranet could replace an EDI solution. Considering this question people must remember that these initiatives are their early stages, only some pilots have been launched. There is only a little experience of them. It is uncertain how advanced properties they yet practically include and what are the possibilities to integrate them to the existing ERP systems. The mentioned initiatives are not very useful if the same data must first key up to the ERP system and then for example to the WWW based form.

On the other hand these initiatives include also the types of actions of EDI that was noticed earlier in this thesis. There is quite a realistic vision that in the future the EDI based solutions and the internet or extranet based solutions will be more integrated each other. For example the WWW based forms will be integrated more to EDIFACT based format. There is still much work before the extranets between different companies or even the internet service providers can offer some EDI services like helpdesk as effectively as the value added networks VAN s of the EDI service providers. However, the costs of the data interchange using internet or extranet are much lower. On the other hand people can notice that most of the mentioned service providers provide both the EDI solutions and the internet based or the electronic commerce based solutions. So it is possible to continue the utilizing the service concept of the same service provider for further development from the EDI based solutions towards the advanced solutions based on the types of actions of the electronic commerce.

The best possibility to use these solutions based on internet or extranet can be the case in which it is not sensible to invest to quite an expensive EDI solution because of a small enterprise partner or because of a small volume of the EDI traffic. In the future the opening of the extranet also to the selected organizations for the trading actions should be consider more. The opening of the extranet can be implemented for example for each single small organization at one time or small organizations can form a network and the large partner of these small organizations operates with them using this network and its own extranet.

Benefits of EDI were difficult to be measured in figures. Logistical benefits are the better speed and correctness of the logistical operations and the more accurate logistical planning. The logistical benefits and influences of EDI and the conclusions connected with the existing needs of EDI in logistics have been discussed more exactly earlier in this thesis, especially in the chapter 10. A large amount of money or items must be handled with an EDI trading partner often enough. It is difficult to say which amount of EDI partners is enough, because that depends from the case enterprise, but the estimations that it is useful to have many EDI messages in use with the same EDI partner because of the partnership benefits, are quite near the truth.

In this thesis the good sides of the EDI based solutions are treated much. People must remember also the bad sides of EDI. Every EDI project has quite many problems. In the phase of taking EDI into use, the main problems are usually the problems connected with information technology of the applications. It is not easy to avoid the thought that the providers of the ERP systems should give more their own resources to provide the better products and software for the interfaces between the ERP application and the EDI application. On the other hand the ERP systems at all should support better the make-to-order model or the assemble-to-order model. The properties of the provided ERP systems are also limitations to the functions, which are wanted from EDI or ERP, if there are not a willingness or resources to make the wanted modifications and customizations using the own resources of the company.

However, the experiences gained from the EDI project, the results of the surveys of this thesis and also the information about the new technologies and the initiatives found from internet can be utilized as a basis for further development. One example for utilization can be the preparation for the introduction of the new release of the current ERP system, which include the elements of the WWW based network computing architecture NCA. There still is much work to be done and further efforts have to be made to create a comprehensive, fully functional system.

REFERENCES

Benesko, Gary. Electronic Commerce in the 21st Century. Research Triangle Consultants Inc., November, 1994.

Bowersox, Donald & Closs, David. Logistical Management: Integrated Supply Chain Process. USA, McGraw-Hill, 1996 730 p. ISBN 0-07-006883-6.

Bryan, Martin. Guidelines for using XML for Electronic Data Interchange. [WWW-document] The SGML Center Updated January 25, 1998 Available: http://www.geocities.com/WallStreet/Floor/5815/guide.htm

Bryan, Martin. An Introduction to the Extensible Markup Language (XML), [WWW-document] The SGML Center Last modified October 13, 1998 Available: http://www.asis.org/Bulletin/Oct-98/bryanart.html

Chiu, Huan Neng. The integrated logistics management system: a framework and case study. International Journal of Physical Distribution & Logistics Management, 1995. Vol. 25, No. 6, pp. 4-22

Christopher, Martin. Logistics and Supply Chain Management: Strategies for Reducing Costs and Improving Services. London, Pitman Publishing, 1992. 231 p. ISBN 0-273-03415-4.

The Collaborative Planning, Forecasting and Replenishment Committee. Wal-Mart /Sara Lee/ Lucent Pilot Overview. [WWW-document] Last modified July 25, 1997. Available: http://www.cpfr.org/pilot.html

Darling, Charles B. & Semich, J. William. Wal-Mart's IT secret: Extreme integration. [WWW-document] Datamation, Nov. 1996. Available: http://www.datamation.com/PlugIn/issues/ 1996/nov/11cover.html

Fogarty Donald W, Blackstone John H, Hoffmann Thomas R Production and Inventory Management 2nd ed., 1991 870 p. ISBN 0-538-07461-2

Gattorna John L. & Walters David W. Managing the Supply Chain A Strategic Perspective MacMillan Press Ltd., 1996 360 p. ISBN 0-333-64817-X

Gill, Philip. IT helps integrate the food chain. [WWW-document] Computer Week, Nov. 19, 1996 Available: http://www.zdnet.com.au/compweek/issues/ 1996/11/22/food.html

Haapanen, Mikko, Valta Erkki. Logistiikka, Espoo, Ekondata 1990. 206 p. ISBN 952-90-2264-6

Houser, Walt. EDI Meets the Internet The Role of Value Added Networks [WWW-document] Last modified May 9, 1997 Available: http://www.va.gov/publ/standard/edifaq/vans.htm

Instrumentarium Corporation. Annual Report 1998 Helsinki 1999 76 p.

Isotalo, Heikki. Master's Thesis: Development of the Operative Information System to support the Core Logistics Processes of Datex-Engstrom. Helsinki University of Technology Department of Industrial Management 1997 72 p.

King, Julia. Sharing IS secrets. Computer World, Vol. 30, No. 39 Sept. 23, 1996.

Lisa Support. About LISA. What is LISA? [WWW-document] Referred October 15, 1999. Available:http://w3.fi.datex-ohmeda.com/lisasupp/lisa.shtml

Manufacturing Systems Europe. IT Glossary Information Technology in Manufacturing. [WWW-document] Last modified March 26, 1999. Available: http://www.manufacturing-europe.com/Glossary/Glossary.htm

Maula, Marjatta. Kansainvälistyminen ja tietotekniikka. Jyväskylä 1991 SITRA 115. 154 p. ISBN 951-563-279-X

Maximizing value in supply chain, Chief Executive Magazine October 1996

McAteer, James F. Internet-Based EDI: Boosting Business-to-Business Electronic Commerce. SRI Consulting, Business Intelligence Program. D96-2024 USA, Sept. 1996. 12 p.

McHale, Mary. EDI & JIT manufacturing. [WWW-document] Electronic Commerce & Irish Organizations Group Last modified February 7, 1996. Available: http://www.cs.tcd.ie/courses/ism/sism/resource/discuss/ecirl95b/msg00028.html

Mäkelin, Matti. Asiakas – ja palvelukeskeinen tietotekniikka: teoriaa ja esimerkkejä. Helsinki 1987 SITRA A82 186 p. ISBN 951-563-201-3

Niilo-Rämä, Rami. Master's Thesis: Improving visibility in the supply chain with electronic commerce solutions Lappeenranta University of Technology Department of Industrial Engineering and Management 1998. 58 p.

The OBI Consortium About OBI Background [WWW-document] Last revised April 28, 1999. Available: http://www.openbuy.org/obi/about/OBIbackgrounder.htm

The OBI Consortium OBI White Paper A comprehensive overview of Open Buying on the Internet (OBI). [WWW-document] Last revised April 28, 1999 Available: http://www.openbuy.org/obi/library/white-paper.html

Open Trading Protocol Consortium. Internet Open Trading Protocol Business Description [WWW-document] January12, 1998. Available: http://www.otp.org/otp/Home.nsf/f86055a20977be50862564b3004d010a/42b496239c5956aa8625655a007b1835/$FILE/Bus+Desc+v+0-9+A4+pdf.pdf

Oracle Corp. Oracle EDI Gateway User's Guide Release 11 March 1998 240 p.

Prescient Systems. How QR works. [WWW-document] Last modified March 19, 1999. Available: http://www.prescientsystems.com/howqr.html

Prescient Systems. Supply Chain Management: Preparation for A Successful CRP [WWW-document] Last modified July 1, 1998 Available: http://www.prescientsystems.com/library/SCMART1.html

Quarmby, Chris. Self Service Web Applications - The Business Benefits [CD-ROM] Oracle Corp UK Ltd., 1999 Available: Oracle Applications User Group Europe Conference Proceedings 17-20 March, 1999 Barcelona, Spain.

SETELI. Sähkö- ja elektroniikkateollisuuden liitto. SET-EDI Teollisuusyritysten välinen tiedonsiirtojärjestelmä. [WWW-document] Last modified November 5, 1998 Available: http://www.setedi.elma.net/

TIEKE. Tietotekniikan kehittämiskeskus ry. OVT-kansio. 1998

U.S. Department of the Treasury Financial Market Service Electronic Data Interchange Implementation Guidebook [WWW-document] Updated September 22, 1998 Available: http://www.fms.treas.gov/edi/ediguide.html

Verity, John. Clearing the cobwebs from the stockroom, New Internet software may make forecasting a snap. [WWW-document] Businessweek, Oct. 21,1996. No.43. Available: http://www.businessweek.com/1996/43/ b3498166.htm

Whatis.com Bar Code. [WWW-document] Last modified on May 18, 1999. Available: http://www.whatis.com/barcode.htm

Whatis.com Extranet. [WWW-document] Last updated October 13, 1998.Available: http://www.whatis.com/extranet.htm

Whatis.com The Internet. [WWW-document] Last modified October 14, 1998. Available: http://www.whatis.com/internet.htm

Whatis.com Intranet. [WWW-document] Last modified October 8, 1998. Available: http://www.whatis.com/intranet.htm

Whatis.com Virtual Private Network (VPN) [WWW-document] Last modified May 12, 1999. Available: http://www.whatis.com/vpn.htm

Discussions at Datex-Ohmeda:

Bonsdorff von Claes, D-O Global IM Director 21.6.1999

Cajanus Anja, Manager of Supply Management several times

Happonen Veikko, Group Leader Mechanical Components Group 28.5.1999

Isotalo Heikki, Systems Manager several times

Lampinen Janne, Logistics Manager 4.6.1999

Pajunen Heli, Customer Service Manager 3.6.1999

Pekkarinen Reijo, Purchasing and Material Handling Manager several times

Rydström Mikael, D-O Global Infrastructure Manager several times

Salo Arne, Logistics Director D-O Nordic15.6.1999

Vornanen Jyrki, Productions Planning Manager 7.6.1999

Email discussions:

Kyrel Corp: Luojumäki Jyrki, Material Manager, 6.7.1999

Nokian Tyres: Tuutti Pasi, several times

Vaisala Corp: Vilpponen Mauri, 18.8.1999

Meetings:

Arrow-Finland Corp: Marttila Eero Sales Director 9.8.1999

Avnet Nortec Corp: Salminen Hely Business Development Analyst 22.7.1999

Elma Corp: Kuivalainen Jyri, Marketing Director 31.8.1999

The Finnish Post: Widell Ritva, Project Manager 24.6.1999

Sonera Corp: Helin Liisa Project Manager, Pellinen Timo Sales Manager 1.9.1999

Appendix I

Questions to the suppliers of Datex-Ohmeda

What are the main principles of your EDI-solution? How many trading partners do you operate using EDI?

How widely EDI is in use in your company for example in purchasing and in sales? Which messages are used? How much do you operate with your trading partners without EDI?

How much own and how much company outside resources do you need for EDI?

Which are the biggest benefits achieved by EDI operations compared to the situation in which no EDI system is in use?

How much EDI has been like expected? In which EDI has not been like expected?

What must the company starting its EDI operations take into consideration at he beginning?

How much EDI has made easier the work of the users of EDI from their own perspective?

How easy to use EDI has been? How much EDI has reduced mistakes, increased speed, released the resources of the purchasers to the other work? How well have worked orders, order responses, forecasts, order changes and invoices and tenders?

What is the most difficult connected with EDI?

How much time was spent from the first sending of the test data before the EDI usage became more stabilized and the first expected benefits were achieved?

How easy can you broaden your EDI system, if you need for example more EDI messages?

Which benefits you get from your trading partners using EDI?

What is the priority of EDI as a tool of logistics compared to the other tools of the logistical development?

What is the future of EDI when the use of the internet has widely increased?