

**Electronic Commerce and Document
Interchange: EDI Applications in Denmark**

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Electronic Commerce and Document Interchange: EDI Applications in Denmark

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Abstract

This paper analyses trends in EDI messaging in Denmark. Between 1995 and 1999, there has been a sharp increase in the number of companies capable of sending and receiving EDI messages as well as an increase in the number of EDI messages transmitted. The major part of the increase is attributed to the health sector. Most of the companies analysed within this paper only apply browser-EDI in business-to-business trade to a limited extent. This analysis highlights the potential for expanding the EDI traffic by its integration with ERP systems within Danish companies (Oracle, SAP/R3, Concorde and Navision) and also indicates the large potential for EDI growth and application within the public sector. It is believed that this data highlights and represents significant trends in EDI applications solutions within the Danish marketplace both now and in the future.

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1. Introduction

This study commenced in January 1998 and focussed on electronic commerce (business-to-business) in the Danish private and public sector. In this study electronic commerce comprises business-to-business e-commerce communication: between businesses, including internal communication between groups of companies (business-to-business); with public authorities (business-to-administration) but *not*: with consumers (business-to-consumers).

The purpose of the study was to test the scope of EDI applications, the changes in applications over the period 1995-1999 and to suggest a potential development of EDI applications for the period 1999-2001. In 1996, most attention was focused on application of the EDIFACT framework standard in business-to-business commerce. EDIFACT provided an approach for solving a number of problems in connection with sending and receiving orders and invoices or the logistics of just-in-time deliveries. Among the challenges in 1996 were issues such as preparing business specific manuals in application of EDIFACT, solving discrepancies in relation to the American ANSI-standard and adjusting privately arranged data exchange formats. Manuals in application of the EDIFACT standard were prepared through EANCOM/HANCOM (EAN Denmark). In addition, EAN Denmark also assigned location numbers for identification of a company (or parts of it) in connection with EDI transactions as it was seen to be crucial that both the product code and order were accurate when ordering goods.

Since 1996 the Internet and TCP/IP has become so disseminated as the common communication infrastructure, that a range of new companies and public authorities had decided to apply entry forms, etc to enable data entry over the Internet. Meanwhile, money transfers have been done via proprietary formats such as SWIFT (employed by the banking industry). Other central technology applications in this period comprised data-warehousing and data-mining in addition to developments in financial and production control systems, all of which were important to EDI development. Within the Danish public sector, it is especially common to file data from companies into a data-warehouse and the application of Basis Procurement is also significant in terms of EDI applications. Within the private sector, integration software modules to management accounting systems such as Oracle, Concorde, Navision and SAP/R3 enable full integration with EDIFACT. There is a range of

different interests related to EDI applications, within the Danish marketplace, in connection with type of transport, integration and standards of message.

This paper measures and analyses the scope and dissemination of EDI applications from 1995-99 by means of five indicators:

1. number of assigned **EAN location numbers**;
2. **VANS-based traffic**;
3. evaluation of **trade and industry associations**;
4. large, **private companies' application of EDI**, and
5. the **public sector's application of EDI**.

The number of assigned **EAN location numbers** reflect the number of companies that are able to send/receive electronic data in EDIFACT-format. These numbers do not indicate how many companies actually apply EDIFACT; but it is assumed that an increase in the assignment of EAN location numbers reflect an increase in the use of EDI. The **VANS-based traffic** shows the scope of transmissions and bytes that are sent via VANS operators. These figures indicate increases/decreases in electronic data traffic on these VANS and, therefore, are a good indicator of increases in EDI activity. The last three indicators have been derived from the qualitative data collected from these organisations.

For the purpose of this study, EDI traffic has been categorised into two areas:

- **the transport form** e.g. TCP/IP or X.25, and
- **the message format**, e.g. EDIFACT-based or own (proprietary) formats.

Internet traffic is TCP/IP-based, whereas VANS uses X.25 as the most prominent communication infrastructure. In this study VANS traffic is used as an indicator out of several transport forms. The message has also been categorised according to EDIFACT or proprietary formats.

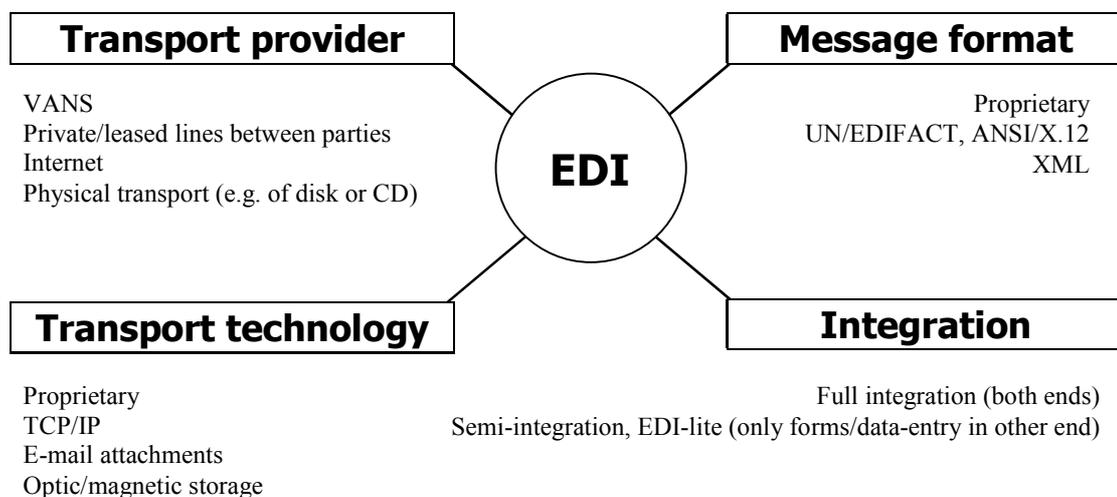
To determine the degree of integration of EDI into the existing IT-systems of the organisation, data interchange and data processing have been examined from both ends of the communication, i.e. from each end of the EDI-pipe. The analysis also describes the depth of EDI integration with a view to automation. Where EDI has not yet been fully integrated in both ends of communications, we normally find systems in the initiating company that are integrated with the company's own systems via either proprietary (P) or EDIFACT (E) standards. Within the co-operating company (in the other end of the EDI-pipe) we find de-coupled local systems, normally

applying *form-based* EDI, where the co-operating organisation uses, for example, a Web-browser to complete/update a form and return it electronically to the initiating company's systems.

When a company stores data for the organisations it co-operates with, for example by means of databases, it is to the advantage of the co-operating organisations as they don't have to re-enter formerly entered (and stored) data. This solution can also be established on an industry-wide basis. Companies without their own EDI modules can establish a common database between a group of member companies that need to exchange documents horizontally or vertically with large companies with fully integrated EDI. A complete classification of EDI applications should include a large number of categories each with different sets of values as shown on Figure 1. These categories have been aggregated into three main groups:

- **proprietary standards** that include all EDI applications where the messages are never based on EDIFACT, except browser EDI,
- **EDIFACT-based standards** that include all EDI applications where the message on its way is based on EDIFACT, including *form-based EDI* that is converted to EDIFACT “on the reverse side”, and
- **browser-EDI** that describes the *form-based EDI* which is never EDIFACT-based.

Figure 1 EDI Typology



2. Vendor Mediated Traffic

The number of assigned location numbers has increased heavily in the period 1990-99. Between 1995 and 1997 there was an increase of 60% in the number of companies that could send and receive EDIFACT-messages (see Table 1). The increase in the number of EAN-numbers was similar during 1997 and 1999. An analysis of the number of users of the EDIFACT-standard in Denmark showed an increase in the number of small companies amongst the new users of EDIFACT. The same pattern was found in 1998. EAN Denmark estimates that at the present time there are about 50,000 companies in Denmark that are able to use EDIFACT. The amounts of assigned EAN-numbers have increased significantly from 1990 to 1999. During 1996 and 1997 there was a remarkable increase in the assignment of EAN-numbers to smaller enterprises. From 1995 to 1996 there was a 26% increase in the EAN-numbers, and from 1996 to 1997 there was a 31% increase. The increase in the assigned EAN-numbers was at the same level in 1998 as in 1997. In 1998 there are twice as many EAN-numbers in use as in 1995. The growth has continued in 1999. Yet, it is not possible to directly equate the number of EAN-numbers with the number of users of EDI because the EDI-traffic can be transported by other means than VANS.

Table 1 EAN-numbers for enterprises for the period 1990-1999

Year	N	Index (1990=100)	Index (1995=100)
1990	16	100	3
1991	63	394	14
1992	154	963	33
1993	262	1638	57
1994	371	2319	80
1995	461	2881	100
1996	580	3625	126
1997	760	4750	165
1998	937	5856	203
1999	1184	7400	257

From 1995 to 1997 the use of EDIFACT increased about 45% per year in regard to the number of messages and about 33% per year with respect to the size of the messages (see Table 2). Between 1997 and 1998 there was also an increase of 34% in the number of messages sent, however, 45% more bytes were sent. The major portion of the EDIFACT-traffic was handled by VANS-operators. EDIFACT-traffic was of moderate volume either through direct connection or through the Internet. It is our estimate that more than 85% of the total EDIFACT-traffic is handled by VANS-operators. The increase in the EDIFACT-traffic is significant with growth rates above 30%. This is a very high rate compared to the known diffusion of other technologies. Figure 2 illustrates the development of VANS traffic month by month based on January 1995 equal index 100. At the turn of the century, EDI by means of EDIFACT/VANS has matured in Danish business life.

Table 2 Summary of the use of EDIFACT based on number of bytes and messages for the period 1995 – 1999*).

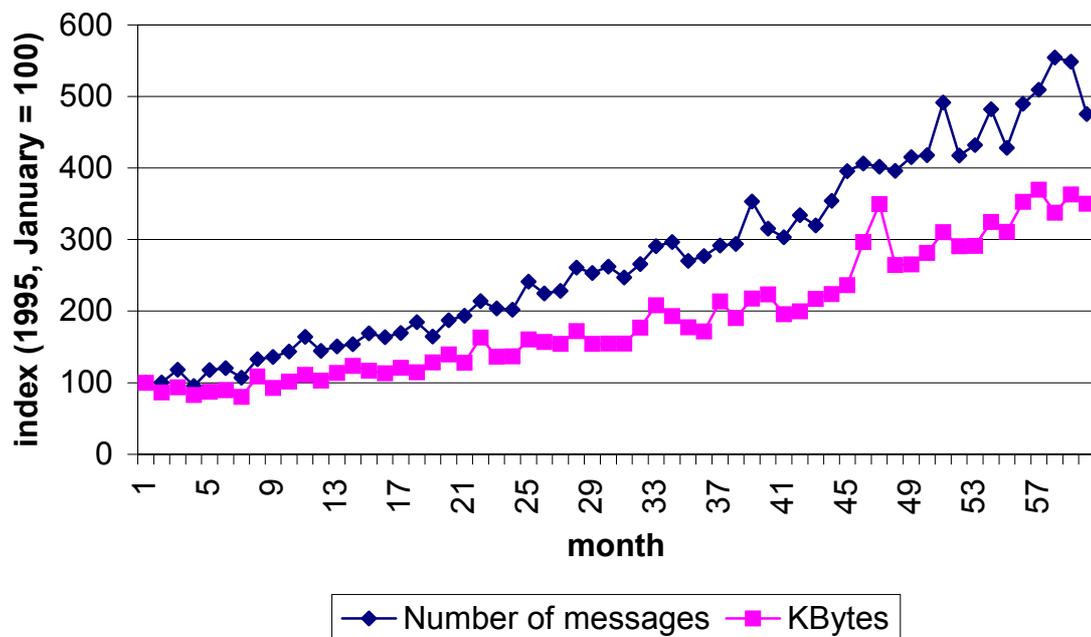
Year	KBytes		Messages	
	Number of messages	Yearly increase (%)	Number of messages	Yearly increase (%)
1995	32.595.785		12.629.296	
1996	43.980.498	35%	18.408.015	46%
1997	58.325.636	33%	26.605.714	45%
1998	81.058.956	39%	35.537.146	34%
1999	110.254.656	43%	48.334.484	36%

*) Figures redone based on change in instrumentation of measurements

The health care sector in particular, is the single greatest user of EDIFACT. Indeed, the health care sector has also seen a significant increase in EDIFACT VANS-traffic. With respect to total the number of messages during 1998; MedCom traffic accounted for about 39% of the total VANS-traffic. During 1997 MedCom traffic was approximately 25% of the total VANS-traffic. Although, the health sector accounts for the marked increase in EDIFACT traffic over VANS, a number of other areas also increased their EDIFACT applications, primarily within distribution and banking/finance. EDIFACT users within industry, distribution and wholesale have increased. It is the large companies that provide the motivating force within these groups. EDIFACT applications are relatively low in terms of VANS traffic within

retailing, finance and the public sector (except the health sector). Finally, the agricultural sector has substantial EDIFACT applications via VANS, as does the shipping sector in the area of large, global oriented shipping companies.

Figure 2 VANS traffic monthly development since 1995 (month by month)



3. Evaluation of Industry Associations

Trade and industry associations/organisations were also interviewed. Interview data has been evaluated in terms of the scope of electronic commerce and classified according to transport medium of **proprietary, EDIFACT-based and browser-EDI standards** (see Section 1 of this paper for a detailed summary of each standard).

Order and invoice messages that are exchanged in EDIFACT-format comprise the largest volume of messages according to the industry associations. At present, small companies have great expectations of current development projects on EDI solutions by means of Internet technology (form-based EDI solutions). Several VANS operators are involved in this work. It is characteristic for companies with EDI implementations for their interchange to involve relatively few partners and a relatively small number of messages.

The banking sector has a long tradition of EDI applications, but less than 2 per cent of all EDI transactions are EDIFACT-based. They are especially used in transactions between banks and large customers, such as the interchange *between den Danske Bank and Dansk Supermarked*. EDIFACT-standards have been prepared for the very important financial transactions between banks and their customers.

The mortgage credit sector was facing one of their biggest commitments when they launched the mortgage credit network in 1999. Material is currently being collected on this implementation. This network is an EDIFACT-based Intranet solution that will combine all parties within the mortgage banking sector: the seven mortgage credit institutions, legal advisers and intermediary lenders. It will be up to the individual mortgage institutions and intermediary lenders to promote their own image in relation to customers via open Internet solutions.

Within the Danish Chamber of Commerce, which has 2,000 member companies, less than a handful of companies make transactions via VANS (less than 0.1 per cent). Companies that apply EDI are mainly found within the food industry and the pharmaceutical area for example, MedCom. Contrary to this, all large and medium-sized insurance companies participate in the EDI exchange of the two major EDIFACT documents in production within the insurance sector (80 per cent of all transactions). The remaining 20 per cent come from small insurance companies that until now have found an EDIFACT solution too expensive due to the price of EDIFACT converters. The insurance industry plans an entry-based solution which utilizes Internet technology, which can convert messages to/from EDIFACT format. Apart from the EDIFACT exchange, the insurance industry – like the banking sector – has applied EDI for many years, both internally in the industry and in exchange with other sectors, such as the banking community.

Less than 10 per cent of communication is made by means of proprietary standards, more than 50 per cent of communication takes place via EDIFACT, while there is less than 1 per cent application of browser-EDI internally in the industry. Over the next 2 – 3 years the industry expects EDIFACT- applications to increase by 10-20 per cent and browser-EDI application by 20-30 per cent.

Within the agricultural sector there is a substantial application of EDI in relation to veterinary authorities and consultative institutions due to the large efforts made by LEC. LEC is the major, Danish provider of IT-related services to the sector. At present, LEC is working on developing EDI applications within the export

restitution area. The Agricultural Council in Denmark has also indicated that the industry association cannot pressure their members to make them apply EDI.

Similarly, the Danish Ship Owners' Association and the Danish Provisions Suppliers' Association (DLF) point out that they do not play a very active role in promoting EDI due to large players such as Mærsk, the United Steamship Company, EAC, Dansk Supermarked and FDB. There is no need for special initiatives in this area. DLF is involved in the technical part of the EDI application due to their members' interests in EDI and their membership of EAN Denmark. DLF represents the producer link (approximately 150 members), and consequently the association is very involved with VANS operators. As an industry association for such companies as MD Foods, Carlsberg and Danisco, DLF plays a central role in relation to EDI applications in the supply chain and business relations. Problems are evident, however, primarily in the physical transport of goods. There is an obvious need for co-ordination within the logistics, distribution, marketing and sales areas.

Data communication between DLF's members and the provisions trade has grown substantially. Many products are transported daily and there is a large need for data. Producers, in co-operation with the provision trade, have promoted the EDI trade standards. DLF has appointed an EDI committee that is looking after members' interests in relation to the pace and direction of EDI applications.

Table 3 Dissemination of EDI in the financial sector

Business sector	EDI-use ^{a)}			Potential for EDI ^{b)}
	Proprietary EDI	EDIFACT	Browser-EDI	
Assurances and pensions	<10%	> 50% (10-20% growth) ^{c)}	< 1% (20-30% growth) ^{c)}	30-40%
Banks	70-80%	<2% (10-20% growth) ^{c)}	<0,1% (5-10% growth) ^{c)}	20-30%
Mortgage credit sector	70-80%	EDIFACT Intranet from 1999	< 1%	20-30%

Notes (applicable to Table 3 – 6):

- The EDI-use is distributed on proprietary-EDI, EDIFACT, Browser-EDI and potential for EDI. The sum of the row equals 100%. Thus in the assurance and pension industry, our respondents estimated that less than 10% of the documents are handled through proprietary EDI-solution, more than 50% of the documents are exchanges using EDIFACT-solutions and there is a potential for expanding the EDI-use in this sector with more than 30%. Browser-based EDI-exchange covers in 1998 less than 0,1% of the total number of document exchanged.
- Denotes the potential for EDI relative to the total number of documents handled
- The growth rate in the parenthesis equals the expectation to the increase in EDI for the period 1998-2000. Thus, for the insurance and pensions, the informants expect that there will be an increase in the EDIFACT-based exchange of documents (10-20%) and a more rapid growth in the browser-based EDI with 20-30% annually.

Table 4 Dissemination of EDI in production and commerce

Business sector	EDI-use ^{a)}			Potential for EDI ^{b)}
	Proprietary EDI	EDIFACT	Browser-EDI	
Manufacturing	Standards are converted	15% (15% growth) ^{c)}	< 1%	80-85%
Wholesale	n.a.	< 5% (10-50% growth) ^{c)}	< 1%	>95%
Handcraft and small industries	n.a.	< 5% (10-50% growth) ^{c)}	< 1%	>95%
Construction and dwelling	n.a.	< 5% (10-50% growth) ^{c)}	< 1%	>95%
Retail distribution	n.a.	20-30% (20-40% growth) ^{c)}	< 1%	70-80%
Agriculture	30%	30% (10-20% growth) ^{c)}	<10%	30-40%

Notes: a) - c) See Table 3. n.a. = not applicable

Table 5 Dissemination of EDI in the transport sector

Business sector	EDI-use ^{a)}			Potential for EDI ^{b)}
	Proprietary EDI	EDIFACT	Browser-EDI	
Freight	>30%	>30%	>10% (20-30% growth) ^{c)}	30%
Mail	>20%	20-30% (>90% for foreign mail)	<10% (20-30% growth) ^{c)}	40%
Shipping	>30%	>30%	>15% (20-30% growth) ^{c)}	20-30%

Notes: a) - c) See Table 3.

Since 1995, the number of members who apply EDIFACT has increased by approximately 20 per cent. Approximately 75 per cent of the users apply invoice and order documents. There were 15 per cent more trading partners who applied EDI in 1997 than in 1995. Tables 3-5 indicates that over the next 2-3 years there is an expectation that EDIFACT applications will increase by 10-20 per cent and browser EDI will increase by 20-30 per cent.

4. EDI Applications in Private Companies

As part of this study, the amount of EDI-based traffic in private companies which does not go via VANS operators, has been estimated by interviewing seven private companies representing a cross section of non-vendor EDI traffic within the private sector.

In 1995, 31 per cent of Danish companies applied EDI. In 1997, the figure was 33 per cent and 36 per cent in 1999 according to reports from the Ministry of Research and Information Technology. In other words, the proportion of companies applying EDI (approximately 15,000) is largely unchanged although it has increased about 15 per cent. The communication with the banking sector has generally been higher, 61 per cent in 1999.

From 1997 to 1999, the number of companies applying EDI in connection with document interchange with the public sector doubled from 10 to 20 per cent, while their EDI communication with customers rose from 16 to 38 per cent. EDI application to interchange with suppliers and co-operative organisations only rose from 25 to 36 per cent. It is mostly invoicing (approximately 33 per cent) and placing of orders (approximately 23 per cent) that are carried out utilising EDI. The application of EDI is smaller within such activities as changing orders, delivery status, etc.

A crucial distinction has been made between the different links in the supply chain. In some small companies and in companies with a market consisting mostly of small businesses, (for example within the HVAC trade), Internet usage has spread quickly and is applied in both information retrieval and direct commerce. In some large companies the picture is the reverse, as they almost only apply EDIFACT or their own standards.

In 1998 there was nothing to support the argument that browser EDI was more important than EDIFACT and proprietary EDI in relation to purchase orders, invoicing, etc. to companies in general. In 1998, only 15 per cent of the companies used the Internet for electronic purchases. This figure more than doubled in 1999, where 87 per cent of all companies in Denmark had access to the Internet, and 39 per cent of these used the Internet to purchase goods/services and 36 per cent paid over the Internet. It is, however, still a minor part of the companies that are able to take orders (22 per cent) and accept payment (8 per cent) via the Internet. According to a

recent survey by the Ministry of Research and Information Technology, 95 per cent of all companies expect to be Internet-connected by year 2000. According to the expectations by the companies, almost all figures of utilisation of the Internet will double from 1999 to 2000. We expect these expectations to be optimistic though.

Over the years Internet usage by companies start by companies climbing up the usage ladder. First getting access, then using the Internet for information retrieval and e-mail communication, moving on to applying Internet for marketing, product information, services, financial information, knowledge division, etc. Towards the top, the companies are ordering and paying for goods and services, while further up they are also able to take orders and payment.

5. EDI Applications in the Public Sector

The public sector is to play a key role in disseminating the application of EDI. This has been actively encouraged by the Danish government through an initiative called the EDI Agenda. This study has collected data from public sector organizations to determine their role in the development and use of EDI applications. Interviews were carried out either on site or by telephone. Data from previous studies indicates that in 1997 approximately one third of governmental agencies applied EDI in their interchange of data with private companies, and that almost every second governmental agency applied EDI when exchanging data with other public agencies (see Table 6). The application of EDI is limited, however, and involves primarily pilot projects and a moderate number of messages.

Table 6 Dissemination of EDI in the public sector

Business sector	EDI-use ^{a)}			Potential for EDI ^{b)}
	Proprietary EDI	EDIFACT	Browser-EDI	
Central/national government	<10%	10-20%	10-20% (10-40% growth) ^{c)}	<50%
Counties and municipalities	<10%	<20%	<10% (10-40% growth) ^{c)}	<60%
The health sector	<10%	20-30%	<1% (5-10% growth) ^{c)}	50-60%

Notes: a) - c) See Table 3.

At present, three factors might change this picture. One factor is the Basis Procurement approach developed by Kommunedata, National Procurement Ltd. and the Agency for Financial Management and Administrative Affairs. The second factor is a commitment to a common reporting system from companies to the public sector where the initial participants are the Statistics Denmark, the Central Customs and Tax Administration and the Commerce and Companies Agency. The third factor involves an increased dissemination of MedCom, in regard to the number of messages and/or users.

MedCom is a project and an organisation that aims to introduce a given number of electronic messages in the Danish health sector. The purpose of MedCom I (1996) was to test the messages created by the project. The purpose of MedCom II (1997-2000) is to disseminate electronic messages. The current dissemination project numbers 37 million messages a year, out of which approximately 20 million are prescription messages. MedCom has been established on a county basis, which does not exclude communication between the counties. It only implies that the counties are in charge of the projects. The result has been a considerable variation in dissemination of MedCom standards between the counties.

For example, FynCom was a forerunner for MedCom. The Center for Health Informatics, which is responsible for FynCom, is also responsible for a central co-ordination of EDI development on Funen. In January 1998 alone, approximately 780,000 EDIFACT messages were sent within the health sector (prescriptions constitute 61 per cent, laboratory replies 19 per cent and discharge letters (comments) approximately 13 per cent). On a yearly basis this corresponds to a transmission of approximately 10 million messages.

Laboratory replies, prescriptions and discharge letters via EDIFACT constitute approximately 30-40 per cent of the possible number of messages of this particular type. Funen (FynCom), North Jutland, Århus and North Schleswig counties are at the forefront in EDIFACT applications. In connection with referrals, laboratory orders and accounts the EDIFACT application is smaller. The application of EDIFACT is relatively small in Ribe, Bornholm, Storstrøm, Frederiksborg and West Zealand counties, including the Copenhagen Hospital Co-operation, other than for prescriptions.

To join this project, general practitioners must obtain a location number from the National Board of Health. They then must acquire the technical equipment, and finally they must be registered at a VANS operator (Kommunedata and/or Dan Net). The price of the registration includes a subscription charge and license fee for the application of software (EDIMAN and EDICARE). In addition, they must pay for the documents they forward. At present, there are 120 out of 290 general practitioners in the City of Copenhagen who can send/receive EDIFACT.

There is clearly a potential for increasing the percentage of EDIFACT messages. In total, there have been approximately 37 million messages in the health sector, out of which prescriptions from general practitioners and specialists to pharmacies constitute approximately 20 million. In other words, from 1995 the number of messages has increased by approximately 30 per cent.

6. Conclusion - the State of Current and Future EDI Applications

There appears to be no clear status for the three types of EDI solutions. It is even more difficult to forecast future developments. Within a three-year period, however, it is estimated that EDI applications will increase by 30-50 per cent annually (measured in number of transactions).

The expectation is that applications of browser-EDI will increase from 10 per cent to 25 per cent (measured in share of the total electronic document interchange). The EDIFACT-based applications, however, are also expected to increase from 50 per cent to 55 per cent in the period 1998-2001, including an increase in the browser-EDIFACT area. Application of proprietary standards is expected to decline relatively. With an average annual increase in the total number of EDI messages between 30 and 50 per cent, it is predicted, as indicated, that there will be an increase in form-based EDI applications over the next three years.

Based on interviews within these public sector, private companies and industry associations it is estimated that the number of electronic transactions based on proprietary standards will have increased by 44-68 per cent by the end of year 2000. EDIFACT traffic will have increased by 121-151 per cent, while browser-EDI will

have increased by 55-84 per cent. It is anticipated that there will be a relatively large increase in browser-EDI in addition to an increase in EDIFACT-based messages.

Within this study “Browser-EDIFACT” under EDIFACT-based applications have been included, i.e. form-based EDI converted to EDIFACT on the reverse side. This part of the EDIFACT-based application is expected to increase in the same order as Browser-EDI. Within the integrated EDI applications it is expected that an increase in EDIFACT-based solutions and a stagnation of proprietary standards will take place. The relatively small increase in number of messages using proprietary standards, indicated by the figures, reflect partly an increased volume in existing solutions and partly a decline in the total number of proprietary solutions.

This development depends on whether large framework systems, such as SAP/R3, in the future, will contribute to proprietary integration between different companies with similar framework systems, or whether the framework systems will focus on integration with other systems (obviously EDIFACT-based).

If the objective is to realise full integration at a later stage, it is important whether form-based EDI is tied to open or closed standards on the reverse side. The figures also reflect a fear that companies or industries that expand their EDI application through form-based EDI by means of browser-EDI may at the same time exclude themselves from future integration with the more open EDIFACT world.

Although we have found a clear overall growth in EDIFACT and an increasing number of enterprises using EDIFACT, SMEs are still in the infant stage of developing these solutions. In 1997 the Confederation of Danish Industries and The Danish Chamber of Commerce agreed to implement a project on EDI specifically starting with the Danish steel and machine industry (Henriksen & Andersen, 1999). The purpose of this project is to implement trade documents based on EDIFACT-standards transported via the Internet. What is interesting with this project is that the end-to-end integration is not the primary target for the project. This could be interpreted as a step-back in the B2B e-commerce development.

However, it also reflects a major shift in the policy agenda to electronic commerce. In Denmark, a number of partners from government, business and labour organisations adopted a plan of action for electronic commerce in 1996. In 1996, EDI solutions were almost synonymous with transport of data via a company's own data links or by the use of VANS operators. The data format was normally proprietary on the company's own links and EDIFACT-based via VANS. Such solutions were

characterised by high supply security and data protection. Since then, Internet technology has advanced.

The Internet can now be used as a method of transport, open client/server solutions can be created by means of World Wide Web technology and e-mail standards can be utilised with document attachments. The application of all of these technologies can be on both the Internet and the closed networks between business partners. Today, these alternatives open new and mixed EDI solutions, which apply EDIFACT messages or existing proprietary message formats in different measures. The Internet technologies also allow EDI solutions where it is evident that only one of the partners in the data interchange benefits from the full integration between the data interchange and the company's own data processing. In such circumstances, the other partner will have little or no cost increases.

Whether Internet EDI is the answer to cost savings, communication with occasional business partners and to non-production applications is yet to be proved. Areas that encompass security, the trusted third party, reliability and the indirect cost issues are also yet to be fully explored.

7. A Final Note on XML

While most of this study took place, XML was not yet matured. Since then, XML as a common vehicle for EDI has become of paramount importance. This is not to say that XML solves all problems with EDIFACT and ANSI X.12 standardisation, in fact the same problems like getting a shared understanding of the semantics of the individual fields within the message remains the same. Still XML ease the work to cross the gap between different platforms, and the use of style sheets makes it possible to easily transform the data into ordinary browser-EDI described in this article and similar WAP-interfaces using WML.

8. References

- Andersen, K. V., Bjørn-Andersen, N., & Wareham, J.(1998). Using the Public Sector as a Locomotive for Electronic Commerce: The Case of Denmark. *Proceeding of the 11th International Conference on Electronic Commerce*, Bled, Slovenia
- Andersen, K. V., Bjørn-Andersen, N., Juul, N. C., Henriksen, H. Z., & Bunker, D. (2000). *Business-to-Business E-commerce: EDI in Transition*. DJOEF Publishers, Copenhagen, Denmark.

Danish Ministry of Research and Information Technology (1996). *Electronic Commerce in Denmark – a national EDI action plan*. (URL <http://www.fsk.dk/fsk/publ/elcom>). Copenhagen: Danish Ministry of Research and Information Technology.

Danish Ministry of Research and Information Technology (1996). *IT Usage in Danish Companies 1996 (in Danish: Danske virksomheders brug af IT 1996)* (URL <http://www.fsk.dk/fsk/publ/it-brug/>). Copenhagen: Danish Ministry of Research and Information Technology.

Danish Ministry of Research and Information Technology (1997). *IT Usage in Danish Companies 1997 (in Danish: Danske virksomheders brug af IT 1997)* (URL <http://www.fsk.dk/fsk/publ/1997/itvibrug/>). Copenhagen: Danish Ministry of Research and Information Technology.

Danish Ministry of Research and Information Technology (1999). *IT Usage in Danish Companies 1998 (in Danish: Danske virksomheders brug af IT 1998)* (URL <http://www.fsk.dk/fsk/publ/1999/danskit/>). Copenhagen: Danish Ministry of Research and Information Technology.

Danish Ministry of Research and Information Technology (2000). *IT Usage in Danish Companies 1999 (in Danish: Danske virksomheders brug af IT 1999)* (URL <http://www.fsk.dk/fsk/publ/2000/danskit/>). Copenhagen: Danish Ministry of Research and Information Technology.

Henriksen, H. Z. & Andersen, K. V.(1999). Internet-based EDIFACT-trade documents for Danish SMEs: An analysis of the pre-implementation phase. *Proceedings of the 12th International Bled Electronic Commerce Conference*. Bled, Slovenia.

Juul, N. C., Andersen , K. V., & Bjørn-Andersen, N.(1998). Electronic Commerce in Denmark: The Spread of EDI in Business-to-Business Transactions. *Proceedings of the third Usenix Workshop in Electronic Commerce*, Boston, USA.

Further information and statistics available at the EDI-project web-site on URL: <http://www.inf.cbs.dk/~ncjuul/edi/>