Electronic Commerce in Denmark: The Spread of EDI in Business-to-Business Transactions[1]

Niels Christian Juul, Kim Viborg Andersen, and Niels Bjørn-Andersen

Center for Electronic Commerce, Department of Informatics, Copenhagen Business School[2]

Abstract

The use of EDI in business transactions is considered a prerequisite in turning both private and public business towards electronic commerce in the next century. The national strategy in Denmark has been to promote the usage of EDIFACT-based EDI in both the public and private sector. In our study of EDI-usage in Denmark, we have found this strategy only partially fruitful, so far.

We are monitoring the state of EDI usage in Denmark based on VANS, direct proprietary connections, and TCP/IP-based networks to evaluate the governmental actions within the area of EDI. Our study suggests that the governmental initiatives have been successful within the areas vital to the public services and instruments, but lagging in supporting the private sector's need for EDI and lagging in the public sector's own management.

Although Internet based EDI is growing, the business-to-business traffic through VANS, primarily using EDIFACT, hasn't been hampered. Throughout the 1995-97 period VANS traffic shows an annual increase of 33% in number of bytes and 46% in number of messages.

1. Introduction

Electronic commerce in both the public and the private sector involves a broad area of administrative processes and documents. A conventional dilemma for the government is whether to intervene in the diffusion and character of EDI or whether to rely on market forces to determine the manifestation of electronic commerce. In most modern economies, this ideological twist is confronted with the reality of governments' large share of the gross domestic product, which, as a consequence, both directly and indirectly affects the economy through purchasing volume, fiscal authority, etc.

This paper is concerned with why and how the Danish government attempts to stimulate the diffusion of EDI (Ministry of Research and Information Technology, 1996), thereby facilitating electronic commerce at large. Our group has initiated a continued monitoring of EDI-usage in Denmark. The initial results from this monitoring describe the developing usage of EDI from 1995 to 1998 within and between both the private and the public sector (Andersen and others, 1998b).

It has been suggested that there has been an uptake of Internet based business-to-business traffic for the period 1995-1997 and that the VANS operator has been a victim and unaware of this development. EDIFACT should be in the defensive and decreasing. It has also been questioned whether the public sector has been a proactive player in the diffusion of EDI. Finally, small and medium-sized enterprises should be the victims of the EDI use. We have, however, not been able to verify any of these hypothesis.

To distinguish between standards for EDI messages, the means and ownership of transport channels, the technology used in transport channels, and the integration of EDI within the IT systems of the businesses involved, a typology for EDI is presented in Section 2. The governmental instruments are briefly discussed in Section 3, whereas Section 4 presents the Danish background and the national EDI strategy. We evaluate this strategy in Section 8 based upon the survey data presented in Section 5 and examples of EDI implementation in Sections 6 and 7.

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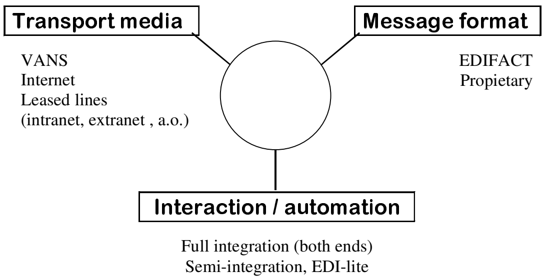
[1] This study was funded by the Danish EDI Council and the Danish National Center for IT Research.

[2] Authors address: Copenhagen Business School, Howitzvej 60, DK-2000 Frederiksberg, Denmark.
URL: `http://www.inf.cbs.dk` and `http://www.cbs.dk/cec`
Phone: +45 3815-2400 Fax: +45 3815-2401.
E-mail: `[ ncjuul | andersen | nba ]@cbs.dk`

Figure 1. EDI Typology



2. EDI, EDIFACT, and the Internet

In 1996, most of the attention was focused on application of the EDIFACT framework standard in business-to-business commerce. It opened up the possibility of solving a number of the problems that may occur in connection with sending and receiving orders and invoices and the logistics of just-in-time deliveries. UN/EDIFACT is a UN accepted global standard that makes it possible to reduce transaction costs and ensure a quick/safe delivery of data. Among the challenges in 1996 were preparing business specific manuals in application of EDIFACT, solving discrepancies in relation to the American ANSI-standard and adjusting privately agreed formats.

Manuals in the application of the EDIFACT-standard have been prepared through EANCOM (EAN Denmark). In addition to the manuals EAN Denmark also assigns location numbers to identification of a company (or parts of it) in connection with EDI transactions. If you order goods it is of course important that both the product code and order are accurate.

Since 1996 the TCP/IP technology has become so disseminated that a range of new companies and public authorities have decided to apply data entry forms, etc. to transfer orders of goods over the Internet. Transfer of data in the electronic form can also be done via proprietary formats, such as the SWIFT system used among banks.

Other central technology applications in this period comprise datawarehousing and datamining[3] in addition to developments in financial and production control systems, all of which have been important to the EDI development. Within the public sector it is especially the common filing of data from companies into a "datawarehouse" and the application of Basis Procurement that are significant in terms of EDI application. Within the private sector it is the integration modules to management accounting systems, like Concorde, Navision and SAP/R3, that enable full integration with EDIFACT. Thus, there is a range of different interests in terms of EDI application connected to the type of transport, integration and standards for the message itself, as illustrated by Figure 1.

2.1 Media and Formats

One key to the understanding of EDI implementation is to distinguish between two levels of EDI traffic:

- **The transport form**: E.g. disc, CD-ROM or tape via physical postal service, VANS operators, Internet, own network based on closed (proprietary) standards, or own (closed) network based on open standards, e.g. TCP/IP.
- **The message format**: EDIFACT-based or own (proprietary) formats.

2.2 EDI Integration in Business Systems

On this basis and in accordance with Figure 1 we have also looked at the degree of integration between data interchange and data processing in both ends of the communication. The analysis also describes the depth of the EDI application with a view to automation. Where EDI has not yet been fully integrated in both ends, we normally find systems that:

- in the initiating company's end are integrated with the company's own systems via either *proprietary standards* (P) or *EDIFACT* (E), and
- in the ends of the cooperating companies are decoupled the local systems, normally by applying *form-based EDI*, where the cooperators e.g. use a Web-browser to complete/update a form and return it electronically to the company's systems.

To the extent that a company stores data for its cooperators, e.g. by means of databases, the solu-

[3] Datawarehousing applies common storing of data, which can be retrieved by means of datamining. Oracle, e.g. provides such solutions.

tion is to the advantage of the cooperators who e.g. are saved from reentering former entered (and stored) data. The solution can also be established on the basis of business. Companies without their own EDI modules which need to exchange documents horizontally or vertically with large companies that integrate EDI fully can establish a common database between a group of member companies.

2.3 EDI Types

A complete classification of the EDI application today will include a large number of categories, which we have gathered into three main categories:

1. **Proprietary standards** that include all EDI application where the messages are never based on EDIFACT, except category 3.
2. **EDIFACT-based standards** that include all EDI application where the message on its way is based on EDIFACT, including form-based EDI that is converted to EDIFACT "on the reverse side".
3. **Browser-EDI** that describes the form-based EDI which is not EDIFACT-based.

As our survey has been keen on EDIFACT, the obvious fourth category, Browser-EDIFACT, has been included in the second category when reporting numbers.

3. Governmental Actions

To comprehend the structural features, the initiatives at the local level of government, and the organizational initiatives, we propose to distinguish between actions by the government that are either direct or indirect in scope. *Direct actions* are targeting EDI usage by subsidizing the direct investment for ongoing EDI use, for example, by defining protocols for EDI use by customs and port authorities. *Indirect actions* capture initiatives which aim at increasing EDI "awareness" or acceptance, accomplished through public procurement as well as participation in EDI councils, international committees and special interest groups(Andersen, 1997).

We view both direct and indirect actions as having four modes (Damsgaard and Lyytinen, 1997; Andersen and others, 1998c). Whereas, the first three modes encompass the traditional government actions, organizational management is equally important:

1. pedagogical,
2. economic,
3. normative initiatives for the use of EDI in general, and
4. organizational management for the public sectors' own organizations

In many countries such as Denmark, the public sector may be a more avid user of EDI than the private sector. Consequently, government actions may affect both the demand-pull as well as the supply-push for EDI in the private sector. Accordingly, when we address the question "how does government intervention affect the EDI-diffusion process", both the public sector's diffusion and the private sector's adaptation are of equal interest(Southern, 1997; Graham and Lobet-Maris, 1994).

A plethora of instruments reflects how complicated it is to stimulate the diffusion of EDI and to estimate how government intervention affects the process. For example, the TradeNet in Singapore did not achieve success status merely by bottom-line analysis and top-down steering. On the contrast, this example showed the need to *stimulate and evaluate EDI diffusion in its organizational context*, public or private regardless. Also, *local government* and *quasi-governmental organizations* might be just as successful, or even more so, in initiating low-cost EDI solutions compared with central government.

We believe this is a very important observation given that governments have multiple forms, as well as the fact that the distinction between private and public is no longer as clear as it was decades ago. Such political and commercial changes in the environment pose challenges for the successful diffusion of EDI. However, these notions are all too often ignored (Saxena and Wagenaar, 1997; Scala and MacGrath, Jr., 1993).

Accordingly, governments should not see it as their primary role to *pursue top-down steering or legislation* of the EDI diffusion process. Using such crude strategy might stifle innovation, discourage competition, and eventually leave the national economy worse off. Instead, central government should move onward on a large variety of fronts, including fostering conditions that tear down obstacles for effective EDI use. More specific examples could be encouraging legislation for digital signatures, investing and building an information technology infrastructure, as well as organizing a watchdog against monopoly practices.

4. The Case of Denmark

Based on the many instruments available, a national strategy on EDI was proposed by the Danish government in 1996 (Ministry of Research and Information Technology, 1996).

4.1 The Importance of the Public Sector in Denmark

The public sector in Denmark redistributes about 70% of the GDP (at factor costs), covering a variety of expenditures (unemployment insurance, housing subsidies, health care, elder care) and income sources (income taxation, corporate tax, consumer tax, import tax, etc.). In addition, about 50% of the total public expenditures are allocated through the local government (Jørgensen and Pedersen, 1994). It is estimated that the total public sector procurement is about 90 billion Danish kroner (US$13 billion).

The transfer of income is a vital part of the Danish society and is the major reason for the relatively early introduction of electronic payment transfer from the government to unemployed persons. The generous welfare system created a need for an instant check on social security numbers (CPR number), household income, documentation from doctors on medical need, etc.

The three critical characteristics of the Danish public sector—a high degree of income redistribution, highly decentralized services, and a large collection of data from companies and citizens - have created a push for the government to informate itself for technical, economic and legitimization purposes. As such, EDI has been rendered a high priority area by the central and local authorities.

Local authorities in charge of the health, education, and transportation sectors view electronic commerce as vital in all areas of procurement, as well as a means of retrieving information from citizens and commercial clients. Central government and semi-governmental units, such as the postal service and train service, perceive electronic commerce as a means to achieve strategic advances, cost and time reductions, in addition to improved overall communication. As a consequence, the Danish public sector has become the primary locomotive for the diffusion of electronic commerce relative to the private sector. In the next section we will present the overall EC strategy formulated by the Danish national council on EDI.

Table 1. Government expenditures: Consumption, transfer, investment, other expenditures (1996)

	Billion Danish Kroner	Percent of GDP
Consumption (salary, goods and services, etc.)	255,3	25,2
Transfer of income	342,6	33,8
Investments	22,3	2,2
Other expenditures	6,3	0,6
Total Government current expenditure	626,5	61,8

Source: (Statistics Denmark, 1998)

4.2 The National EDI Strategy

The EDI Council is the administrative unit responsible for the electronic commerce strategy. The Ministry of Research and Information Technology and the Ministry of Business and Industry grant about DKK 18 million over a 3-year period to finance the increased activities of the Danish EDI Council. Moreover, these ministries provide a pool of DKK 6.6 million over a 3-year period to subsidize standardization work, in particular, across industrial boundaries. These subsidies are distributed under the auspices of the Danish Agency for Development of Trade and Industry, as recommended by the Danish EDI Council.

The national electronic commerce strategy was formulated in 1996 in a joint effort between representatives for the public and private sector:

- Ministry of Research and Information Technology
- Ministry of Business and Industry
- Confederation of Danish Industries
- Danish Commerce and Service
- The Danish Chamber of Commerce
- Danish Bankers' Association
- The Danish Insurance Association
- Agricultural Council of Denmark
- Danish Federation of Small and Medium-Sized Enterprises
- The Danish Shipowners' Association
- The Association of Danish Mortgage Banks
- Danish Contractors' Association

The strategy has seven key areas:

1. Establishment of EDI standards in all sectors
2. EDI to be used for public procurement contracts under EU tendering by 1998
3. All public-sector financial systems should handle all commercial documents in EDI by the end of 1998
4. EDIFACT-based interchange of administrative information with the public sector in fax, statistics, etc.
5. Development of EDI software to facilitate the above
6. Legislation on digital signatures and electronic documents by early 1998
7. Danish EDI Council to act as initiator and coordinator

The strategy is joined and supported by all major players in both the public and private sector:

- Ministry of Finance's Agency for Management and Administration of Financial Affairs
- Told·Skat (the Danish Inland Revenue)
- Danmarks Statistik (Statistics Denmark)
- The Armed Forces
- Danish Palaces and Properties Agency
- DSB (Danish State Railways)
- National Association of Local Authorities In Denmark
- Association of County Councils in Denmark
- Copenhagen Hospital Cooperation
- The City of Copenhagen
- IT Trade Association
- Danish Data Association
- Danish EDI Council
- EAN-Denmark
- National Procurement Limited Denmark
- Association of Purchasers in State, Councils and Municipalities
- EDI-Building
- EDI-Transport Denmark
- Danish Pharmaceutical Association

Furthermore, the Headquarters Chief of Defense Denmark, the Danish State Railways, the Copenhagen Hospital Cooperation, the Danish Palaces and Properties Agency, as well as the Ciy of Copenhagen have used the adopted strategy by including their suppliers' ability to partake in EDI as an integral condition for inviting tenders as of 1998. Finally, the Danish government has made it official policy that all public procurement in year 2000 should be done using EDI.

5. Status of EDI in Denmark

We have interviewed and collected data on the use of EDI in various organizations directly involved in electronic commerce in the public and private sectors throughout the Spring of 1998. Furthermore, we have compiled data from the companies reporting data to the public sector and collected data from the VANS operators for the period 1995-1997. The data was collected between December 1997 and May 1998.

Additional data from surveys done by the Ministry of Research and Information Technology has been incorporated in this paper as well. The survey on IT in the private sector (Ministry of Research and Information Technology, 1997a) was based upon 2,001 questionnaires distributed to Danish companies. 387 were returned. Companies with 50+ employees have an over representation in the number of returned questionnaires. The survey of IT in the public sector covers the local authorities (Ministry of Research and Information Technology, 1997b) with responses from 205 of the 275 Danish municipalities and 12 of the 14 Danish counties.

5.1 Basic EDI-usage

The latest official figures from the Ministry of Research and IT are compiled in Table 2 - Table 4. These figures give an indication of how far the strategies of the organizations have been implemented.

We see that within the local government, only 8% of the municipalities used EDI, whereas 75% of the counties and 15% of the private enterprises used electronic commerce within procurement. Thus, while EDI adoption has been quite successful at the county level, substantial opportunities exist for increasing electronic transactions at the lower governmental levels.

When considering the variety of tasks in which EDI is used, approximately 50% of the counties used it to obtain information about products and services, whereas roughly 42% used it for payment. In contrast, only 5% of the municipalities used it for payment purposes. Thus counties appear to have a significant lead in utilizing electronic commerce. This is most likely attributable to the business-to-business EDI predominant in the health sector, which is primarily administrated by the counties in Denmark.

We further note that 60% of the ministries and 36% of agencies and directorates have a home page. 90% of the ministries and 53% of agencies and directorates may be contacted via an official E-mail address. 36% of the counties have a home page and 64% have an E-mail address. 16% of the municipalities have a home page and 30% have an E-mail address (Ministry of Research and Information Technology, 1997).

Table 2. EDI in Denmark, 1997: The procurement function

	Yes	No	Planned 1997/98	Total	(N)
Municipalities	8%	68%	24%	100%	(205)
Counties	75%	17%	8%	100%	(12)
Enterprises	15%	77%	7%	98%	(387)

Table 3. Electronic commerce: The content of EDI (percent)

	Information on products/services	Prices and discounts	Delivery conditions	Ordering of products/services	Payment for products/services
Municipalities	6	4	3	5	6
Counties	50	34	25	34	42
Enterprises	15	7	5	6	2

Table 4. Informatization in the Danish Public Sector (percent)

Level of gov-ernment/ year		No use of elec-tronic records, management or mail systems	Electronic mail used for internal or external use	Electronic record-ing or electronic case administration systems introduced	Electronic handling of incoming mail and electronic case administration
Central	1993	31	49	20	0
	1995a	15	34	49	2
	1996a	4	14	46	35
Local	1995b	11	45	38	6
	1996c	2	19	28	51
Counties	1995b	7	36	57	0
	1996c	0	21	14	64

Note. a= spring, b= primo, c= ultimo

Table 5. EDIFACT traffic by VANS in number of bytes and messages, 1995-1997.

Year	Bytes		Messages	
	Number	Growth per year (%)	Number	Growth per year (%)
1997	57.110.724		26.593.813	
		33%		45%
1996	43.007.936		18.401.306	
		33%		46%
1995	32.375.495		12.630.458	

Accessing the overall organizational transformation via IT, most of the applications are localized or integrated internally. However, there has been a high degree of informatization during the period 1993-1996. In 1993, for example, 31% of the central government units had no use of electronic records, management systems or mail systems, while in 1996, only 4 percent have no use of these applications. Similarly, in 1995, 6 %of the municipalities used electronic incoming mail and electronic case administraion, while in 1996, 51% of the municipalities used these applications.

5.2 *VANS and EDIFACT*

Our survey (Andersen and others, 1998b) shows a continuous increase in number of EDI-messages transferred through VANS-operators and a sharp increase in number of companies capable of sending and receiving EDIFACT.

Figure 2. EDIFACT via VANS 1995-1997, in number of messages per month

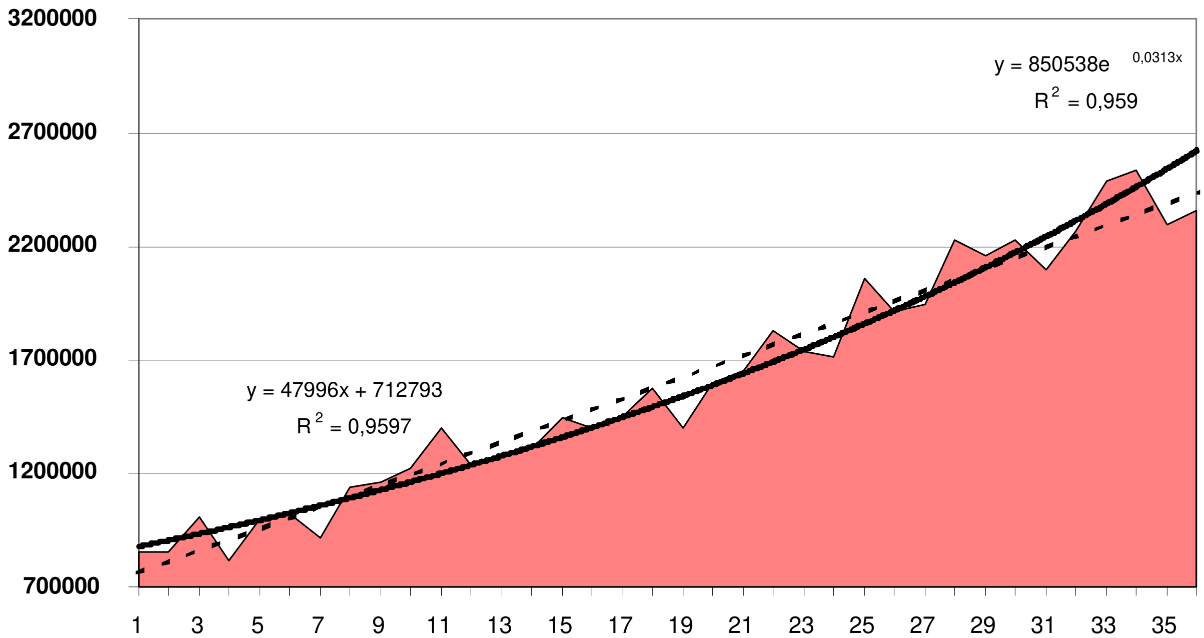


Table 6. Allocated EAN B- og C-location numbers to enterprises, 1990-1997

Year	Number of newly allocated numbers		Accumulated amount of B and C numbers	
	B-number	C-number	Total	Index (1990=100)
1990	0	16	16	100
1991	2	45	63	394
1992	25	66	154	963
1993	55	53	262	1.638
1994	59	50	371	2.319
1995	45	45	461	2.881
1996	77	42	580	3.625
1997	146	34	760	4.750
Total	409	351	n.a.	n.a.

Note. *B-numbers are EAN-location numbers sold without the associated manual. C-numbers are EAN-location numbers including manual.*

As shown in Table 5, more EDIFACT messages have been sent via VANS measured both in terms of number and size. From 1995-1997 the EDIFACT application has increased on average by approx. 45% annually in terms of number of messages and by approx. 33% in terms of size of messages. If we compare the number of bytes via VANS in EDIFACT-format in December 1997 with the number in January 1995, the increase amounts to approx. 82% over the three years. Measured in terms of messages, the study shows that *176%* more messages were sent in December 1997 compared with January 1995 (Figure 2).

Table 6 shows the sharp increase in the number of companies capable of sending and receiving EDIFACT messages. The analysis of the number of users of the EDIFACT standard in Denmark shows a particular increase in the number of small companies among the new users of EDIFACT. From 1995 to 1996 the total number of companies that could send/receive EDIFACT messages increased by 26 percent compared to 31 percent from 1996 to 1997. Among the small companies the increase amounted to 90 percent from 1996 to 1997.

5.3 Internet Based EDI

Rather than using VANS operators, one might use the Internet for EDI. Approximately 50% of Danish enterprises with more than 5 employees have access to the Internet. Almost 80% of the enterprises communicate electronically from the enterprise via call connections or leased lines (Ministry of Research and Information Technology, 1997).

At present, it is very limited how much companies apply browser-EDI for business-to-business trade. Only five per cent of the companies have used the Internet for electronic commerce, whereas approx. 35% of the companies use EDI via VANS or proprietary (closed) circuits. As yet, the companies are not convinced that delivery is ensured, nor secured, on the Internet.

It is predicted that browser-EDI, which can be called a relatively inexpensive integration of the extreme ends of the value chains, will continue to make headway. The end of the communication where the EDI, possibly the EDIFACT message, is integrated into the company's other business processes will benefit substantially from this. Therefore, the solution must be seen as a first step towards full integration in the "browser end" in order that data also can be interchanged electronically with the other business processes in this end.

The companies will increasingly apply browser-EDI so they themselves can offer "VANS-services" and services/sales via Web pages on the Internet. According to our estimates this will not reduce the number of companies that apply EAN-numbers or the number and the size of EDIFACT-transmissions.

5.4 Distribution of EDI Types by Sectors

Based on the interviews in industry associations and various other available data we have made a quantitative estimate of the status of the EDI application as shown in Table 7 and Table 8. In the headings of the tables the electronic interchange of data has been divided into three format types: proprietary EDI, EDIFACT and browser-EDI. The column to the extreme right shows the growth potential for electronic communication, which is defined as the remaining quantity of documents that have not yet been converted to EDI. The sum of the four columns equals 100%.

The tables' extreme left column shows industry areas. The cells of the tables show our estimate of the present coverage in percentages at the beginning of 1998 for the three categories in addition to our estimate of the annual increase in the period 1998-2000. In the insurance area less than 10% of communication is made by means of proprietary standards, more than 50% of communication takes place via EDIFACT, while there is less than 1% application of browser-EDI internally in the industry. In the next 2 – 3 years the industry expects EDIFACT- application to increase by 10-20% and browser-EDI application by 20-30%.

Table 7. Dissemination of EDI in the financial sector, production and commerce, and the transport sector

Sector	EDI type			Potential
	Proprietary EDI	EDIFACT	Browser-EDI	(not realized)
Insurrance	<10% coverage	>50% coverage (10-20% growth)	< 1% coverage (20-30% growth)	30-40%
Banks	70-80% coverage	<2% coverage (10-20% growth)	<0,1% coverage (5-10% growth)	20-30%
Mortgage credit	70-80% coverage	EDIFACT-based Intranet from 1999	< 1% coverage	20-30%
Industry	n. a.	15% coverage (15% growth)	< 1% coverage	80-85%
Wholesale	n. a.	<5% coverage (10-50% growth)	< 1% coverage	>95%
Crafts and small industries (SMEs)	n. a.	<5% coverage (10-50% growth)	< 1% coverage	>95%
Construction	n. a.	<5% coverage (10-50% growth)	< 1% coverage	>95%
Retail commerce	n. a.	20-30% coverage (20-0% growth)	< 1% coverage	70-80%
Agriculture	30% coverage	30% coverage (10-20% growth)	< 10% coverage	30-40%
Heavy freight	>30% coverage	>30% coverage	>10% coverage (20-30% growth)	30%
Postal services	>20% coverage	20-30% coverage*	<10% coverage (20-30% growth)	40%
Shipping	>30% coverage	>30% coverage	>15% coverage (20-30% growth)	20-30%

Notes: The growth in brackets denotes the expected annual growth in messages measured in percentage of the previous year for the period 1998 - ultimo 2000.

n. a. means "not available".

* domestic messages; but >90% coverage of non-domestic messages.

Table 8. Dissemination of EDI in the public sector

Authorities	EDI type			Potential
	Proprietary EDI	EDIFACT	Browser-EDI	(not realized)
Central level	<10% coverage	10-20% coverage	10-20% coverage (10-40% growth)	<50%
Local levels (counties, municipalities)	<10% coverage	<20% coverage	<10% coverage (10-40% growth)	<60%
Public Health	<10% coverage	20-30% coverage	<1% coverage (5-10% growth)	50-60%

5.5 EDI Usage by Type

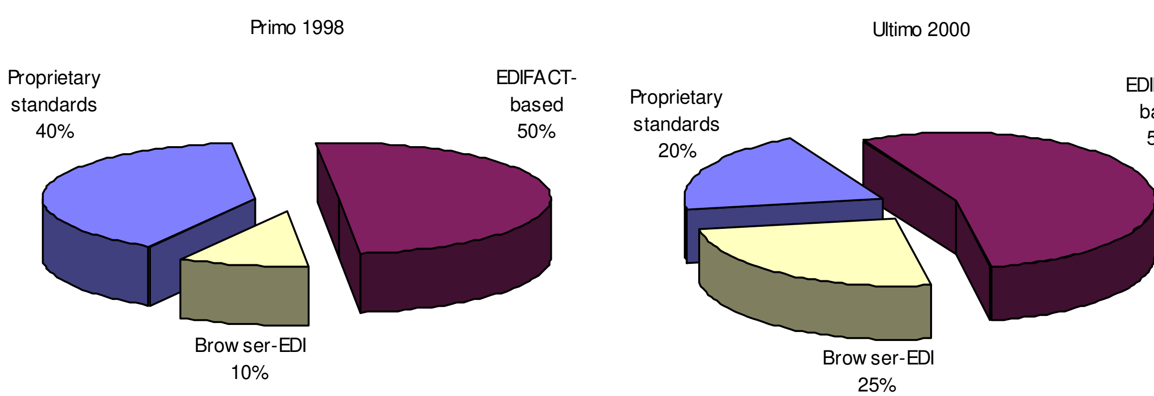
It has not been possible to compile enough data to give a precise summary of the current distribution of EDI usage among our three EDI classes. A prediction of the future distribution is, of course, even harder to make. Based on our current information, a yearly growth in number of transactions between 30% and 50% is not unlikely.

Compared to the total amount of EDI-usage, Browser-EDI is especially likely to raise its share (from 10% to 25%), while the EDIFACT-based EDI is only expected to raise from 50% to 55% in the 1998-2000 period. Consequently the share of proprietary standards is expected to deminish from 40% to 20%. Figure 3 summarizes the distribution of EDI usage among our 3 EDI types by early 1998 and by the end of year 2000.

6. Business Associations Taking Part in the EDI Strategy

In general, the business associations assess that it is first and foremost order and invoice messages that are exchanged in EDIFACT-format. At present, small companies have great expectations to current development projects that focus on EDI solutions by means of the Internet technology, the so-called form-based EDI solutions. Several VANS-operators are involved in the work. It is characteristic for companies that have implemented EDI that their interchange involves relatively few partners and a relatively small number of messages.

Figure 3. EDI-usage by proprietary standards, EDIFACT, and Browser-EDI in 1998 and 2000



6.1 Insurance and Banking

The banking sector has a long tradition for EDI application, but less than 2% of all EDI transactions are EDIFACT-based. They are especially used in transactions between banks and large customers. EDIFACT-standards have been prepared for all important financial transactions between banks and their customers.

The mortgage credit sector is facing a big commitment when they launch their mortgage credit network in 1999, an EDIFACT-based Intranet solution[4] that will combine all parties within mortgage banking: the seven mortgage credit institutions, legal advisers and intermediary lenders. However, the customer will not be linked to the system, as it will be up to the individual mortgage institutions and intermediary lenders to make their own image in relation to customers via open Internet solutions.

6.2 Industry and Commerce

Within the Danish Chamber of Commerce, which numbers approximately 2,000 member companies, less than a handful of companies make transactions via VANS at present. The only companies that apply EDI are found within the food industry and the pharmaceutical area with MedCom, which corresponds to less than 0.1% of the Chamber of Commerce members.

Contrary to this, all large and medium-sized insurance companies participate in the EDI exchange of the two EDIFACT-documents that are in production within the insurance sector. The interchange comprises approximately 80% of all transactions. The remaining 20% derive from small insurance companies that until now have found an EDIFACT-solution too expensive on account of the price of EDIFACT-converters. The insurance industry plans a data-entry based solution by means of the 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 in many years, both internally in the industry and in exchange with other sectors, such as the banking community.

Within the agricultural sector there is a substantial EDI application in relation to the veterinary authorities and the consultative institutions that need accounts data. This development is especially due to the large efforts made by LEC. At present, LEC is working on developing EDI application within e.g. the export restitution area. The Agricultural Council in Denmark has also indicated that the industry association cannot push their members too much to make them use EDI.

6.3 Transportation

In a similar way, the Shipowners' Association and the Danish Provisions Suppliers' Association (DLF) point out that they do not play a very active role; but wait for the largest players to take action. 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 application in the supply chain and the business relations. The problems that are taken up involve primarily the physical transport of goods. There is a need for coordination within logistics, distribution, marketing and sales.

The data communication between DLF's members and the provisions trade has grown substantially. Due to the many products that are transported daily, there is a large need for data. It is the producers in cooperation with the provisions trade that have made the EDI trade standards. DLF has appointed a EDI committee that is taking care of members' interests in relation to pace and direction of EDI application. Since 1995, the number of members that apply EDIFACT has increased by approximately 20%. Approximately 75% of the users apply invoice and order documents. There are 15% more trading partners who apply EDI in 1997 compared with 1995.

7. EDI Application in the Danish Public Sector

In the previous sections we have reviewed both the context and the status of informatization in Denmark through 1996/1997. We will therefore proceed to pre-

[4] EDIFACT-messages are transported by means of TCP/IP in a new closed Intra-/extra-net.

sent some of the prime examples of EDI use in the Danish public sector in order to illustrate how the public sector is the main driver in EDI diffusion.

7.1 The Danish National Board of Industrial Injuries

The Danish National Board of Industrial Injuries is a financially autonomous agency under the Ministry of Social Affairs handling individual work related injuries. The work process involves retrieval of data, checking of legal data/ reference materials, and cooperation with other colleagues in the office. Most of the external contact is done through traditional mail (incoming mail is scanned) and phone. Within the organization communication is either face-to-face meetings, phone meetings, memos, and exchange of electronic documents. In 1995, the Board received 327,000 letters, while they sent off 375,000 letters. They received 46,000 notifications of injuries and made 90,000 decisions.

In 1997, the insurance companies and the Board started using EDI. The insurance companies are required by law to use the board in cases of worker compensation related to injuries. The Board needs to check insurance numbers, the insurance companies need to check social security numbers. By using EDI, the two partners have bypassed a legal barrier, which prohibits insurance companies from obtaining direct access to centrally stored personal data.

7.2 Public Procurement

The most demanding challenge for the near future is to implement EDI based electronic trade into public procurement. While the need to obtain cost reductions in administrative processes is evident, the barriers of technique, tradition and attitude are still pervasive.

National Procurement has assumed a major role in preparing the public sector in Denmark for the electronic procurement of goods and services. In 1997, National Procurement Ltd. introduced an EDIFACT based database which encompassed all goods and services in the current paper based Procurement System. In addition, an electronic public procurement system has been designed in cooperation with the central and local public network operators.

These two systems are completed with EAN location numbers for all subscribers as well as a set of EDI documents and standards which will form the backbone of a thorough public trade environment. This will be combined with an open interface to other 3rd party goods and services databases and administrative systems used in the public sector

In the course of 1998 all public authorities will be able to commence transacting via EDI. Together with National Procurement, Ltd., the Agency for Financial Management and Administrative Affairs is developing a basic procurement system for public financial management systems. The procurement system became operative for local and central government users as of February 15 1998.

7.3 Taxation

The Danish Central Customs and Tax Administration (Customs*Tax) also aims to receive all documents electronically. Their EDI strategy consists of two major elements: 1) A strategy for the handling of all incoming data from companies electronically through an alliance with the Statistics Denmark and the Danish Commerce and Companies Agency, Ministry of Business and Industry; 2) enabling citizens to deliver their advance tax assessments and income tax statements via the Internet and voice-response.

The requirements for EDI applications used by Customs*Tax customers are:

1. Right amount on time.
2. Better servicing of companies, including a reduced effort on their behalf.
3. Effective use of resources.
4. Accurate and lawful administration.
5. Development oriented.
6. Political satisfaction.

The new EDI interface developed by Statistics Denmark, Danish Commerce and Companies Agency, the Ministry of Business and Industry, and the Central Customs and Tax Administration enables companies to deliver their declaration regarding VAT and excise duty electronically. In 1997, more than 20% of all Danes made use of the service to enter and transmit information for the advance tax assessment and the income tax return by telephone. Less than 1% used the Internet for this task in 1997.

Table 9. Central Customs and Tax Administration: Documents handled manually and electronically, 1997 (1,000)

Document:	Manual data entry	Electronic data transfer	
		EDI	Phone
Employers' income statement	1,000	10,000	0
Interest (financial institutions)	150	31,000	0
Trade union dues	100	5,300	0
Income tax statement	780	30[a)]	600
VAT	1,600	0	0
Intrastat	900	4,000	0
Import and export, total	2,800	1,100	0

a) Via Internet

7.4 Health Sector

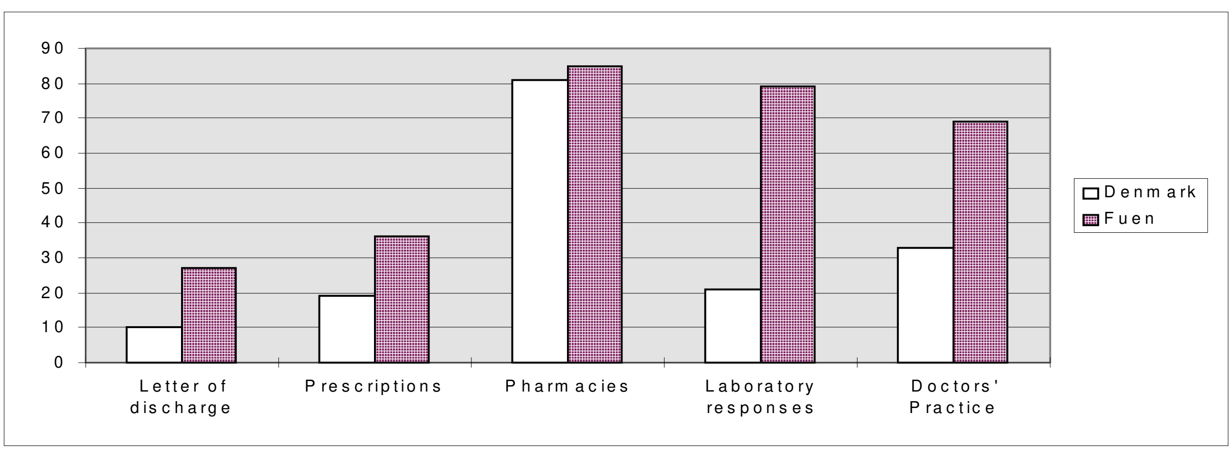
The Danish health care sector is considered to be one of the most automated in Europe. Currently, 15% of discharge letters, 7% of laboratory results, and 10% of pharmacy prescriptions are handled by EDI on average. In the Copenhagen city, EDI is also used in the communication with dentists and opticians.

Within Fuen county, the general practitioner (GP) sends a referral to the hospital department, and the hospital sends discharge letters to the GP and the municipal social administration and the health insurance using EDI (Andersen, 1998a; Fuen County, 1995). Also, when the pharmacy, hospital and GP order medicine, EDI is replacing paper based order and invoice forms. Currently, the FuenCom project is being expanded to cover the entire country (MedCom).

After establishing a computerized health data network within the organization, the county estimated that substantial revenue had been achieved (Fuen County, 1996). There is, however, major variance in how much of the communication is wired. In Figure 4, we compare the communication in Fuen and the average communication in Denmark based on the number of letters of discharge, prescriptions, pharmacies, laboratory test results, and doctor's practices.

Twenty-seven percent of the letters of discharge are computerized and are part of a network in Fuen County. Yet, at the national level, only 10 percent of the letters of discharge are part of a network. Most remarkable, however, is that almost 80 percent of the laboratories send and receive their messages through electronic communication in Fuen County, whereas only 20 percent of the communication in the labs are processed electronically at the national level. Furthermore, more than 4 out of 5 pharmacies are wired. This is true for Fuen County as well as the national average.

Figure 4. Network Distributed Messages in Fuen and in Denmark on Average



Note. Data provided by the Danish Center for Health Informatics.

8. Conclusion

The Danish government has launched a very ambitious plan in 1996 to expand electronic commerce in general and the procurement function in particular by introducing the technical capability by 1998 to realize electronic commerce at all levels of government by the year 2000. Our data shows that the central government is on the right track and likely to succeed within procurement. In other areas, such as the health sector and taxation, the strategy is successful as well. Not only is the diffusion rate very high, the public sector has also been innovative in co-developing the EDIFACT standards within the taxation, health, and insurance areas.

One of the issues that fascinates us is the Danish public sector's role as a major market player in buying goods and services, which makes electronic purchasing and procurement vital in fulfilling the goals of efficient cost-management. Second, we found that while the government has been using EDI instruments at the top-levels of government, the initiatives often comes from the *lower levels of government*.

The government has, by following a multi-dimensional strategy combining direct and indirect actions, stimulated the use of EDI, not only in their own organization, but also at other levels of government. In addition, they are applying normative, pedagogical and economic actions to enhance EDI in the communication with their business partners.

Although the governmental initiatives have been successful within the *areas vital to the public services and instruments*, they are lagging in support of the private sector's need for EDI as well as the public sector's own management. Examples are numerous*:* *on-line systems* within an organization, information systems for *joint use horizontally and vertically within the public sector*, EDI/ data network *with the suppliers* of taxes, goods, etc. *and the citizens*, *international network* in the criminal justice area, etc. These information systems present challenges for the system manager, but also, from our perspective, for the core functions within the public administration and its network.

Moreover, in the intermediate future, we see problems emerging for governments if they continue to focus upon control and power, rather than favorable relationships with trading partners. For example, building national and supranational data networks where EDI is the major vehicle will confront political challenges such as privacy issues. With the open exchange of legal and health data, total privacy can never be completely assured using EDI and IOS. However, networks must not be constructed to maintain or reinforce governmental power-balances, rather, the goal must be to demonstrate efficiencies (human labor savings, savings in time and transportation, better utilization of capital in scheduling, etc.), for the large investments in EDI.

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