Business-to-business data sharing: 
A source for integration of supply chains

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Abstract

The flow of information between parties in a supply chain is crucial for carrying out an effective and efficient transition of consignments. To support the flow of information, diverse communication systems exist. Although the electronic data interchange technology has been around for more than 30 years now, it has not reached small- and medium-sized enterprises to any significant extent. The results of more than 20 case studies imply that smaller companies run the risk of being permanently excluded from integrating their logistics operations in the supply chain. However, the advent of the Internet and concepts of electronic business open up new perspectives for small- and medium-sized enterprises. © 2002 Elsevier Science B.V. All rights reserved.

Keywords: Data sharing; Information technology; Information systems; Logistics; Supply chain; EDI; Internet; B2B electronic business

1. Introduction

To provide effective support for the functioning of the logistics channel, the overall information systems architecture must be capable of linking or coordinating the information systems of the individual parties into a cohesive whole. In practice, each company’s information system should support both proprietary and shared data. Since it is needed to manage the company, the proprietary data would be accessible only to those employees who have legitimate internal business needs. The shared data should be available through appropriate information interfaces to customers, logistics suppliers, or any other party having a need to know, through a contract or standard to which all parties agree [1]. This has become more important in later years as many companies are increasingly outsourcing their logistical activities to third parties, which in turn heightens the demand for effective data sharing [2].

This article lies within the scope of the shared data segment and, by carrying out several case studies, it tests whether the above statement “The shared data should be available through appropriate information interfaces...through a contract or standard to which all parties agree” is a vision or a reality. Additionally, the goal is to analyze to which extent small, medium, large and huge companies, taking part in the supply chain, utilize advanced information technology.

To be able to position the information system, often called the logistics information system (LIS), within the concepts of logistics, LIS may be defined as follows (adapted from [3]):
Logistics Information System is an interacting structure of people, equipment, and procedures which together make relevant information available to the logistics manager for the purposes of planning, implementation, and control.

This definition implies that the data sharing between parties in the supply chain is of fundamental interest, and that the flow of information is essential for carrying out an effective and efficient movement of consignments. By using more advanced technology and data sharing, one can increase the resource utilization and thus reduce costs [4]. Development in information and communication technology has made it possible to integrate the supply chains so that the links between suppliers, producers, customers and third parties have been easier to establish. The elementary factor in making these links feasible is that the companies must develop the information systems in accordance with standards and communication technology that the other parties can agree to [5]. There exists a general consensus about this, but the means of communicating the relevant data or information are a different story.

Establishing electronic links with their suppliers and customers enables companies to transmit and receive purchase orders, invoices and shipping notifications with much shorter lead times than previously, which gives potential to speed up the entire shipping transaction [6]. The most common technology for moving such messages between larger companies is electronic data interchange (EDI) meaning that “structured data, by agreed message standards, is transferred from one computer to another, by electronic means” [7]. However, there exists a barrier through which smaller companies are not able to break: the cost of implementing EDI communication technology, and the cost of installation and maintenance of value-added networks (VANs), place electronic communications out of reach for many small- and medium-sized enterprises (SMEs). For the most part, these businesses rely on telephone and fax for their business communications. Even the larger companies that use EDI do not often realize the full potential benefits because many of their business partners do not use EDI. Therefore, although the technology has been around for more than three decades now, it has not reached SME’s to any significant extent. Whereas 96% of 1998’s Fortune 1000 companies in the USA are using EDI, 98% of the other companies are not [8]. The EDI is a solution made by the large companies for the large companies, while the small- and medium-sized ones do not have the opportunity to join the society.

The results of the case studies, carried out in 20 companies, show that the larger companies are using EDI technology to communicate business data but experience problems in communications with the smaller companies. The smaller ones do not often have resources or basic information technology to implement EDI modules, and the consequence is that those companies risk being permanently excluded from integrating their logistics operations into the supply chain.

The advent of the Internet opens up new perspectives for the SMEs. The Internet makes electronic business affordable even to the smallest companies. Companies of all sizes can communicate with each other electronically through the public Internet, networks for company use only (Intranets) or for use by a company and its business partners (Extranets), and private VANs. The Internet provides a new technology for doing EDI. Ultimately, many companies plan to adjust their EDI programs to Internet solutions, but in the meantime Internet technology increases the number of protocols that a business must support. As a result, companies are moving from traditional EDI translators to EDI gateways which then serve as a single management interface for the EDI system [9]. This serves the smaller companies as well, since they do have an interest in signing up for such gateways to enable communication with their often much bigger customers.

2. Framework

The framework chosen for this work is a simple short supply chain, including different parties commonly belonging to a logistics network: a
supplier of raw materials, a producer of intermediate goods, a producer of final goods, and lastly a consumer. A transport operator takes care of transporting the goods between these parties. A still more simplified illustration is shown in Fig. 1 where the actual parties are three: the producer of intermediate goods, the producer of final goods and the transport operator.

In addition to the material flow, which of course is single-directed, two other flows are identified in this simple logistics flow scheme. These are the information flow and the resource flow, both double-directed. The information flow is shown between all parties taking part in one section of the supply chain, i.e. between the supplier and the receiver and the responsible transport operator. This is not always done in practice, but is applicable if desired. The resource flow consists of the vehicles used for the goods transportation, traveling fully or partially loaded from the consignor to the consignee and empty back to the consignor. In this article the information flow, or rather the data sharing between these parties, is in focus. To be able to analyze the interchange of data, the case studies have been chosen so that a handful of each type of companies have been selected to represent three categories of companies: the producers of intermediate goods, the producers of final goods and the transport operators.

3. Method

In this section the methodological approach will be described. The approach is twofold: to perform a literature search covering the area of information exchange in logistics, and to carry out case studies.

3.1. The literature study

A literature study was conducted in the early phase of this research. It can be divided into two distinct areas, one focused on general relationships between companies, and the other focused on information technology and usage of logistics information systems.

The study revealed that there is a large amount of both books and articles covering the area of supply chain management and business logistics, especially American literature. This is also the case for information technology, information systems and Internet literature that covers technical aspects of information issues. However, when linking together concepts like supply chain management and business logistics, or material management and information technology or information systems, one is often led to literature that describes the management information systems, how these are used internally in different companies, and how they contribute to make an effective flow of material possible, or a description of technical solutions to support these systems. Trying to find literature on the data sharing between parties in a specific supply chain often results in technical descriptions of the information systems and information technologies, such as how EDI works and how “essential” it is for companies to be able to communicate business data. The literature found has been used as a basis for the conceptual part of this research.

A substantial lack of scientific literature appears when one tries to locate publications that deal with data sharing and the management aspects of the information flow. This is an area of study which has to be covered in much more detail from the viewpoint of systems theory as well as organization theory, to mention only some relevant disciplines.
3.2. Case studies

In general the case studies were all based on interviews. Even so, there are two distinct approaches that have been used when conducting these interviews. The one applied to both the producer and the transportation companies was based on open, in-depth interview techniques; the other, applied only to the producers, was based on survey techniques and a questionnaire, but complemented by interviews [10]. The reason for using a questionnaire was that the producing companies were very dissimilar, having different structures, and the likelihood of being able to attain the desired information and lead the open interviews into required areas of the operation, without using some kind of questionnaire, was considered low.

All the respondents were managers of either information systems departments or logistics departments, depending on the company structure. The main goal was to investigate in general what kind of information technology was in use and what kind of information systems, to support the data or information flow, were in operation.

The interviews were conducted by paying the companies at least two visits, with approximately 2 or 3 hours of interviews each time. During the first meeting, quite broad information was collected about the information technology and the information systems in general terms. The later meeting or meetings were accomplished for more details of specific parts of the company’s information technologies and information systems. Moreover, on these later occasions the information flows between the companies and at least three customers were analyzed.

The producers, both of intermediate products and of final products, were sent a questionnaire that had been prepared. The questionnaire was then followed up with a rather short interview, approximately 2 hours long. The purpose of the interview was mainly to secure a common understanding of the questions, and also to guarantee adequate answers to the few open-ended questions included in the questionnaire.

The aim of these case studies was to examine the relationships between the companies concerned and some of their suppliers or customers. The focus was on the information flow between these parties and the technical capabilities for advanced and well-structured exchange of information.

4. The case studies

In this section the results of the case studies will be discussed. First an overview of the results will be given, followed by a deeper analysis of the companies, classified into sizes.

The definition used here is the official European Union definition [11]: an SME

- has fewer than 250 employees, and
- has either an annual turnover not exceeding Euro 40 million, or an annual balance sheet not exceeding a total of Euro 27 million.

In addition, to allow distinctions across the great variation in size of companies larger than SMEs, the term “huge” has been introduced by the author. Huge companies are considered to have more than 10,000 employees and a total turnover of more than Euro 1000 million.

4.1. Overview of the companies

The companies have been categorized into three types: producers of intermediate products, producers of final products and transport operators. The transport operator group includes 7 companies that operate all modes of transportation. The companies provide door-to-door freight transportation service, which means that all except the road transport companies carry out intermodal or multimodal transportation. The representatives of road transportation are actually dominant in the selection of companies, but even the ones operating on rails have a fair share of representatives. The companies range in size from SMEs with Euro 4 million in total turnover up to a huge firm with Euro 2756 million. Most of the companies in the group are large, and this quite well reflects the situation in the Swedish and North European

\[1\] In January 2001, the value of 1 Euro was approximately 1 US dollar.
transportation industry, whose operators are relatively few but large.

The group of producers of intermediate products comprises 6 companies that provide material to firms in the machinery, electronic, plastic and paper production businesses. Their size varies from SMEs with a turnover of approximately Euro 7 million to huge companies with a turnover of Euro 4000 million.

The group of producers of final products comprises 7 companies that are operating in different businesses, from grocery producers to electronic device producers. The companies are all rather large, the smallest having approximately Euro 56 million and the largest up to Euro 4533 million in total turnover. An overview of the companies is shown in Table 1. The information shown in Table 1, and the main results from the case studies of each size-group, are discussed in detail in Section 4.2.

4.2. Empirical results

An analysis of the companies was made with a data-sharing perspective, where the capabilities to communicate with other parties are the focal point. The analysis of the results has been further divided into two categories: an analysis of the production companies and an analysis of the transport operator companies. Then, to be able to draw more general conclusions from the results, a common analysis has been made where mutual problems, experienced by both parties, are put forward in one subsection. In view of the limited number of cases, we have to be careful about such conclusions, and the results can in no way be statistically significant. However, the author feels that the results are consistent with the expectations and that the case studies may be representative.

4.2.1. Production companies

Turning first to the production companies, the results from the case studies are summarized in Table 2. The results are that the SMEs have only internal information systems, mainly in order to deal with administration- and production-oriented tasks. They do not have advanced communication modules such as EDI, nor do they have the basic information technology to implement such aids. Their main communication methods are therefore telephone and fax.

The larger companies do often have integrated communication modules and, in some instances, EDI communication modules implemented. The ones that have such an advanced communication module have been forced to implement it by their larger customers, and have not thought of integrating the system backward, towards their suppliers.

The huge companies have advanced information and communication systems. These can communicate by using many different kinds of methods, including on-line communication, standardized e-mail messaging, Internet, and even EDI. The data-sharing integration is both forward- and backward-directed, as they have been able to influence the suppliers to integrate their communication systems and have large customers that in turn require EDI communication capabilities.

4.2.2. Transport operator companies

If we now look at the forwarding companies, the main results from the case studies are summarized in Table 3. As seen in Table 3, the SMEs do not have any kind of management information systems that can be used for external communication purposes. Consequently, they communicate by telephone and fax. Even worse, the companies in question do not even have developed routines or processes to communicate data and information with other partners, especially not in case of exceptional occurrences.

The larger companies have some kind of management information systems. These systems were either developed in-house or adapted from a standardized production system, an MPC system. The integrated communications modules were often missing, even though the basic information system can support such modules. These companies hesitate to implement EDI modules because they do not see the benefits, either since they do not have very many customers that require EDI communications, or since they cannot afford the implementation cost.

The huge companies, on the other hand, are well equipped for sharing data with their partners.
Table 1
Overview of the case study companies

<table>
<thead>
<tr>
<th>Branch</th>
<th>Type^a</th>
<th>Status^b</th>
<th>Turnover^c</th>
<th>Employees^d</th>
<th>Size^e</th>
<th>EDI^f</th>
<th>Internet^g</th>
<th>On-line^h</th>
<th>Fax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transp. Op.</td>
<td>Road/air</td>
<td>2756</td>
<td>40,100</td>
<td>H</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Transp. Op.</td>
<td>Road</td>
<td>1756</td>
<td>4700</td>
<td>H</td>
<td>YES</td>
<td>YES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transp. Op.</td>
<td>Rail</td>
<td>1600</td>
<td>17,000</td>
<td>H</td>
<td>YES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Machinery</td>
<td>Intern.</td>
<td>4000</td>
<td>45,000</td>
<td>H</td>
<td>YES</td>
<td>F/B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Electronics</td>
<td>Intern.</td>
<td>222</td>
<td>2500</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Plastics</td>
<td>Intern.</td>
<td>67</td>
<td>800</td>
<td>L</td>
<td>YES F/-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Plastics</td>
<td>Intern.</td>
<td>26</td>
<td>68</td>
<td>L</td>
<td>YES F/-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Machinery</td>
<td>Intern.</td>
<td>8</td>
<td>75</td>
<td>SME</td>
<td>YES F/-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Food suppl.</td>
<td>Intern.</td>
<td>7</td>
<td>50</td>
<td>SME</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Furniture</td>
<td>Final</td>
<td>4533</td>
<td>36,400</td>
<td>H</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Paper prod.</td>
<td>Final</td>
<td>3333</td>
<td>15,000</td>
<td>H</td>
<td>YES F/-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Computers</td>
<td>Final</td>
<td>n.a.</td>
<td>n.a.</td>
<td>L</td>
<td>YES F/B</td>
<td>YES</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Groceries</td>
<td>Final</td>
<td>88</td>
<td>740</td>
<td>L</td>
<td>YES F/B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Machinery</td>
<td>Final</td>
<td>85</td>
<td>790</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Machinery</td>
<td>Final</td>
<td>70</td>
<td>250</td>
<td>L</td>
<td>YES F/-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Groceries</td>
<td>Final</td>
<td>56</td>
<td>530</td>
<td>L</td>
<td>YES F/-</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^a Which kind of business the company is in, either a transport mode or a main product category.
^b Whether the product is a final product, consumed as it is by the consumer, or an intermediate (interm.) product that is used further to produce a final product.
^c The total turnover of the year 1997 in million Euro.
^d The total quantity of employees in the company, not just the branch in question (if more than one branch).
^e The size according to the size categorization. SME = small- or medium-sized enterprise; L = large; H = huge.
^f Using EDI communication technology, YES or NO. F = forward integrated (towards its customer); B = backward integrated (towards its supplier).
^g Internet usage to communicate with customers or co-organizations, not just to retrieve general present information or use internally (Intranet).
^h The companies are providing traditional on-line service to their customers.
^i For better clarity, “NO” has been indicated by “—”.
^j n.a. = data not available.

Table 2
Results from the production companies’ case studies

<table>
<thead>
<tr>
<th>Size</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SME</td>
<td>Have some kind of material requirement systems, MRP, or manufacturing planning and control systems, MPC, but no integrated communication modules; communicate through telephone and fax; hesitate in joining the EDI society because they: do not have the basic information technology do not have the resources do not identify the need (amount of transactions)</td>
</tr>
<tr>
<td>Large</td>
<td>Have some kind of MPC systems and integrated communication modules; communicate by telephone, fax, even e-mail and EDI; the ones using EDI are only forward integrated (towards their larger customers)</td>
</tr>
<tr>
<td>Huge</td>
<td>Have advanced MPC systems and integrated communication modules; communicate by all possible methods; integrated both backward and forward (towards suppliers and customers)</td>
</tr>
</tbody>
</table>
They have developed advanced in-house management information systems with all possible communication modules. Some even help their customers to implement EDI technology by providing these with consultation and even equipment, since they have realized that they cannot benefit from their investments without having more participants using electronic communications.

4.2.3. Common problems

To be able to identify common issues that make the data sharing between different parties difficult, an analysis has been conducted that looks into common problems of the production and transportation company categories. The results are summarized in Table 4. As seen from Table 4, the SMEs lack the basic information systems to be able to implement some kind of external communication systems. They communicate only by telephone and fax. Some of the reasons why they hesitate to implement EDI communication modules are:

- the investment is not in the communication module alone, but also in an information system that can support the input and output from such a data-sharing system;
- the customers do not require EDI communication, as they themselves do not have such a technology;
- the number of transactions is so small that it would not justify the investment.

For these and other reasons, the SMEs are not likely to implement EDI communication modules unless forced to do so.

The larger companies in both categories often have more advanced information systems that can handle EDI communication modules. Still, the EDI implementations are not general and the main reason remains the cost of implementation. The ones that are forced to implement such a system do so, as the investment is more or less limited to the purchase of the communication module and the implementation. The general information systems and technology are already in place.

The huge companies have implemented both information systems and communication systems that are capable of communicating by many different means, EDI and others. They still have problems realizing the benefits of the EDI implementation, since there are not very many firms capable of joining them in electronic data-sharing efforts.

The conclusion from these case studies and others [12,13] is that there is a need for less expensive methods of data sharing in the supply
chain to make it possible for the SMEs to participate. This is necessary not only for the SMEs, but also for the larger organizations so that they can benefit even more from their already implemented data communication systems, especially the EDI systems.

5. The role of the Internet

From the discussion in the previous section, where data communication is found to be too expensive for the SMEs, the question arises immediately about the capabilities of the well-known Internet to contribute as an inexpensive method of business communication. Just a few years ago, the Internet was far from being a data-dissemination medium available to a broad cross section of the public. This situation was radically changed by the World Wide Web initiative. The rapid take-off of the Internet and the exponential growth in its use are chiefly due to the following factors [14]:

- public domain code and protocol specification;
- large heterogeneous installation base, providing users with ability to browse data independent of the computing equipment used;
- ease of use;
- good browsing capabilities;
- availability of inter-protocol gateways, making it compatible with many other existing protocols.

Before discussing the role of the Internet, let us review the use of Internet and EDI technologies on a worldwide level.

5.1. The use of Internet and EDI technologies

The main barrier in benefiting from an implementation of an EDI communication system has been recognized to be the limited diffusion of the technology. Therefore, if the aim is to point out a technology to improve the data sharing, it is important to identify today’s use and the potential spreading of that technology and try to evaluate its permanence. The evolution of Internet usage during the years from 1994 to 2000 is shown in Table 5. As seen from Table 5, the usage of the Internet is growing at an incredible pace. At the same time, the users of EDI technology have been increasing in a much more slower rate and the users in the USA were approximately 100,000 in 1998, representing a major part of the world’s EDI users [15]. The private usage of Internet has increased enormously and also the registration of hosts that have a specific Internet Protocol address. It is obvious that such an increase in utilization of one single technical solution benefits all the users of the medium, not only the selection of private users. What is most interesting is the

<table>
<thead>
<tr>
<th>Size</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SME</td>
<td>The basic management systems are missing or it is too difficult to add communication modules to the system (such as EDI)</td>
</tr>
<tr>
<td></td>
<td>Communicate by telephone and fax</td>
</tr>
<tr>
<td></td>
<td>Hesitate in joining the EDI society as resources are lacking</td>
</tr>
<tr>
<td>Large</td>
<td>Have in-house developed systems or adapted production systems as management information systems</td>
</tr>
<tr>
<td></td>
<td>Have the possibility to use EDI, but the system is presently not being used by many of their customers</td>
</tr>
<tr>
<td></td>
<td>The ones using EDI have been “forced” to do so, and often do not reap any economic benefit from the implementation</td>
</tr>
<tr>
<td>Huge</td>
<td>Have advanced in-house developed systems and integrated communication modules which communicate by all possible methods</td>
</tr>
<tr>
<td></td>
<td>Still have problems realizing the benefits to full extent as there are just a few using EDI, although these are the large ones with the large volumes</td>
</tr>
</tbody>
</table>
development of registered Internet domains. These domains are largely registered by companies, so the number of registered domains is in fair proportion to how many companies are using the Internet for some purposes. These purposes, at present, mainly concern information distribution to either the public or the customers, and not communication between companies. The growth during the years 1994–1998 can be attributed primarily to SMEs, as many of the larger companies registered domains earlier.

Unfortunately, this way of estimating company domain registration is no longer suitable as many organizations, unions and even private persons have registered a domain and therefore the domains are not used in the same proportion for commercial purposes. But the fact that the commercial use of Internet is increasing at such a pace must be acknowledged to offer a huge potential for using the Internet as a future communication method between companies exchanging business information. This we are experiencing at a time when the number of companies participating in E-business and E-commerce relations is increasing dramatically. This does not, however, mean that the EDI growth will be brought to an end. The Internet has done nothing to slow down EDI growth and can actually give the EDI a second life, facilitating it instead of killing it [16]. The question still remaining to be answered is: how can the Internet contribute, especially taking into consideration the enormous investments already made in EDI communication hardware and software in different companies around the world?

5.2 How can the Internet contribute to supply chain management?

The Internet can contribute and support EDI communications in several ways. Although it is reliable, low cost, highly accessible, supportive of high-bandwidth communications, and technically mature, there are still some valid concerns relating to the use of the Internet for EDI. These concerns revolve primarily around security, message tracking, audit trails and authentication [17]. The most obvious ways of contributing are:

- To use EDI over Internet, where companies, instead of using direct telecommunications between them or a VAN, receive and send EDI messages over the Internet. The negative consequences are mainly approval of acceptance and security issues.
- To send EDI messages with e-mail. Then the EDI message is enveloped in an e-mail message automatically and sent by a well-established message system. This brings higher security than EDI over Internet as the e-mail systems involve high-security systems, e.g. S/MIME.
- By directly using Internet pages for information exchange. This might involve static information pages as well as timetables, price lists and so on. More suitable for the purpose of data sharing is to allow users to key in information. This can

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Table 5
Internet and Internet domain users’ worldwide growth

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet users(^a)</td>
<td>3 million</td>
<td>13 million</td>
<td>100 million</td>
<td>300 million</td>
</tr>
<tr>
<td>Internet hosts(^b)</td>
<td>1.5 million</td>
<td>9.5 million</td>
<td>29.7 million</td>
<td>72.4 million</td>
</tr>
<tr>
<td>Registered Internet domains(^c)</td>
<td>46,000</td>
<td>240,000</td>
<td>1.5 million</td>
<td>(? )</td>
</tr>
</tbody>
</table>

\(^a\) Source: [23] (this presents an estimate of the number of computers connected to the Internet that have a unique Internet Protocol (IP) address).

\(^b\) Source: [24] (these domains are registered with a specific IP address).

\(^c\) Source: [24] (these domains are registered within the domain name system, DNS).

\(^d\) An explosive registration of non-active (non-commercial) domains during the last two years makes the number irrelevant and unsuitable for comparison any longer.
be service booking, information about shipments’ whereabouts, etc.

- A mapping of the contents of an EDI message to a text file or an Internet site for use by non-EDI-established partners and vice versa. The Internet site can be used for just viewing, printing or even direct input to the Internet-accessible database.

For small- and medium-sized companies, the first two alternatives when using EDI technology are not of much interest. However, the latter two are far more promising.

The direct uses of Internet for information exchange are numerous. Such E-business exercises can be classified into two categories, one with static information and the other with dynamic information. In the first case, information such as timetables, price lists, technical specifications, etc. is presented. This information is more of a substitute for printed material, previously sent out to customers. The main benefits are possibilities of more frequent updating and global distribution, more or less to everyone having Internet access. When using Internet more dynamically, it is often an extension of an Extranet, where registered customers can book orders, get price quotations, make inquiries about available capacity and price based on volume and time, etc. A link from the Internet sites to the EDI backbone module can then easily be established by making these sites in an extended markup language (XML) format [18]. As another example, a production company might present all assignments to one transport operator on a dedicated Internet page and enable that operator to key in the progress, the whereabouts of certain consignments, instances of disturbance, etc. [19].

Many other E-commerce services are already in use where the Internet is adopted as a medium. Some are marketplaces, i.e. where suppliers promote their products to many buyers, auctions of available transport capacity are held, producers submit freight that needs to be transported, etc. These services are not analyzed further in this work as the main issue is E-business rather than its subset of E-commerce.

When operating different kinds of information system, there is an even simpler, cheaper and newer alternative. This is to map the content of an EDI message to a text file or an Internet site for use by non-EDI-established partners. The Internet site can be used for just viewing, printing or even direct input to the Internet-accessible database. Fig. 2 shows the “new” scheme where the data are shared through a central database and mapped as

![Diagram](https://via.placeholder.com/150)

Fig. 2. A simple logistics information flow scheme with data mapping (for simplicity, the resource flow is not shown) [22].
needed between different systems, operated by different parties, in the supply chain. As seen in Fig. 2, the technically least competent companies can just sign up for an Internet account and use that corridor to participate, to some extent, in the data sharing between different parties. This solution provides the company with capabilities to view Internet sites, make printouts, and even make inputs to the database (once defined as a contributing, data-sharing partner), such as tracking and tracing information from a transport operator [20]. This keying-in of information is of course done manually, but in a much more efficient way, compared to the older telephone and fax communication methods.

More advanced partners that have a management information system can participate in a more automated manner by making a text file mapping, as both input to and output from their system. Then the central database needs to be able to support standardized text input/output communications. The company participating in this manner needs to design and program its own communication module in the information system. However, this involves only programming efforts since the text input/output function is a standard communication module in all management information systems, and does not require a separate investment in communication modules such as an EDI communication implementation involves.

Many sellers of information systems have already tailored their software to be used on the Internet or in connection with Internet application [21]. And even if the system has not been adapted to Internet, the already EDI-established users do not have to change anything, as the communication with the database can be done by default in a standardized EDI format using the EDIFACT standard.

The location of the central database is technically not an important issue, although it may involve organizational and commercial problems. The database can be operated by one of the participants in the supply chain or by a third-party information service provider, independent of all other parties. The fundamentals of the solutions do not change according to who is responsible for operating the database. This is of course a crucial issue when it comes to accessibility, pricing, data security, etc. but that issue is outside the scope of this paper.

6. Conclusion

The aim of this article is to analyze to what extent small, medium, large and huge companies, taking part in the supply chain, utilize advanced information technology to share data. To provide effective support for the functioning of the supply chain, the overall information systems architecture must be capable of linking or coordinating the individual information systems of the parties. EDI is the most common technology for moving such messages between companies, but the cost of implementing it places such electronic communications out of reach for many SMEs, so they have not adopted it extensively. Even the larger companies that use EDI do not reap the full potential benefits because many of their business partners do not use the EDI technology.

More than 20 case studies, based on interview techniques, were carried out in both transportation and production companies. These case studies show that SMEs do not have the basic information systems to be able to implement some kind of advanced communication system. They communicate only through telephone and fax. Some of the reasons why they hesitate to join the EDI society are:

- the investment is not in the communication module alone, but also in an information system that can support the input and output from such a system;
- the customers do not require EDI communication, as they themselves do not have such a technology;
- the number of transactions is so small that it would not justify the investment.

There is a need for less expensive methods of sharing data in the supply chain to make it possible for the SMEs to participate. The advent of the Internet opens up new perspectives for these companies, as it makes electronic communication affordable to even the smallest companies. The
Internet can contribute to and support EDI communications in diverse ways. The most obvious ways are:

- to send *EDI messages with e-mail*, where the EDI message is enveloped in an e-mail message automatically and sent by a well-established message system;
- to use *EDI over Internet*, where companies receive and send EDI messages over the Internet instead of through direct telecommunications;
- direct use of Internet to distribute information or collect it, with an Internet page key-in capability;
- an even more simple, less expensive and newer alternative is to map the content of an EDI message to a text file or an Internet site for use by non-EDI-established partners.

The results of this investigation indicate that the effective data sharing between different parties in the supply chain is more of a vision than a reality, especially when SMEs are taking part. The method last mentioned above, though, is promising for the small companies that must join other partners in their data-sharing efforts to make better coordination possible in the supply chain.

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