

**"EDI IN EUROPE - EMPIRICAL ANALYSIS
OF A MULTI-INDUSTRY STUDY"**

by

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Table of contents

- I. Introduction
- II. Methodological Approach
- III. Common Framework of Analysis
- IV. Empirical Results
 - A. Costs and benefits of an EDI application
 - B. Planning and Implementation
 - C. Perceived Success
 - D. Intraorganizational Impact
 - E. Interorganizational impact
 - (1) Competitive analysis
 - (2) Interorganizational links
 - F. Success factors
- V. Conclusion
- VI. References
- VII. Acknowledgements

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I. Introduction

The use of information and communication technology to support information exchanges has been constantly growing over the last decade. A major focus of interest centers around the exchange of structured information between companies, generally referred to as "Electronic Data Interchange" (Benjamin et. al 1990; Hill, Ferguson 1991; Swatman, Swatman 1991 provide discussions of definitions). While there are reports of widespread adoptions of EDI in the US, reported usage of EDI in Europe is scanty. The TEDIS programme of the European Community was established in this context to increase the competitiveness of European production and service sectors, in view of the Common European Market realized in 1993, by promoting EDI.

The strategic importance of the use of EDI is often stated (Johnston/Vitale 1988, Cash 1985, Jackson 1989, Dearing 1990). It is therefore not surprising to find EDI as a major managerial concern, both from a technological and competitive point of view. There is a growing debate whether the use of EDI just improves the efficiency of operations or really delivers competitive advantages. A differentiated analysis is necessary in order to analyse these issues to advance the understanding of the impact of EDI (Klein 1992, Benjamin et al. 1990, Pfeiffer 1991). Careful company and industry-specific analysis is needed to determine the impact of EDI.

This article is divided into 6 sections. First, a methodology section describes the approach chosen and the cases analysed. An outline of the framework developed, and an analysis of the results are presented highlighting important issues. The article concludes with a short summary.

II. Methodological Approach

The general objective of the study was to analyse the issues

- the diffusion process of EDI,
- the impact of EDI on the competitiveness of single companies and the competitiveness of the industries,
- changes in the management and organizational structure of the organizations using EDI, and
- changes in relationships between organizations.

The present state of research of these issues, esp. on the impact of EDI can be characterized as being in a theory building stage.

As a study of EDI diffusion (Pfeiffer 1991) indicates, the number of successful implementations in Europe, is growing slower than expected and is unevenly distributed among the member states of the EC. This small number of implementations does not really allow for research on the impacts of

EDI by using standardized questionnaires and multivariate analysis. Instead, multi case studies appear best to study EDI-impacts. Bonoma (1985) advocates the use of case study research in environments "where the existing body of knowledge is insufficient to permit the posing of causal questions, and when a phenomenon cannot be studied outside the context in which it naturally occurs" (p. 207). Also, the case study approach focuses on understanding the dynamics present within a single setting (Eisenhardt, 1989). Pettigrew (1988) advises to choose cases of polar types observable, due to the limited number of cases for which data can be obtained in one study. The selection of cases will not rest on how typical a case may be, but on its explanatory power.

In light of the cultural and other variants among European countries, cross-country comparisons were planned to gain an understanding of different impacts through individual country specificities. The selection of companies was not restricted to one single industry. To better understand the impact of EDI on an international scale, cases from Denmark, France, Germany, Italy, the Netherlands, Belgium, Switzerland, and Spain as well as different industries were selected to demonstrate impacts of EDI in different settings.

To preserve local context on one side and to provide a coherent pan-European perspective on the other, a two-pronged method was used. On one side, the authors did the case study work in each country. On the other side, common research questions, a common framework of EDI impact (Chapter III), a common questionnaire for data collection (Table II.1), and case candidates were jointly discussed and selected.

- Company, Industry and Interviewee Data
- Intra-Organizational Level
 - General Awareness
 - Technology
 - Areas of Opportunity
 - Cost/Benefit Analysis and Control
 - Planning and Implementation
 - Control and Security
 - Organizational Issues
- Inter-Organizational Level
 - Industry Analysis
 - Inter-Organizational Links
 - Standards
- Closing Questions

Table II.1: Headings of the questionnaire

The cases (Table II.2) were selected from a sample of accessible success stories in the individual countries. Effort was taken to allow cross-country comparisons, for example in the household appliances industry and transportation industry.

Company Name	Country	Revenue bn 1991	Employees	Industry
DANZAS	Switzerland	10,2 SFR	15.500	Transport
KÜHNE&NAGEL	Germany	5,3 DEM	9.500	Transport
DSB (Edifragt)	Denmark			Transport
REG. HEALTHCARE (RHC)	Netherlands	Public (Hospitals)	n/a	Health Care
INDUSTRILINK	Denmark	5 companies	n/a	Steel and Tools
CIBA-GEIGY	Switzerland	21 SFR	92.000	Chemicals
BARILLA	Italy	2.754 LIT	6.820	Food
BOSCH SIEMENS HAUSGERÄTE (BSHG)	Germany	6,5 DEM	23.000	Household Appliances
BRUN PASSOT	France	254 FFR	160	Office Equipment
ALCATEL BELL	Belgium	30 BFR	7.500	Electronics
MERCADONA	Spain	145 PTA		Food
WHIRLPOOL	Italy	1.400 LIT	6.500	Household Appliances
TECHNISCHE UNIE	Netherlands	0,8 NLG	1000	Distribution
LEROY MERLIN	France	3 FFR	6.000	Distribution

Table II.2: The companies selected

A working conference using GroupSystems was held to present and discuss the first version of the case studies. After the case writing process was finished, another working conference was held to analyse the cases. The researchers met in the Hohenheim CA Team-Room to identify classification schemata and to analyse issues derived from the framework.

Two classification schemata proved powerful: the rationale for doing EDI and the direction of the EDI link in the value chain (Table II.3). Other classifications were discussed but did not further differentiate. These were adoption of EDI as an initiator or reactor (Cash and Konsynski 1985) and degree of competition in the industry.

Rationale of doing EDI	Strategic Reasons	Operational Reasons
Direction in the value chain		
Upstream	Alcatel Bell (B) Technische Unie (NL)	Whirlpool (I) Leroy Merlin (F) AECOC-Distributor BSHG (D)
Downstream	Brun Passot (F) Industrilink (DK) BSHG (D)	Ciba-Geigy (CH) Barilla (I) AECOC-Manufacturer
Mediators	Kühne&Nagel (D) DSB (DK) Regional Healthcare NL)	Danzas (CH)

Table II.3: Classification of Cases

III. Common Framework of Analysis

Numerous frameworks for EDI research have been proposed (Cash et. al. 1988, Barber 1991, Konsynski 1992, Klein 1992, Swatman and Swatman 1992), each of them with a different perspective and purpose. The authors therefore developed a conceptual framework of analysis as a common basis for individual field research, allowing a clear classification of the empirical material and further cross-case-analyses. This common framework of analysis uses two dimensions:

- (1) The process which results in an EDI application and its impacts, and
- (2) A number of levels on which to discuss EDI- related issues.

In the dimension of process, three stages are identified: (a) the context within which the application was developed, (b) the planning and implementation process through which the application was realized, and (c) the impacts as result of the application.

Context (1a) refers to anything which is important to understand the setting in which the EDI application took place, e.g., type of company, general awareness of EDI, competitive situation, motivation to adopt new technologies etc.

In the planning and implementation stage (1b), potential applications of EDI are analysed and prioritized.

A plan describes the objectives, the structure and the content of the project, the resources needed, the development process and the general steps for the successful completion of the project.

Cost benefit analysis as part of the planning process investigates whether the investment into an EDI-system is beneficial itself, and is more attractive than other investment alternatives. There are at least two problems with using capital budgeting for EDI-systems.

- (1) If the rationale to implement an EDI system is to rationalize existing procedures, the system can be considered as an isolated replacement investment. If EDI is seen as part of a strategic plan, aimed at gaining or defending competitive advantage, quantifying the various cash flow components will often not be possible. The effects of the proposed information system need to be related to market-oriented performance measures.
- (2) Under conditions that organization have to learn and to adapt themselves to a new technology, management on a strict financial basis can harm the diffusion process. Formal techniques of cost benefit analyses are appropriate under conditions of rationalization and control (Parker et. al. 1989).

After the decision "to do EDI" has been taken, the implementation has to be planned and realized. Implementation is seen as a process of organizational change, that combines technical, human, and organizational variables in a sequence of steps to complete the system. Planning is not sufficient for implementation success (Lucas 1981).

The EDI application will result or will not result in the intended effects/impacts (1c). The degree to which the objectives of the company are realized generally is used as an indicator of success.

Interorganizational systems such as EDI-systems appear to have a wide range of impacts (Gupta and Neal 1992, Barber 1991, Emmelhainz 1991, Holland. et. al. Blackman 1991, Callaghan 1987). Technical impact involves applications that must generate or accept the data. Significant changes may effect operating procedures or the definition of work. Business procedures must change to confirm with EDI messages and to use new communication patterns, report formats, and internal controls. The shift in the business processes changes skills and responsibilities of employees. There may be an impact on the basic attitudes among business functions, which now must work closely together. EDI may imply changes in business strategy (Cash and Konsynski 1985). Moreover, the EDI application can effect the context variables.

Its intraorganizational effects, on one side, do not appear to differ too much from those associated with Information Systems (Holland et. al. 1992, Scott Morton 1991, Bjørn-Andersen et. al. 1986, Whisley 1970). On the other side, the extent of intraorganizational impact can be hypothesized to vary with the initial motive to adopt EDI. If EDI is an element of a strategic plan, one would expect EDI to be associated with changes at all levels. If EDI is driven by direct cost reduction, one would expect EDI to be associated with changes at lower levels only.

Different frameworks have been proposed to classify this wide range of impacts. Cash et. al. (1988) posit that the 7-S-framework (Athos and Pascale 1982) is useful and provide three categories: (1) Systems (2) Skills and Staff and (3) Style, Structure and Strategy. Barber (1991) classifies the effects of EDI in four areas: (1) People, (2) Management practices, (3) Support Structure, and (4) Corporate culture.

All classification schemata suggest different levels of impact: from the tasks of individuals to departments and whole organizations; from changes in procedures to changes in staff and organizational structure. This leads to the second dimension of the common framework.

(2) In the second dimension, EDI-related issues are categorized into various levels. With regard to the context we distinguish between the societal, inter-organizational-, and intraorganizational level. Relevant influences on a societal level are the rise of new services and industries, the role of governmental bodies in stimulating EDI, and the availability of a telecommunications infrastructure etc.

On an interorganizational level, questions related to the industry structure, the competitive forces within the industry, inter-company cooperations etc. can be treated. It has been predicted (Cash et. al. 1992, Konsynski and Warbelow 1991) that the links between business partners through the integration of EDI-systems would push towards major changes in the business relationships. Strategic alliances would be created as a result of the close integration of business processes through full scale EDI systems, and that business process integration of previously proprietary and isolated information systems owned by different business partners through EDI, would change the economics of doing business and the competitive situation.

Within the organization, technical, organizational, and strategic issues are of interest.

Finally, within the individual organizations EDI may lead to changes on the individual, group or departmental level.

IV. Empirical Results

The empirical results will be described according to the categories:

Costs and benefits of EDI
Planning and implementation of the application
Perceived success
Intraorganizational impact
Interorganizational impact
Success factors for EDI implementation.

A. Costs and benefits of an EDI application

The companies were asked about their practice of EDI systems evaluation. Questions related to an ex ante evaluation of the project within the planning process, and to the ex post evaluation.

In general, cost benefit analysis was seldom applied. In only three cases was an ex ante evaluation done. Various other reasons, such as

- Management's belief that EDI with suppliers should be an integral part of the logistics system (Technische Unie),
- The need to have a new information system in place, with EDI as a part of it (Kühne&Nagel),
- Telepurchasing as a central part to the company's strategy and as a means for survival (Brun Passot),
- Experimentation with a new technology, without regard to cost and benefit issues (Ciba-Geigy),

were stated. They related to the strategic intent of the EDI-system, the EDI-system as an element of a broader plan, and the necessity of organizational learning.

Company groups	Average	Upstream Integrators	Downstream integrators	Mediators
Benefits from EDI				
Reduced document handling	3,92			
Reduced inventory levels		3,8	3	1
Improved business relations	4,21	3,75	4	4,5
Better service to customers	4	2,8	4,6	4,75
Competitive advantage	3,85	3,2	4,4	4,25
New business opportunities	3,92	1,4	3	2,75
Ex post: Realized competitive advantage		3,4	4,2	2,75

Table IV.A.1: Importance of EDI benefits

Table IV.A.1 provides an overview on the statements about potential influencing factors (importance ranging from 1 to 5). "Reduced document handling" (average 3,92) was ranked highest among the "tangible benefits", while "better cash management" ranked lowest with 1,14. Nearly all less tangible benefits had about the same average of about 4. Only "new business opportunities" had a lower average of 2,5.

Among cost factors mentioned, "interface to existing systems" and "communications hardware and software" ranked highest with an average of 4,21 and 3,14. Eleven companies reported improved business relations with their trading partners. A realized competitive advantage was ranked 3,85, with 9 companies rating it 4 or 5, thus indicating to have fully realized the intended strategic benefits.

Tangible benefits systematically got higher average rankings in companies with an operational motive to do EDI than in companies with a strategic perspective on EDI. The same difference holds true for cost factors. It could be argued, that a strategic rationale for EDI results in a lower perceived importance of tangible and short term-oriented factors.

Analysed according to direction the sample supports the hypothesis that most strategic advantage is expected from downstream EDI: better service, expected and realized competitive advantage and the chance for new business opportunities receive the highest scores. Upstream EDI is mainly motivated by the potential for reduced inventory and improved business relations with suppliers.

B. Planning and Implementation

Planning and implementation are seen as key factors for the success of EDI-projects (see Chapter III).

In 5 of 14 cases, the EDI project was systematically and bureaucratically planned, in 8 it was systematically planned only in some areas, while in one case it did not benefit from any formal plan but was realized through an ad hoc approach. In half of the cases, EDI was a part of a wider strategic business plan (e.g., logistics, business reorganization, flexibility strategy etc.). It seems that previous and vast telecommunication (EDI or other) experience creates the basis for formalized and systematic EDI planning.

All but one of the companies studied were "first movers" in their respective industry. This would indicate that the companies were acting as "pioneers" without a role model or proven planning process to imitate or adapt. In the case of BSHG a clear orientation for the household appliances manufacturer was given through the example of supplier-manufacturer links in the automotive industry.

All firms started the EDI implementation with a pilot that in only one case was seen as a failure. Typically the partners chosen for the pilot were "key business partners" with high trading volumes and previous experience in telecommunications. Piloting EDI-applications coincides with the implementation strategies chosen: only in two cases a "big bang" procedure was selected. In all other cases the EDI-project began with an initial "parallel running stage" towards a complete replacement of the paper-based messages.

Nearly 60% of the cases adopted a "phased penetration" predicting growing numbers of users to be connected or transaction percentages to be handled. Two routes for EDI growth were found: one aiming at user growth (65% of the cases), and the other one aiming at message type growth (25% of the cases), usually from orders to invoices to financial documents. 10% of the companies attempted both. Different approaches were adopted to get partners into EDI, ranging from discounts on EDI software prices to some kind of partnership (co-makership, win-win partnerships). The majority of the companies implemented top-down, more precisely middle-down, with line management being the principal actor.

Comparing the cases along the dimensions "rationale" and "direction", no significant difference could be identified.

While the implementation processes observed differed in detail, some stages were common for all cases (Table IV.B.1).

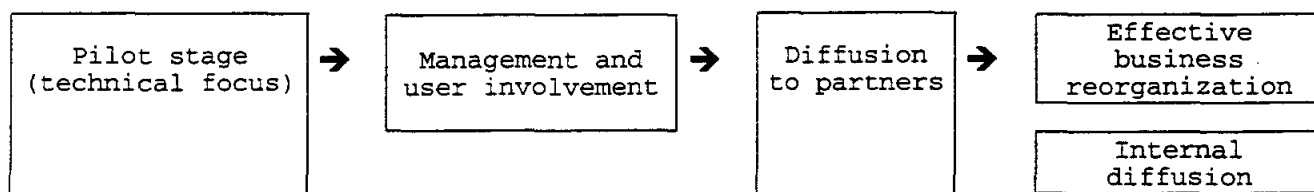


Table: IV.B.1: Stages of EDI implementation

C. Perceived Success

Success of an IS-implementation is achieved, when all planned objectives have been achieved. From the companies' point of view, nearly all EDI projects were seen as a success. Successful implementation was identified as:

- creation of a running EDI application,
- cost reductions,
- reduction of lead times,
- reduction of inventory levels,
- growth of sales,
- penetration among suppliers or customers, and
- creation of new kinds of services.

In spite of this generally positive perception, some shortcomings were mentioned in the interviews. For example:

- smaller cost reductions than planned,
- lower penetration rates than planned,
- longer implementation time than planned.

Upstream EDI applications show a similar pattern in accordance with the market power the companies exert towards their suppliers. All companies are major players in their highly

competitive industries with a strong position towards their suppliers. All succeeded in linking with a remarkable number of trading partners.

The companies implementing EDI downstream show a more differentiated picture. The major player companies (Barilla, Henkel, BSHG) succeeded in linking customers but with some resistance and a stagnant penetration rate. Brun Passot operates as small player in a highly fragmented industry and its success is impressive. The creation of new services results in being exclusive supplier of office products for large accounts which increases sales dramatically, and demonstrates differentiation through EDI.

The three companies from the transport sector show a similar pattern. The European market of 1993 is igniting competition, and these competitors try to position themselves as major players in the European arena. An internal communications network, able to integrate the customer into the information flow, becomes a prerequisite for transport services providers. EDI represents a strategic advantage for the first movers, soon becoming a strategic necessity/other for survival. As not all customers are willing to join in a win-win-partnership, an awareness-raising process becomes necessary: "It is very difficult to force customers into processes that obviously are advantageous for them", a Kühne&Nagel manager stated.

D. Intraorganizational Impact

The intraorganizational impact was analysed according to the layers and arguments put forward in common research framework.

The analysis of the cases revealed that the impact of EDI is more frequent at the individual level (80% reported changes) followed by department level (50%) and organization level (35%). In all cases where EDI affected the individual level, data entry and data verification had been suppressed. There seems to be a hierarchy of impacts, as hypothesized. All the cases reporting changes at the department level also experienced changes at the individual level. At the organization level, the evidence is less strong: 80% of the cases reporting changes at this level also reported changes at the individual level and 60% at department level.

Grouping of the responses according to the rationale for EDI reveals an interesting pattern (Table IV.D.1). Where the rationale for EDI was business strategy, the extent of change is far greater than in those cases where the rationale was operational.

EDI motive	Strategic Reasons	Operational Reasons
Impact level		
Individuals	100%	50%
Departments	62%	33%
Organization	38%	33%

Table IV.D.1: Reported changes though EDI according to EDI motive

It is somewhat surprising that the extent of impact at the organization level is relatively low (38%) for those cases that initiated EDI for strategic reasons. It could be argued, that it is too early to experience significant changes at that level. The statements on changes expected in the future support this argument. A majority (79%) reported that EDI will affect new activities in the near future, as well as additional organizational units (64%). Another explanation could consider the size of the firms involved, where the impact of one EDI-application will hardly effect overall performance.

In spite of the abundant literature on the potential of telecommunications to flatten organizational structure, no cases reported any reduction of the organization's hierarchical layers due to EDI alone.

E. Interorganizational impact

Two interorganizational issues were investigated: (1) modification in the competitive arena as a result of the introduction of EDI, and (2) the extent to which interorganizational links were formed between EDI-partners.

(1) Competitive analysis

The competitive position of business partners was measured using Porter's framework (Porter 1985). The questions asked were 'Did EDI change your position within the industry with respect to the following influences in the industry: 'potential new entrants', 'bargaining power of suppliers', 'bargaining power of customers', 'threat of substitute products', an 'industry rivalry' (with 1 = no change, 5 = radical change). Since one of the cases (RHC) cannot be analysed following traditional competitive analyses, it is excluded. Table IV.E.1 shows the remaining 13 cases.

Cases	Mediators		Downstream				Upstream				Sums and Averages									
	Danzas	Kühne&Nagel	DSB (EDIFRAGT)	Regional Healthcare	Industrilink	Ciba-Geigy	Barilla	Bosch Siemens Hausgeräte	Brun Passot	Alcatel Bell	Mercadona	Whirlpool	Technische Unie	Leroy Merlin	Total of "1"	Total of "2-5"	Total Average	Average Mediators	Average Downstream	Average Upstream
Does EDI change the position of your company within in the industry with regard to the following influences ?																				
potential new entrants	2	3	2		4	1	1	1	4	1	1	1	3	3	6	7	1,93	2,33	2,20	1,80
bargaining power of suppliers	1	1	2		1	1	1	1	3	4	2	4	1	4	6	7	1,86	1,33	1,40	3,00
bargaining power of customers	4	2	4		3	1	3	1	4	2	1	4	1	2	4	9	2,29	3,33	2,40	2,00
threat of substitute product/service	2	3	2		1	1	1	1	3	1	1	1	2	1	8	5	1,43	2,33	1,40	1,20
industry rivalry	3	4	5		5	1	1	1	3	3	1	3	2	3	4	9	2,50	4,00	2,20	2,40

Table IV.E.1: Competitive impact of EDI

Even though the total number of changes (non '1' values) indicates changes in only slightly more than half of the cases, a closer look supports the hypothesis that the competitive arena is changed due to the introduction of EDI.

The largest changes were found for the **mediating companies**. Just the 'bargaining power of the suppliers' changed only once. For the dimensions 'new entrants', 'bargaining power of customers', and 'industry rivalry' significant changes in the freight market were perceived. In that market EDI is used as a competitive weapon against the competitors not using EDI.

Downstream integrators reported relatively few changes, consistent with our expectations. 'Bargaining power of suppliers' and 'threat of substitute products' were only marginally relevant. More interesting is the 'bargaining power of customers'. Sponsors providing EDI-facilities for their customers hope for higher customer loyalty. However, customers choose whether they are prepared to use the EDI-service made available. The sponsor can seldom force the service upon the customer. Only if a win-win situation is created, whereby the customer perceives a clear benefit will the customer accept the new possibility. Two downstream integrators (Barilla, Industrilink) reported substantial changes in customer bargaining power. The EDI service provided from Barilla to the distributors is perceived to substantially tie-in the customers. Barilla took an active role in managing the full distribution channel helping the distributors to more effectively handle logistics. The logistics strategy changed from a sell-into-the channel to a sell-out-to the customer principle. These linkages between Barilla and the different partners in the distribution chain, result in minimizing transportation costs, safeguarding product quality given its shelf life, and improving economics of scales in warehousing.

In the case of Industrilink, even though the distributors are now more inclined to buy from the vendors providing the EDI service due to the convenience of the system and the sunk investment, the bargaining power of the distributors to the manufacturers has not been reduced. Still, one could argue that the sponsor is now morally committed to continue providing the EDI service. Due to pressure from the distributors/customers Industrilink has been forced to open the system to competing vendors.

For the **upstream integrators** the situation is reversed, where we would expect to find large changes when an important buyer starts an EDI project. Major changes in the competitive situation have not uniformly been the case. We found the greatest change in the reduction of the bargaining power of the suppliers. The upstream integrator has been able to impose his standard requirements for the use of an EDI system on suppliers. A subscription to the system means a step towards a higher level of integration of the systems of the trading partners. This can then be used as in the case of Brun Passot, where its superior handling of logistics throughout its supply chain allows it to guarantee a 48-hour delivery anywhere. Some customers no longer stock office supplies.

Other important changes in the competitive situation are found in the 'internal industry rivalry', as in the case of Technische Unie (TU). This distributor successfully fended off attempts from manufacturers to bypass the wholesaler (TU) through utilizing EDI very effectively, thus offering a large selection of goods from many different vendors, providing very short delivery times, and at the same time maintaining low inventories. In this case a distributor took charge by utilizing an EDI system for upstream integration, instead of waiting for the manufacturers to take charge and

design an EDI system downstream.

(2) Interorganizational links

The changes in the industry structure towards creating actual links were investigated for the 13 of the 14 cases. To the question whether EDI had created strategic partnerships, the overwhelming response was "no". However, in almost all the cases a change in the direction of a preferred supplier or trading partner was found. The following examples indicate some concrete changes:

Stimulated preferred suppliership (TU, Whirlpool, Alcatel)

Intensified cooperation between business partners (Alcatel, Brun Passot, Industrilink, RHC)

Widened scope of activities (Kühne&Nagel, Barilla)

Strengthened links to customers (Alcatel, BSHG, Brun Passot, DSB, Industrilink).

The establishment of the EDI link, and the obvious benefits associated with using the system once established, provided motivation to do business with the partner utilizing the EDI link over the non EDI-user. The establishment of an EDI link was not a result of a top-down strategic decision to force a strategic alliances with a particular partner. An interpretation could be, that in the long run a strategic alliance is likely to grow out even of an operational level decision to introduce EDI.

In the current study we found few examples of business functions being taken over or outsourced as a result of the introduction of EDI. Only three of the cases provided signs of such changes (Barilla, Leroy Merlin, DSB).

Barilla took over part of the stock keeping functions of certain distributors. For instance, when inventory levels at the distributor fall below a predefined level, purchase orders are triggered by the logistics function at Barilla.

For Leroy Merlin, wholesalers using EDI deliver products directly to Leroy Merlin's outlet stores instead of delivering them to a centralized warehouse. The wholesaler has taken over the stock-keeping function for Leroy Merlin.

DSB changed its relationship with one of its biggest customers, who now outsources its outbound logistics to DSB. DSB employees work permanently in the warehouse planning and organizing the dispatching, providing their customer with reduced lead time on orders, and facilitating just-in-time delivery. From DSB's point of view, the actual packing and preparation for the dispatching can be more effectively planned. EDI facilitated that process.

F. Success factors

Success Factors refer to the critical enablers of the successful development, use and diffusion of an EDI application. Following is a review of 10 success factors frequently mentioned in the literature (Barber 1989, Shaw and Winter 1991, Oppelt and Nippa 1992).

1) **Top Management Support:** The majority of the EDI applications had strong support, commitment and in some cases personal involvement from the company's top management. This finding is consistent with numerous studies which stress the importance of high-level managerial backing for the successful development of strategic information systems. The study revealed some diversity. The champion ranged from the Chief Executive Officer (Mercadona), to his Deputy (Brun Passot), to the owner of the company (Kühne&Nagel), to a member of the Executive Committee (Technische-Unie). The traditional situation of a technical manager or the IT Director playing the role of the project champion was also encountered (Ciba-Geigy, Leroy-Merlin, Danzas, and BSHG upstream). In one instance (Regional Health Care), top management hired the champion from the outside, although this is a rare occurrence.

2) **Win-Win Situation:** In cases where there were tangible benefits, both qualitative and quantitative for the parties involved, the adoption, use and diffusion of the EDI application went smoothly and enthusiastically. The negotiation and set-up time at the partner side was reduced and the necessary changes to the traditional, paper-based procedure swiftly performed.

3) **Strong internal IT Expertise:** A strong IT know-how greatly facilitated the design and implementation of the EDI application. Moreover, it has significantly reduced the risk involved with the introduction of a new technology. In some cases (BSHG upstream, BSHG downstream), the IT expertise was not actually residing within the companies themselves but came from their mother institutions.

4) **Strong IT Expertise of First EDI Partner:** Several cases showed the importance of having as a first EDI partner a company with a strong IT expertise. This reduced the implementation risk and helped establishing the EDI link between the two parties. The first EDI partners included a electronics/computer companies like Phillips (with Technische-Unie and DSB), Hewlett-Packard (with Kühne&Nagel), and Digital Equipment (with Brun Passot).

5) **Strong Business Relationship with First EDI Partners:** In addition to the strong IT expertise, selection criteria for the first EDI partners included the existence of a long-time business relationship, mutual openness, and trust between the two parties.

6) **Evolutionary Approach:** All companies followed an evolutionary approach in launching their EDI application. They first developed a basic version of the intended EDI application (e.g., only placing orders) and tested it with a pilot partner. They then added more capabilities to the application (acknowledgement receipt, delivery bill, invoicing), and adopted a gradual roll-out of the EDI application in terms of the number of partners hooked to the system and the volume of transactions being handled.

7) **Strategic Embeddedness:** The EDI application was fully integrated in the company's logistics chain, as it was explicitly shown in the cases of Alcatel/Bell, Barilla, Kühne&Nagel, Danzas, and Leroy-Merlin.

8) **Business Process Redesign:** Most companies have revised their business and management processes in conjunction with their EDI application. The necessary organizational changes were implemented at only a couple of companies, and are still planned for in the remaining ones.

9) Being the First Mover: With the exception of one case where the EDI application was an internal experimentation (Ciba-Geigy), all other companies were first movers with their EDI development. This had important consequences in terms of potentially increasing market share, creating new business opportunities, or even establishing a new industry standard. Two companies (Brun Passot, Kühne&Nagel) redesigned their business scope.

10) Use of an Available Standard: The use of a commercially-available standard has reduced the development cost and time, and decreased the risk of successfully launching the EDI application.

V. Conclusion

This article presented many results based on conclusions from 14 cases in EDI. Two observations seem to be most important:

- (1) EDI-projects are on one side typical IS-implementation issues and on the other side such interorganizational systems need special attention to achieve success in penetration.
- (2) Organizational change is a necessary condition for effective utilization of information (McKersie and Walton 1991). Only when new work organization accompanied EDI did we see significant performance advantages. Strategic benefits were achieved when EDI was integrated with other systems and when the organization and business processes were re-engineered. The degree of change that EDI necessitates seems to be directly related to its rationale. Companies that adopt EDI for strategic reasons underwent more changes than those with operational reasons.

It becomes obvious, that rationale and such EDI-awareness are key factors, as only in those case with a strategic rationale the potential of using EDI-systems was fully utilized.

VI. References

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