

Electronic Data Interchange And Buyer-Supplier Relationships

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Introduction

In recent years, manufacturing firms have increased their reliance on suppliers. Such reliance on suppliers has created a critical need for firms to better understand the dynamics across the supply chain (8). Many have suggested that supply chain management can lead to faster product development, decreased production lead-times, reduced cost and increased quality (6). According to Lavery (15):

..."Companies started to evaluate the need to increase the efficiencies of the supply chain when businesses that had expanded in the 1980's began shrinking in the face of foreign competition, customer demand and economic pressure. Progressive companies were forced to evaluate and restructure the way they did business and this led to a reexamination and reengineering of the way that products and information flowed along the supply chain."

Defining supply chain management is difficult because corporate leaders, industry experts and business analysts differ on its precise definition. A better way of defining supply chain management might be to demonstrate the elements it entails.

Supply chain management is premised on inter-organizational systems (IOS). Inter-organizational systems are based on information technology that transcends organizational boundaries (27). Johnston and Vitale (14) define an inter-organizational system as:

...An automated information system shared by two or more companies. An inter-organizational system is built around information technology, that is, around computer and communication technology that facilitates the creation, storage, transformation and transmission of information.

The adoption of inter-organizational systems continues to grow at a significant rate. The IOS tools of supply chain management include bar coding (4,5,16,17), Just-in-time (JIT) manufacturing/distribution (20,21), Quick Response (QR) (9,11,21), Point-of-Sale (POS) barcode scanning (22,23) and eCommerce (electronic commerce, or selling products and services online).

Electronic Data Interchange (EDI)

An additional IOS component of supply chain management in recent years is electronic data interchange (EDI) (18). EDI is a computer-to-computer electronic communication method whereby trading partners (i.e. hub organizations and their spoke customer and suppliers) in two or more organizations exchange business transactions. The transactions consist of documents in structured formats that can be processed by the recipient's computer application software (19).

The American National Standards Institute (ANSI) is the coordinator for national standards in the United States. This includes the standards for all industries in the United States regardless of what is manufactured, developed, distributed or marketed. ANSI does not develop national standards; it charters organizations called "Accredited Standards Committees" (ASCs) (3). In 1979, the American National Standards Institute (ANSI) established the Accredited Standards Committee (ASC) X.12 for electronic data interchange (18). Some examples of ASC X.12 EDI documents are purchase orders, order confirmations, customer buying schedules, advanced shipping notices (ASN), invoices and electronic funds transfer of payment (EFT).

EDI is rapidly changing the way business is conducted throughout the world. Firms that use EDI are more efficient and responsive to the needs of their clients and are often more competitive (7). Adopting EDI can eliminate the mailing or faxing of paper documentation and the manual processing of quotations, purchase orders, invoices, shipping documents, customs documents and other business transactions. Because the data is processed and stored automatically, tasks such as re-keying data and printing purchase orders and invoices are eliminated (10).

Advantages of EDI

The advantages of EDI, regardless of whether VAN-facilitated or Internet-based, are numerous and well documented. Value-added networks (VANs) are intermediaries that serve as cost-effective communication links between trading partners, offering the ability for a single entity to communicate efficiently with numerous other parties in a single transaction.

According to Wigand (28) the benefits of EDI are:

1. When data are in electronic form, they can be collected, transmitted, stored, retrieved, processed and analyzed more readily than if the same data were in paper form.
2. Errors associated with keying in data into one system and then re-keying in the same data into a different system can be virtually eliminated.
3. EDI speeds the transmission of data between organizations, enabling just-in-time processes.
4. The use of EDI reduces inventory and inventory-related costs by reducing order lead times, thus benefiting both the manufacturer and the buyer.
5. EDI helps a company's marketing efforts by controlling costs and providing better customer responses.
6. Eliminating the labor-intensive tasks of collecting, sending and receiving paper-based documents increases productivity within the organization.
7. Sales people are able to focus on selling rather than bureaucratic paperwork.
8. Electronic transaction allows for the reduction in personnel time and those involved in paper-based records handling.

Other noted benefits of EDI found in the literature are better cash management, increased business opportunities and improved customer service. In addition, in office-information systems, EDI makes it possible to combine once-separate functions, such as database management, sales analysis, accounting and word processing, into an integrated management information system (13). Furthermore, a company that integrates EDI into

management systems can more readily develop Value-Added Partnerships (VAPs) with suppliers and customers.

Johnston and Vitale (14) also believe that perhaps the most significant outcome of IOS adoption is the positive change it brings to buyer-seller relationships. They say the most successful users of IOS have recognized that increased familiarity with customers, dealers or suppliers afforded by joint systems leads to collaborative behaviors that improve economic performance for both partners. Vlosky et al. (24) suggest that in EDI implementation, key success factors are communication and coordination, joint supplier-buyer pre-planning and multi-functional involvement within and between exchange partners.

Vlosky et. al (24) and Vlosky and Wilson (25,26) found that technologies that span companies, such as EDI, cause short-term disruptions in otherwise stable buyer-supplier relationships due to non-alignment of exchange partner expectations and perceptions within relationships.

In a 1998 study specific to EDI in the forest products industry, EDI was examined in the context of implementation strategies in the home center buyer-wood products supplier channel by Wilson and Vlosky (29). They found that introducing an EDI is an uneven process where the buyer (home centers) gains more than the seller (wood products suppliers). Overall, sellers considered themselves worse off than buyers before EDI is implemented and still worse off than buyers after implementation occurs.

Manufacturer suppliers also had lower expectations of benefits from developing EDI. In what is often a defensive mode, they have reacted to home center requirements without fully understanding the potential benefits that can be gained by their companies.

Continuing previous research, the goal of this study is to update our understanding of how EDI implementation impacts business relationships.

The Study

Populations of interest

The populations in the study were forest product manufacturers in the United States and Canada. Company information such as addresses, phone numbers and points of contact were gleaned from two references (1,2). The study included the top 100 companies in each industry sector as these companies comprise the majority of production. The balance of the sample was randomly chosen from the remaining companies. The final sample size was 1,263 (223 companies in Canada and 1,040 in the United States).

Once the population was defined, a mail questionnaire was implemented. Survey development and implementation for the study was based on the Total Design Method (TDM) recommended by Dillman (12). Accordingly, guidelines for survey structure, cover letter, pre-survey notification, initial survey mailing, post-survey reminder and a second mailing were followed. A tool for improving response rates was promising a complimentary copy of results to respondents who participated in the survey. In addition to improving response rates, it also benefits the respondents by broadening their understanding of EDI.

Research Results

Response rates

Of the 1,263 surveys mailed, 205 were returned as undeliverable. The final useable sample size was 1,058. Of these, 236 responses and 136 responses were received from the first and second mailings, respectively, for an adjusted response rate of 35.8 percent.

Current Status of Electronic Data Interchange (EDI)

Percentage of Respondents Conducting EDI

The percentage of respondents conducting EDI was broken down into two categories, "currently doing EDI" and those that "plan to conduct EDI by 2002". Sixteen percent of respondents indicated that their company is currently conducting EDI, whether it is Internet or value-added network facilitated EDI. Of the respondents not currently conducting EDI, 28 percent indicated that their company planned to conduct EDI by the year 2002. According to the results, 40 percent of the respondents will be conducting EDI by the year 2002.

EDI implementation is highly correlated to company size. Over 85 percent of companies with 1997 sales of \$5 billion or greater were EDI capable while this figure is only 2.5 percent for respondents with sales of \$10 million or less.

Fifty percent of respondents that are conducting EDI implemented it before 1993, with the balance evenly distributed over the past subsequent five years. These early adopters incurred higher costs associated with EDI implementation, primarily due to software and VAN costs, while late adopters have benefited from an increased knowledge base and improved lower cost technology (i.e. Internet).

Who initiated EDI implementation?

As far as who initiated the implementation of EDI, results indicate that the home center exchange partner initiated the implementation of EDI the majority of the time (43 percent of the respondents), closely followed by joint decision (37 percent). The fact that 80 percent of

the time the exchange partner initiated or was involved in the decision to implement EDI supports the notion that this is a customer-driven activity.

EDI Buyer/Seller Relationships

The relationship questions in the study were posed as Likert-type scales where respondents were asked to indicate their degree of agreement or disagreement on a symmetric agree-disagree scale.

Respondents were first asked to identify their perceptions on the relationship that they think their EDI trading partners have with them (**Table 1**). On average, responses indicate that EDI partners are perceived to be fairly committed to long-term relationships with respondent companies (3.7 on a 5-point scale of agreement). Second ranked was the belief that EDI relationships will be better than non-EDI relationships in the long-term (3.6/5.0 scale). To lesser degrees, but still above 3.0, or neutral, respondents believe that short-term relationships are better than with non-EDI partners, that EDI partners are easy to work with in solving EDI-related problems and that their partners have invested significantly in developing the EDI relationship.

Table 1.**Respondents Perceptions of Their EDI Customers**

Scale: 1=strongly disagree to 5=strongly agree

Question	Strongly Disagree (percent)	Disagree (percent)	Neither Agree nor Disagree (percent)	Agree (percent)	Strongly Agree (percent)	Mean Response
Our EDI trading partners...						
Are committed to long-term relationships with my company (n=48)	2.1	6.3	22.9	54.2	14.6	3.7
Will have better business relationships with my company than non-EDI customers in the long-term (n=48)	6.3	6.3	29.2	39.6	18.8	3.6
Have better business relationships with my company than non-EDI customers in the short-term (n=48)	8.3	6.3	25.0	54.2	6.3	3.4
Are easy to work with in solving EDI related problems (n=48)	0	12.5	37.5	43.8	6.3	3.4
Have invested considerable time and expense in developing EDI relationships with my company (n=48)	0	12.5	41.7	35.4	10.4	3.4
Appreciate our technical challenges associated with implementing EDI (n=47)	0	12.8	46.8	34.0	6.4	3.3
Are dependent on us (n=46)	10.9	17.4	34.8	26.1	10.9	3.1

The second set of questions was from the respondent company perspective regarding their attitude towards EDI home center customers (**Table 2**). The response to the statement "My Company is committed to long-term relationships with our EDI home-center customer"

had the highest mean response of 4.3 on a 5-point scale, where 46 percent of the respondents indicating that they strongly agree. Although respondents also believe that their companies give in to partner EDI requirements, they understand their partners need to implement EDI. Respondents felt that they made an investment of time and expense to develop the EDI linkage (3.6/5.0) and had to modify corporate business procedures to accommodate EDI (3.5/5.0). Finally, 38.3 percent of respondents agreed or strongly agreed that they are more apt to share information with EDI partners than with non-EDI partners (3.3/5).

Table 2. Respondent Attitudes Towards EDI Customers
Scale: 1=strongly disagree to 5=strongly agree

My company...						
Question	Strongly Disagree (percent)	Disagree (percent)	Neither Agree nor Disagree (percent)	Agree (percent)	Strongly Agree (percent)	Mean Response
Is committed to long-term relationships with our EDI home center customers (n=46)	0.0	4.3	8.7	41.3	45.7	4.3
Generally gives in to EDI partner's requirements (n=46)	0.0	6.5	34.8	26.1	32.6	3.9
Understands our customers' need to implement EDI (n=47)	0.0	4.3	27.7	46.8	21.3	3.9
Has invested a lot of time and expense developing relationships with EDI partners (n=47)	2.1	12.8	27.7	38.3	19.1	3.6
Had to modify our business procedures to adapt to our EDI partners requirements (n=47)	2.1	10.6	36.2	42.6	8.5	3.5
Is more apt to share information with EDI partners (n=47)	4.3	10.6	46.8	29.8	8.5	3.3

The respondents were queried about their expectations of EDI prior to the implementation of EDI. The following statement: "When we initially implemented EDI with customers, we expected to develop..." was the precursor to a number of benefits (**Table 3**). "A better relationship with customers" and "Increased data accuracy" had the highest mean response of 4.2 with 34 percent and 36 percent of the respondents indicating that they strongly agree to these statements, respectively. Having the expectation of "A reduction in customer base" had the lowest mean response of 2.3 where 22.4 percent of respondents indicating that they strongly disagreed that this was an expected result from EDI implementation.

**Table 3. Expectations of EDI Prior to Implementation
Scale: 1=strongly disagree to 5=strongly agree**

When we initially implemented EDI with customers, we expected to develop...						
Criteria	Strongly Disagree (percent)	(%)	Neither Agree nor Disagree (percent)	(%)	Strongly Agree (percent)	Mean Response
A better relationships with customers (n=50)	0.0	4.0	8.0	54.0	34.0	4.2
Increased data accuracy (n=50)	0.0	0.0	18.0	46.0	36.0	4.2
A reduction in human data entry errors (n=50)	0.0	0.0	28.0	42.0	30.0	4.0
Increased information sharing with customers(n=49)	2.0	2.0	30.6	53.1	12.2	3.7
A stable source of product sales (n=49)	2.0	6.1	38.8	44.9	8.2	3.5
Reduced operating costs (n=49)	2.0	14.3	32.7	36.7	14.3	3.5
Lower prices from EDI partners (n=49)	14.3	20.4	55.1	8.2	2.0	2.6
A reduction in our customer base (n=49)	22.4	32.7	36.7	6.1	2.0	2.3

The respondents were then queried about the actual results of EDI after implementation. The following statement: "Today, after implementing EDI with customers, we have developed..." was the precursor to the same benefits (**Table 4**). "A reduction in human data entry errors" and "Increased data accuracy" had the highest mean response of 3.8, with 22.4 and 20.4 percent of respondents indicating that they strongly agreed with these statements, respectively. "A reduction in our customer base" had the lowest mean response of 2.5 with 48 percent of respondents indicating that they disagree or strongly disagree.

**Table 4. Actual Results of EDI after Implementation
Scale: 1=strongly disagree to 5=strongly agree**

Today, after implementing EDI with customers, we have developed...						
Criteria	Strongly Disagree (percent)	(%)	Neither Agree nor Disagree (percent)	(%)	Strongly Agree (percent)	Mean Response
A reduction in human data entry errors (n=49)	0	10.2	18.4	49.0	22.4	3.8
Increased data accuracy (n=49)	0	10.2	20.4	49.0	20.4	3.8
Better relationships with customers (n=49)	2.0	8.2	28.6	44.9	16.3	3.7
A stable source of product sales (n=49)	2.0	8.2	55.1	28.6	6.1	3.3
Increased information sharing with customers (n=48)	8.3	6.3	45.8	33.3	6.3	3.2
Reduced operating costs (n=49)	6.1	20.4	36.7	26.5	10.2	3.1
Lower prices for EDI partners (n=49)	18.4	20.4	49.0	8.2	4.1	2.6
A reduction in our customer base (n=48)	16.7	31.3	41.7	8.3	2.1	2.5

Two-sample two-tailed t-test were conducted to compare the means of the "before and after" results in Tables 3 and 4. Results indicate a highly significant difference at $\alpha = 0.01$ between means of the following statements: "A better relationship with customers", "Increase

data accuracy" and "Increase information sharing with EDI customers" (**Table 5**). A significant difference at $\alpha = 0.05$ was found between means of the following statements: "a reduction in human data entry errors" and "reduced operating costs". Finally, no significant difference between means were found for the following statements: "A reduction in our customer base", "A stable source of product sales and lower prices from EDI customers". In all cases except "A reduction in our customer base", pre-implementation expectations exceeded post-implementation results.

Table 5. Two-Sampled T-Test Comparing Means of Expectations of EDI Prior to Implementation and Actual Results of EDI
Scale: 1=strongly disagree to 5=strongly agree

Statements Means Were Compared For	Difference in Means	Standard Deviation	t-value	Significance (2-tailed)	
A reduction in human data entry errors	0.2041	0.68	2.112	0.040	*
A reduction in our customer base	-0.1250	0.82	-1.062	0.294	NS
A stable source of product sales	0.1875	0.89	1.458	0.152	NS
Better relationships with customers	0.5306	0.98	3.786	0.000	**
Increased Data accuracy	0.3878	0.89	3.065	0.004	**
Increased information sharing with customers	0.4792	0.97	3.432	0.001	**
Lower prices from EDI partners	0.0000	0.68	0.000	1.000	NS
Reduced Operating Costs	0.2917	0.97	2.090	0.042	*

NS = No Significant Difference

* = Significant at $\alpha = 0.05$

** = Significant at $\alpha = 0.01$

The respondents were asked about their dependence in the relationship with EDI customers. "EDI customers are strategically important to my company" had the highest mean response of 3.8 where 26 percent of the respondents indicated that they strongly agree (**Table 6**). The statement "It would be difficult for EDI customers to replace the sales and profits generated by my company" had the lowest mean response of 2.9 with only 4 percent of respondents strongly agreeing to this statement.

The respondents were asked how valuable were alternative customers, other than EDI customers, for their products. "There are many alternative customers that have the same value to my company that EDI customers do" had the highest mean response of 3.7 where 19.6 percent of respondents indicated that they strongly agree (**Table 7**). The statement "Compared to non-EDI customers", "Our relationship with EDI customers is better" had the lowest mean response of 3.0, however, 56.9 percent of respondents indicated that they neither agree nor disagree.

**Table 6. Dependency on the Relationship with EDI Customers
Scale: 1=strongly disagree to 5=strongly agree**

Criteria	Strongly disagree (percent)	(%)	Neither agree nor disagree (percent)	(%)	Strongly agree (percent)	Mean Response
EDI customers are strategically important to my company (n=50)	2.0	4.0	28.0	40.0	26.0	3.8
If we did not implement EDI, our EDI customers would seek alternative suppliers (n=50)	1.0	4.0	34.0	34.0	24.0	3.7
If they wanted to, our EDI customers could severely penalize us if we are uncooperative in implementing EDI (n=50)	4.0	14.0	40.0	24.0	18.0	3.4
Our bargaining position in the relationship is strengthened with EDI customers because we have implemented EDI (n=50)	10.0	6.0	38.0	34.0	12.0	3.3
It would be difficult for our firm to replace the sales and profits generated by EDI customers (n=50)	12.0	16.0	28.0	20.0	24.0	3.3
We feel we have an equal partnership with EDI customers (n=50)	4.0	16.0	40.0	28.0	12.0	3.3
It would be difficult for EDI customers to replace the sales and profits generated by my company (n=50)	14.0	12.0	48.0	22.0	4.0	2.9

**Table 7. How Valuable are Customers, Other than EDI Customers?
Scale: 1=strongly disagree to 5=strongly agree**

Criteria	Strongly Disagree (percent)	(%)	Neither Agree nor Disagree (percent)	(%)	Strongly Agree (percent)	Mean Response
There are many alternative customers that have the same value to my company that EDI customers do (n=51)	0.0	11.8	27.5	41.2	19.6	3.7
There are many alternative customers for the products we sell to EDI customers (n=51)	3.9	11.8	31.4	31.4	21.6	3.6
The next best alternative to EDI customers would be just as valuable to my company (n=50)	4.0	14.0	44.0	28.0	10.0	3.3
Compared to non-EDI customers, our relationship with EDI customers is better (n=51)	7.8	11.8	56.9	21.6	2.0	3.0

The respondents were asked "How much does your company have invested in the implementing of EDI with customers". "It would be disruptive to my company's operations to end the business relationship with EDI customers", had the highest mean response of 3.7 where 28.8 percent of respondents indicated that they strongly agree (**Table 8**). Furthermore, 23.1 percent of respondents indicated that the investment their company has made in implementing EDI with customers is significant. "The mechanisms we have set up for EDI would make it difficult to end the relationship with EDI customers" had the lowest mean response of 2.8 where 33 percent of respondents indicated that they disagree or strongly disagree.

The respondents were asked, "How has the sharing of information changed with EDI customers, since the implementation of EDI". The statement "My company exchanges more information now with EDI customers than we did before EDI was used" had the highest mean response of 3.2 where 41 percent of respondents indicated that they agree or strongly agree

(Table 9). The statement "My company shares information with EDI customers that we would not have shared before EDI was implemented" had the lowest mean response of 2.8 with 51 percent of respondents indicated that they neither agree nor disagree.

**Table 8. Investments in EDI Implementation with Customers
Scale: 1=strongly disagree to 5=strongly agree**

Criteria	Strongly Disagree (percent)	(%)	Neither Agree nor Disagree (percent)	(%)	Strongly Agree (percent)	Mean Response
It would be disruptive to my company's operations to end the business relationship with EDI customers (n=52)	7.7	7.7	21.2	34.6	28.8	3.7
The investment we have made to implement EDI with customers is significant (n=52)	1.9	21.2	32.7	21.2	23.1	3.4
The investments we have in developing EDI with customers are easily transferable to other processes or operations in my company (n=52)	5.8	13.5	42.3	25.0	13.5	3.3
Our total cost of switching to an alternative EDI customer would be very large (n=52)	1.9	23.1	53.8	13.5	7.7	3.0
The mechanisms we have set up for EDI would make it difficult to end the relationship with EDI customers (n=52)	7.7	25.0	50.0	11.5	5.8	2.8

The respondents were asked, "How accurate, fast and valuable is the information received from EDI customers". All the statements in Table 10 were precluded by the statement "The information we receive from EDI customers is...". The statement "Received faster than non-EDI customers" had the highest mean response of 3.6 where 25.5 percent of

respondents indicated that they strongly agree. This is followed by "More accurate than non-EDI customers" with a mean response of 3.3 where 13.7 percent of respondents indicated that they strongly agree. The statement "More valuable in managing our business than non-EDI customers" had the lowest mean response of 3.0, however, 31 percent of the respondents still indicated that they agree to strongly agree with this statement.

**Table 9. Has EDI Implementation Changed Information Sharing?
Scale: 1=strongly disagree to 5=strongly agree**

Criteria	Strongly Disagree (percent)	(%)	Neither Agree nor Disagree (percent)	(%)	Strongly Agree (percent)	Mean Response
My company exchanges more information now with EDI customer than we did before EDI was used (n=51)	9.8	9.8	39.2	31.4	9.8	3.2
My company shares information with EDI customers that we would not have shared before EDI was implemented (n=51)	19.6	7.8	51.0	19.6	2.0	2.8

**Table 10. How Fast, Accurate and Valuable is the Information Received from EDI Customers?
Scale: 1=strongly disagree to 5=strongly agree**

The information we receive from EDI customers is...						
Criteria	Strongly Disagree (percent)	(%)	Neither Agree nor Disagree (percent)	(%)	Strongly Agree (percent)	Mean Response
Received faster than non-EDI customers (n=51)	11.8	5.9	19.6	37.3	25.5	3.6
More accurate than non-EDI customers (n=51)	11.8	5.9	35.3	33.3	13.7	3.3
More valuable in managing our business than non-EDI customers (n=51)	15.7	9.8	43.1	25.5	5.9	3.0

Conclusions

Forest products companies that have developed good working long-term relationships with home center customers are likely to have difficulties in adapting EDI into the business. The EDI relationships discussed in this paper are typically between suppliers and customers that have a history of activity so we expect a high level of trust to be present. However, we would expect the more power the home center buyer exerts on the wood product supplier, the lower level of trust will be present.

Wood products manufacturers have made a major effort to conform to home center needs for an EDI relationship often hoping that the investment in EDI will create a strong bond between them and the customer. This bond manifests itself in a higher level of commitment to a long-term relationship on the part of the seller.

Over time, as EDI becomes another part of doing business, problems in the relationship caused by implementation will diminish. This will become particularly so as wood product manufacturers that supply products to the home center industry begin to take advantage of EDI benefits.

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