

Making Electronic Data Interchange Add Value to Small and Medium Sized Manufacturing

Although case-study-based success stories of EDI abound, there is little systematic analysis of the impact of EDI across a wide range of companies. This research provides such data by analyzing the workings of EDI in 255 small and medium sized manufacturers in a variety of industrial sectors in the U.S. Findings are presented in five areas: present status of EDI, tactics used to implement EDI, reasons why companies do EDI, relationships between integration and EDI's impact, human resources for successful EDI, and future developments.

Figure 1 shows the relationship we discovered between the consequences of EDI and the extent of EDI integration into other business applications. 'Integra-

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tion' was defined as full or automated data flow between EDI and applications such as accounting, inventory control, and purchasing. 'Impact' was defined as respondents' ratings on a four point scale of how EDI affected issues such as: customer good will, sales, expediting, production planning and labor usage. Implicit in this picture is an important story about how electronic data interchange (EDI) is used in small- and medium-sized manufacturing enterprises, and about how technology, organization and people must be brought together in ways that can make EDI valuable for manufacturing. This article is a report of the research findings [1] that generated the above graph. In this article we discuss the implications of those findings for making EDI add value to small- and medium-sized manufacturing. Here we summarize the background of the research and some of its more intriguing findings.

The Role of EDI and the Need for Empirical Data

Electronic Data Interchange (EDI) is the automated transfer of standards-based, structured, business data. Because it can speed the flow of information and pass data automatically to other automated applications, EDI is a powerful tool for improving business processes. The importance of EDI will grow in the future because it can help in major transitions that are going on in manufacturing: smaller but deeper supply bases, more value-added activity contracted to suppliers, shorter product life-cycles, agile manufacturing, and network based bidding/contracting procedures.

To provide value, EDI requires that members of a supply chain alter internal business systems, change inter-organizational business relationships, and adopt new information technology. To further complicate matters, many of the companies involved are small and ill-equipped

to deal with socio-technical change. Those companies will need help. For help to be effective, assistance programs must be based on systematic information about the benefits of EDI, the conditions under which those benefits are manifest, and the difficulties that stand between implementation and payoff. In order to obtain this information a questionnaire was developed with funding from the U.S. Air Force Manufacturing Technology Program, and deployed with funding from the Manufacturing Extension Partnership of the National Institute of Standards and Technology.

Research Method

Phase One of the research consisted of in-depth interviews with a variety of people engaged in EDI. Representatives included members of four industrial sectors - automotive, aerospace, electronics, and office furniture. Large and small companies were included. Wherever possible two interviews were conducted in each company, one with an expert in the

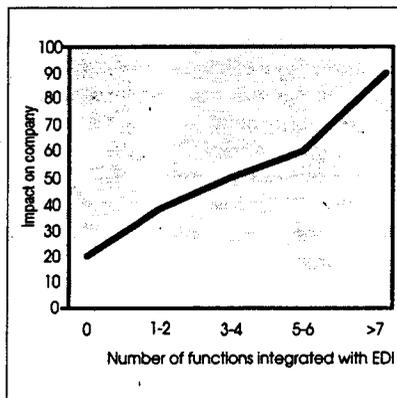


Figure 1: Impact on company by number of functions integrated with EDI

technological aspects of EDI, and one with an expert in the business aspects of EDI. Based on content analysis of the interviews a fixed-choice questionnaire was developed. Because of the thoroughness of the original interviews, it was possible to assure that the response categories in the survey were comprehensive, thus allowing in-depth data to be collected without asking respondents to write long or complicated open-ended responses. As a result we were able to collect deep information with a mailed

questionnaire which respondents were able to complete in less than one hour.

The questionnaire contained eight sections: Respondent's Work Setting, EDI Environment, Initiating EDI Relationships, Complying With Requests to do EDI, Internal EDI Operations in Your Company, Costs and Benefits of EDI, Facilitators and Inhibitors of EDI Implementation, and the Future of EDI in Your Company. Considerable efforts were made to assure deployment of the questionnaire to appropriate respondents within civilian and defense oriented small- and medium-sized manufacturing companies. In order to get the survey to appropriate respondents, support was enlisted from the following groups: Aerospace Industries Association, Automotive Industry Action Group, Semiconductor Equipment and Materials International, Telecommunications Industry Forum, and the U.S. Army Tank and Automotive Command. In all, 255 responses were obtained.

Findings

Present Status of EDI

Most small- and medium-sized manufacturers do EDI only with their customers, and mostly for reasons of 'ordering' and 'shipping and receiving'. Integration of EDI into these business functions is common but at a low level. (Percentages of the sample reporting integration are as follows: 'Ordering': full integration - 36%, partial integration - 44%, and no integration - 21%. 'Shipping and receiving': full integration - 32%, partial integration - 49%, and no integration - 19%.

Implementation Tactics

There is considerable disparity between EDI implementation methods that are rated by their users as being effective, and the extent to which respondents as a whole actually use those effective tactics. Failure to use effective implementation tactics is particularly evident in smaller companies who attempt to establish EDI with their suppliers. Effective tactics that are under-used include: participation in pre-implementation planning, specification of particular transaction sets, provision of implementation guidelines, target dates for implementation, help desk, and implementation manuals.

Reasons to do EDI

By far the most important reason why companies engage in EDI is to satisfy a customer who is demanding that business be done electronically. Once the focus moves from satisfying customers to improving internal operations, the greatest value of EDI is seen in terms of its ability to assist with just-in-time (JIT) systems. (For comparison, 64% of the sample saw EDI as having 'major' impact on

'customer good will', while 44% saw it as having such an impact on JIT). Although a desire for business process improvement is not the most common reason to do EDI, such desire plays an important role in assuring that EDI has beneficial consequences for a company. The correlation between 'internal motivation to implement EDI' and 'overall impact of EDI in a company' is $r = .539$ ($p < .001$), while the correlation between impact and external motivation is negligible.

The Importance of Integration

The benefits of EDI are clearly tied to its integration into other business applications. Many selected case studies and much anecdotal evidence support this contention. This is the first time to our knowledge, however, that the importance of integration has been demonstrated in a large sample which includes several industrial sectors and a wide range of firm size. Three sets of findings provide complementary views on the importance of integration. First, EDI's impact increases with the degree of integration into particular functions. As an example, the more highly automated the integration between EDI and accounting, the greater the impact of EDI on the accounting function. Significant correlations ($p < .005$) were found between integration and: accounting ($r = .300$), MRP ($r = .412$), order entry ($r = .471$), production scheduling ($r = .399$), purchasing ($r = .262$), and shipping and receiving ($r = .494$). The second set of findings on integration show that the overall impact of EDI is associated with the number of functions into which there is some (as opposed to no) integration.

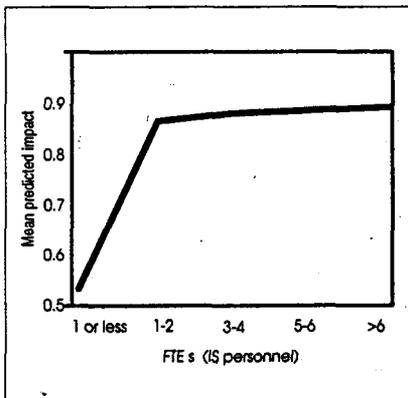


Figure 2: Impact of EDI against full time equivalent (FTE) information systems

The graph shown in Figure 1 depicts these findings.

Finally, there is a relationship between the total number of functions into which a company has integrated EDI, and the impact of EDI on a large number of specific business activities. Analysis of variance shows statistically significant relationships ($p < .01$) for: back orders, busi-

ness process engineering, collections, business data errors, time needed to send and receive information, integration of other business applications, machine utilization, manufacturing time, money and cash flow management, on-time delivery, paper and form costs, partial shipments, production planning, stock inventory, time for delivery to customers, and the costs of management personnel. Because these data show only associations among variables, we cannot say that EDI integration causes all the improvements cited above. The pattern, however, cannot be denied. There is something about EDI integration, or about a company's ability to integrate, that is powerfully related to a company's ability to function well.

Human Resources

Analysis of variance shows that the impact of EDI is greater when more than one Full Time Equivalent (FTE) Information System (IS) person is devoted to EDI. Presumably this is because "number of IS personnel" is a proxy for the amount of talent, time and expertise that a company can bring to bear on its EDI operations. The relationship between impact and human resources holds regardless of company size. (The Beta in a multiple regression analysis for IS FTEs, with firm size controlled is $.348$, $p < .001$). In other words, even smaller companies need significant IS expertise to derive large value from EDI. The relationship between human resources and impact is illustrated in figure 2, which plots EDI impact (with company size controlled) against FTEs devoted to IS. Finally, we discovered that even though EDI impact and FTEs are related, it is also true that larger companies tend to have a greater number of FTEs involved in EDI. (The correlation between firm size and IS FTEs is $.318$ $p < .001$). Thus if small firms are to make good use of EDI, tools and assistance programs are needed to provide IS expertise or to help them make the best use of the IS expertise they already have.

The Future

Respondents reported plans to increase the number of transaction sets they were using, their numbers of EDI trading partners, and their levels of integration. In particular, large increases are expected in the level of EDI carried on with suppliers. While plans for EDI expansion are wide-spread, the expansion will be greater for companies who are already using EDI to good advantage. Correlations among relevant variables, all at $p < .001$, are as follows. Expected increase in integration: with present level of integration, $r = .380$; with present impact of EDI, $r = .492$. Expected increase in transaction sets: with present level of

integration, $r = .376$, with present impact of EDI, $r = .476$.

Two Perspectives on Using Our Data

The use of EDI in small- and medium-sized manufacturing can be characterized as low-level, weakly integrated, and implemented mostly in reaction to pressure from customers. We also know that smaller firms will have trouble implementing the integrated EDI that is needed to provide value-added from electronic commerce, and that companies presently enjoying the benefits of EDI are the best candidates to further exploit the value of EDI as a technology and as a business process.

One way to view these findings is from the point of view of individual companies. From this perspective our research does nothing more than provide some insight as to which companies will enjoy a competitive advantage over others, and some details of why that advantage may exist. But from the point of view of industrial sectors made up of interdependent trading partners, our data show that overall improvement may be inhibited by problems in certain parts of the system. To the extent that a system view is taken, our data can help design support programs which will increase the value of EDI to all elements of the system, and thereby improve the overall functioning of large sectors within the industrial economy. ■

References

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