

**Promoting Electronic Data Interchange:
Building a Foundation for Support to Small Business^a**

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EXECUTIVE SUMMARY

Background

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 Air Force Manufacturing Technology Program, and deployed with funding from the Manufacturing Extension Partnership of the National Institute of Standards and Technology.

To assure a relevant set of respondents, mailings were chosen with the assistance of five organizations:

- Aerospace Industries Association
- Automotive Industry Action Group
- Semiconductor Equipment and Materials International
- Telecommunications Industry Forum
- U.S. Army Tank and Automotive Command

Recommendation 1: Specific, effective implementation methods must be supported by EDI assistance programs. The data identify a number of specific tactics which are particularly useful for helping to establish EDI with trading partners. Because we know these tactics work, EDI support programs should make a point of propagating their use. Those tactics are: meetings sponsored by the company requesting EDI, trading partner participation in pre-implementation planning, specification of particular transaction sets, specific target dates for implementation, implementation guidelines and manuals, a help desk, and consulting and technical assistance.

Recommendation 2: Programs must be able to help companies who are operating at many different levels of EDI maturity. Support programs must understand their clients'

needs and must be prepared to render context-appropriate assistance. Critical aspects of context include: state of EDI and information technology sophistication, status of EDI integration, views of EDI as a tool to maintain customer good will or as a means to improve internal operations, and knowledge about the link between EDI and business process change.

Recommendation 3: EDI support programs must assist with integration. The benefits of EDI are clearly tied to levels of EDI integration, even for small- and medium-sized manufacturers. While many companies have some form of integration, those existing levels are minimal. Therefore, programs are needed to help move companies from states of lesser to greater integration.

Recommendation 4: Programs must help smaller companies establish EDI with their suppliers. We can expect an increasing number of smaller companies to attempt to establish EDI programs with their suppliers. These smaller EDI initiators, however, often do not have the experience needed to effectively mobilize and organize their supply base.

Recommendation 5: Programs must help companies make effective use of information system expertise in support of EDI. The impact of EDI increases with the number of information system (IS) personnel involved. 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. Because IS human resources tend to be limited in small firms, EDI support programs must assist in helping companies deploy IS expertise to best advantage.

Recommendation 6: Programs must help companies react to requests for EDI. A large number of companies have no EDI and are being pressured by customers to implement such systems. EDI assistance programs are needed to help those companies move from no EDI to some EDI, and thus avoid being put at a competitive disadvantage.

Recommendation 7: Support programs must be prepared to handle a large volume of business. EDI support programs should be structured in a manner that will allow them to assist a large number of companies. This capacity is important because over the next few years manufacturers will engage in a great deal of activity to increase their numbers of trading partners, numbers of transactions sets, and extent of integration.

Assuring Viable EDI Support Programs

If proper choices are made about program design, the coming expansion of EDI will yield a ready client base for EDI support activities. To assure the success of those activities, program evaluation, using clear metrics of success, should be implemented. One set of metrics must deal with the question of whether an assistance program is offering appropriate services and operating in a manner that allows it to meet customer needs. A second set of metrics must assess impact on the customer, thus making it possible to track a support program’s functioning against its accomplishments.

INTRODUCTION

This document contains data-based recommendations for designing support for electronic data interchange (EDI) in American manufacturing. Supporting EDI deployment is important because EDI can improve business process and serve as the foundation for new forms of electronic commerce (EC).

If EDI is implemented successfully on a wide scale it will do a lot more than improve the efficiency of small sets of trading partners. Rather, it will improve the competitive position of whole industrial sectors. To reach its full potential, EDI will have to be adopted by a wide variety of companies, large and small, rich and poor, automation-focused and automation-illiterate.

To reach all these companies, EDI assistance will have to be offered by regional assistance organizations such as Manufacturing Technology Centers, Electronic Commerce Resource Centers, and Small Business Development Centers. The design of those assistance programs should be founded on reliable and systematic information about how EDI is actually implemented, what impact it really has, and what problems most commonly inhibit the full use of EDI.

In recognition of the need for good EDI assistance programs, the Air Force MANTECH program and NIST's Manufacturing Extension Partnership funded a research program to discover how to best support EDI in small- and medium-sized firms. Phase One, funded by MANTECH, was to develop a questionnaire which could efficiently provide in-depth information from a large number of companies. Phase Two, funded by NIST, was the deployment of the questionnaire and the development of the recommendations in this report.

BUSINESS NEED FOR EDI¹

Electronic data interchange is the automated transfer of standards-based, structured, business data. The *structure* comes from an historical decision to cast EDI as an electronic analogue of traditional paper transactions. Thus, there are automated versions of forms for countless business activities such as purchase orders, ship notices, and payment advices. In the U.S., the *standards* are usually those of the ANSI ASC X.12 Committee, who at last count (Feb, 1994) has developed 229 different highly structured transactions.² Because the processing of the data is *automated* it is possible to transmit the business information electronically among trading partners. *Business* refers to information required for exchanging goods and money. For the most part EDI does not include electronic mail communication or product description data (e.g., CAD).³

Cost and Cycle Time

EDI is important because manufacturers are under relentless pressure to reduce costs, improve efficiency, and shorten the product life-cycle. EDI contributes to these efforts by speeding the flow of information, and by casting data in a form that is readily accessible for a wide variety of uses. As a result of these capacities, EDI is also a powerful tool for improving business processes. For example, EDI reduces the likelihood of errors in manual data entry and thus eliminates the need for a variety of data quality checks.

As an example of how dramatic an effect EDI can have, consider the following real-case scenario of Acme Interiors (a pseudonym for an actual company), a first-tier automotive supplier of interior components.

After doing EDI with its customers for some time, Acme decided to implement EDI with its suppliers. Acme's priority was to automate its "release" system, the method by which it informed its suppliers how much material it would need, and by when. Acme had 580 separate part numbers to order, several different plants to which material had to be delivered, and many different suppliers. On its customer side, Acme was already well automated. As orders arrived via EDI, Acme's computers analyzed customers' orders, and developed material requirements to fill the order. But then Acme resorted to fax, regular mail, and express mail to pass information down its supply chain. At present Acme has partially implemented its supplier EDI, and cut its release processing costs from approximately \$800,000 per year to \$250,000 per year. Acme estimates that when it soon reaches full automation, costs will drop to \$75,000 per year. While Acme did not collect data on time savings, removal of all that paper processing must certainly have markedly compressed the time required to move information from customers to suppliers.

EDI's Role In The Changing Structure of Supply Acquisition

The way in which supplies are acquired has been undergoing profound change. The first trend is for companies to reduce the size of their supplier base. One motivation for this reduction is a desire to improve supplier relations by focusing on fewer companies. This shift reflects a realization that value derives from suppliers who are willing to provide valuable advice, share design work, and provide reliable quality. The second motivation is a desire to simplify business by reducing the number of partners with whom one transacts business. In either case, fewer suppliers contribute to manufacturing's need to improve quality, lower costs, and shorten the product delivery life-cycle.

The success of these new supplier arrangements is heavily dependent upon good information flow among trading partners. Electronic data interchange is important because of its ability to contribute improvements to that information flow. Because companies are working at decreasing the number of their direct suppliers, more (and more complex) information will have to pass across organizational boundaries. One element of this trading partner pattern is that companies may ask their remaining suppliers to provide more parts or more complex assemblies of parts. In either case, information exchange among the trading partners becomes richer. A second element of the new trading partner pattern is the likelihood that in order to meet their new obligations, the remaining direct suppliers will have to develop more complex relationships with their suppliers. Under all these scenarios, the emerging supplier structure is one of more complex interactions which will require EDI support to be effective.

While one trend is to decrease supply bases, there is also a trend in other sectors of the economy to broaden the base. A prime example of this phenomenon is the Administration's Reinventing Government initiative, which places heavy emphasis on letting and negotiating bids via electronic means, thus greatly increasing the ease with which a large number of companies can do business with the government. As these activities spread in the commercial and government sectors, EDI will become ever more important as a means of doing business.

In sum, two changes are going on within different sectors of the economy. One trend is to decrease the supplier base and the other is to widen the supplier base. Both represent situations that are very different from the current state of affairs, and both require EDI to work successfully.

Automated Coordination

Consider a vision of what a fully functioning EDI environment would allow. An end-user would have an order electronically conveyed to the original equipment manufacturer (OEM). The OEM's automated systems would identify needed suppliers, place orders, calculate costs and delivery times, schedule the production process, pay suppliers, and accept payment from customers. Analogous and compatible systems would be at work along the complete supplier chain. Throughout the process, any interested party could query the system to determine the status of any transaction. These automated systems would also enable the resolution of non-

routine problems. For example, EDI will help people track down the source of damaged goods, facilitate unanticipated changes to orders, or adjust to new pricing arrangements.

EDI's contribution to the above vision is *automated coordination* which serves to decrease product cost, decrease delivery time, and improve product quality. These benefits derive from the capacity of EDI technology to:

- Eliminate communication error
- Decrease communication time
- Allow more frequent communication among parties
- Organize information
- Save time compared to human processing of written information
- Make data available for powerful application software to solve problems in areas such as scheduling or financial analysis
- Put people to work; more useful than pushing paper

EDI as an Element of Agile and Virtual Business Process

EDI is also important because it is a necessary ingredient for the development of agile and virtual manufacturing processes. “Agility” refers to the ability of a company to quickly respond to new business opportunities. In many cases a company cannot be agile unless it is part of a “virtual enterprise”, i.e., a condition in which businesses that are separated by geography and core expertise are able to come together to engage in complex inter-related business activities. While structured business data is not the only type of information that must flow for such arrangements to work, EDI data is critical for these relationships. For example, without EDI it would be very difficult to coordinate changes in materials requirements among increasingly complex and inter-dependent networks of trading partners.

In addition to the specific contribution of EDI to agility, EDI is also useful as a stepping stone to other forms of automated data exchange. This is because at present EDI is the most common and advanced form of complex automated data exchange that takes place in American business. Consequently business’ experience with working out EDI arrangements can serve as a model for working out uses for other forms of automated data exchange. By promoting EDI, one is helping American business to build on its strengths in pursuit of increased competitiveness through agile and virtual business arrangements.

NEED FOR ASSISTANCE IN SUPPORT OF EDI IMPLEMENTATION

While the value of EDI can be considerable, so too are the costs and frustrations associated with its implementation and management. Further, problems increase as efforts are made to derive ever greater value from EDI technology and its associated business processes.

Benefits and Implementation Problems

The benefits of EDI can be arrayed on a continuum of "implementation difficulty". At the easier end are benefits that emerge from using EDI to solve *discrete problems*, such as error reduction in purchase orders, more accurate notification of the arrival of shipments, and reducing the need for labor by clerical personnel or buyers. While solving these problems may have enormous advantages, they are also relatively simple to solve because they are unconnected (or at least loosely connected) to other business and technological systems. For example, consider the process of a company sending its customer an advance ship notice (ASN) when goods leave the shipping dock. In the best of all worlds that notification would also automatically prime the company's accounts receivable system. *But it does not have to.* Even without that level of integration, as an encapsulated activity, it may still be a good idea to send the advance ship notice.

However, even this simple use of EDI is not without implementation problems. "Stand alone" EDI still requires the purchase of hardware and software, training, establishing backup systems for humans and machines, and business process change. These problems only become worse as more extensive uses of EDI are made.

The *mid-level of difficulty* involves the application of EDI to improve a company's internal systems integration and operations. Examples here include using EDI to support a just-in-time inventory system, or simplifying payment systems. To continue the previous example, consider the extension of the ASN into accounting. Followed to its logical conclusion, this extension could lead to a condition in which the invoicing system is completely eliminated. After all, electronic purchase orders and material releases provide a customer with knowledge of what it bought. The ASN tells the customer to get ready to pay for the goods, and the producer to expect payment within a predetermined amount of time. Bar-code scanning of received materials confirms the ASN. A host of other electronic transactions take care of adjusting for changes to orders, returns of incorrect or damaged shipments, and similar difficulties. By integrating all this data, the need for formal invoicing is eliminated.⁴ Making this change however, does require changes in inter-organizational business systems, i.e., agreements on how bills will be paid, and internal systems, i.e., the elimination of formal invoicing and the development of an integrated "virtual" invoicing system.

The *most difficult* benefits emerge from using EDI to improve relations with trading partners, i.e., to move toward a true integrated enterprise. An example of activity at this level is to consider a situation in which EDI is used to integrate an entire supplier chain, thus shortening

the purchase acquisition life-cycle, and thereby making manufacturing more responsive to changing customer needs. The advantages of supply chain integration stems from the fact that changing needs at the top of a supply chain (i.e., within an OEM) can have ripple effects throughout the chain. An automobile manufacturer for instance, may receive an unexpectedly large order from a fleet owner. The manufacturer may communicate this information directly to its suppliers, but how long does it take for the information to get through that first-tier supplier, through another layer of suppliers and finally, to a third-tier supplier who must supply a critical sub-component? Often the delay is long enough that the OEM has difficulty making its deadline to its customer. Improving this process would have enormous impact for the automobile industry, but making it happen is extremely difficult. One problem is that all companies involved are probably not doing business via EDI. Thus, new technology is required. A second problem is that EDI alone is not enough. Those technological systems must be integrated into other automated systems within the supply chain companies in order to assure that information received is immediately passed on as needed. Third, integrating the internal systems of participating companies may require a lot of technology and business change within each of those companies. Finally, all companies involved must agree to new inter-organizational arrangements which assure timely transmission of important information.

The reason these benefits fall on a continuum of difficulty is that each subsequent level requires success at the previous level, and because each requires close cooperation among a wider variety of diverse functions and organizations. Further, the types of problems that must be solved at each stage differ, with the nature of the problems becoming less precise and more difficult. It is one thing to install a new microcomputer and an EDI translator. It is several orders of magnitude more difficult to assure collective business process in a long supply chain.⁵

Any effort to implement or use EDI involves some combination of problems that are rooted in technology, human resources, and business process. Although all elements will always be present, the ratio of these difficulties changes with the shift in emphasis from discrete, to internal operations, to relations with trading partners. As this shift takes place, the difficulty of business process problems will loom ever larger.

Need for Systematic Information

If EDI is indeed both useful and problematic, effective programs are required to support its implementation. The challenge is to design these support programs for maximum value to their users. Therein lies the problem. We know these problems exist, but we do not know exactly what they are, precisely how serious each one is, or the specifics of the settings in which each is manifest. "War stories" abound, and each expert is convinced that he or she knows the problems and their solutions. These convictions may be correct, but they are also likely to reflect the tellers' unique perspective. If entire industrial sectors are to make better use of EDI, reliable information is needed about the benefits of EDI, the conditions under which those benefits are manifest, and the difficulties that stand between implementation and the realization of payoff. The results reported below are an effort to provide that systematic information.

Program Design

Finally, it is important to understand where the findings of this report fit in the overall process of program design. The findings provide guidance on the functional requirements of support, but are silent about the many different forms that support programs might take. As examples of possible variations in form, consider that programs may:

- Be centralized or decentralized
- Be free or fee for service
- Provide brief or ongoing assistance
- Offer assistance through many combinations of training, access to information, user-group support, individual consulting, consulting to groups of trading partners, and assistance with technology acquisition
- Involve various cooperative arrangements between government and private sector centers of expertise
- Differ depending on needs in particular localities or industrial sectors

Our hope is that by providing information on functional requirements for EDI support programs, planners will be more effective at matching practical possibilities for support with the realities of EDI implementation.

METHOD

The questionnaire (Appendix A) contains eight sections:

1. Respondent's Work Setting
2. EDI Environment
3. Initiating EDI Relationships
4. Complying With Requests to do EDI
5. Internal EDI Operations in Your Company
6. Costs and Benefits of EDI
7. Facilitators and Inhibitors of EDI Implementation
8. 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. Support was enlisted from the following groups:

- Aerospace Industries Association (AIA)
- Automotive Industry Action Group (AIAG)
- Semiconductor Equipment and Materials International (SEMI, a trade group)
- Telecommunications Industry Forum (TCIF)
- US Army Tank and Automotive Command (TACOM)

Arrangements with these organizations varied widely in terms of the number of companies addressed and the method of reaching them. A summary appears in Table 1.

Organization	# of Respondents (replies/total)	Description of Respondents	Method of Reaching Respondents
AIA	32/300*	suppliers to AIA members	Bulk mailing to AIA; AIA mailing to purchasing personnel among members, who passed the instruments on with cover letter to approximately 10 suppliers who the AIA member thought could provide useful insight on EDI.
AIAG	174/527	voting representatives	Cover letter and EDI interest group mailing list supplied by AIAG. Mailings done by ITI, personally to each voting representative. Three efforts to reach respondents: 1-questionnaire, 2- reminder without questionnaire, 3- reminder with questionnaire.
SEMI	7/56	Members interested in EDI	Bulk mailing to SEMI. Questionnaires sent by SEMI with their cover letter to potential respondents interested in electronic commerce. Reminders sent out by SEMI via e-mail.
TCIF	17/300*	Members interested in EDI	Bulk mailing, ITI to TCIF. TCIF did mailing to companies likely to be interested in EDI. Reminders sent 2 weeks after initial mailing by TCIF.
TACOM	25/114	Small company parts suppliers to TACOM, at least \$100K of business with TACOM (1993-1994).	Mailing list supplied by TACOM. Mailings done by ITI addressed generically. Three efforts to reach respondents: 1- questionnaire, 2- reminder letter without questionnaire, 3- reminder letter with questionnaire.

* Indicates approximate number of potential respondents.

Table 1. Samples - Size, Description and Method of Recruitment

FINDINGS AND RECOMMENDATIONS

Recall the reasons for doing this research, i.e., to provide an empirical foundation for planning EDI support programs for small- and medium-sized manufacturers. Given this filter of interpretation, what lessons can we learn from the data?⁶

Recommendation 1: Specific, Effective Implementation Methods Must Be Supported By EDI Assistance Programs

The data identify a number of specific tactics which are particularly useful for helping to establish EDI with trading partners. Because we know these tactics work, EDI support programs should make a point of propagating their use. Those tactics are:

- Meetings sponsored by the company requesting EDI
- Trading partner participation in pre-implementation planning
- Specification of particular transaction sets
- Specific target dates for implementation
- Implementation guidelines and manuals
- A help desk
- Consulting and technical assistance

Supporting data

Two sets of questions show that effective methods of EDI support are under-used. The first set of questions deals with “EDI implementation methods”(Tables 2 and 3).⁷

	Use of Tactic			Impact of Tactic		
	<i>Mandate</i>	<i>Suggest</i>	<i>Do Not Use</i>	<i>Major Contributor to Success</i>	<i>Minor Contributor to Success</i>	<i>No Impact/DK⁸</i>
Provide implementation guidelines	23	40	37	51	37	12
Particular transaction sets	26	48	26	49	44	7
Attendance at meetings you sponsor	6	28	66	46	46	8
Target dates for implementation	15	57	28	40	45	15
Participation in pre-impl planning	10	58	32	38	54	8
Particular value added networks	9	37	55	32	50	18
Participation in EDI user group	7	41	52	27	53	21
Response to survey of EDI capability	11	53	36	26	65	9
EDI software packages	6	46	48	22	59	20
Specific consultants or consulting services	3	19	79	19	69	13

Table 2. Implementation Methods Used by Those Who Initiate EDI - Percent of Respondents

	Use of Tactic			Impact of Tactic		
	<i>Mandate</i>	<i>Suggest</i>	<i>Do Not Use</i>	<i>Major Contributor to Success</i>	<i>Minor Contributor to Success</i>	<i>No Impact⁹</i>
Particular transaction sets	81	14	5	78	17	5
Joint pre-implementation planning	31	33	35	64	29	7
Target dates for implementation	62	34	4	62	32	7
Meetings sponsored by company requesting EDI	30	48	22	50	44	5
Particular value-added networks	28	44	28	36	46	18
Specific EDI software vendors	8	59	33	29	48	22
Surveys regarding EDI capability	26	49	25	25	58	17

Table 3. Implementation Methods Imposed by Customers - Percent of Respondents

The “impact” section of these tables show that particularly useful implementation methods include:

- Attendance at meetings sponsored by the company requesting EDI
- Participation in pre-implementation planning
- Specification of particular transaction sets
- Target dates for implementation
- Implementation guidelines

Despite their value, however, the “use” section of the tables show those effective methods to be relatively under-used, especially by the respondents who initiated EDI.

The second set of relevant questions concern the importance of specific methods of assistance that are given or received (Tables 4 and 5).¹⁰

	Provide Assistance		Contribution to Success			
	<i>yes</i>	<i>no</i>	<i>major</i>	<i>minor</i>	<i>none/dk¹¹</i>	<i>inhibitor</i>
Implementation manual with transaction details	35	65	67	22	11	0
Help desk	35	65	66	28	7	0
Discounts on software or other EDI services	13	87	60	30	10	0
EDI tests with select users	41	60	58	33	9	0
Background literature on EDI	32	68	52	38	8	0
Training	12	88	50	40	10	0
Consulting, technical assistance	30	70	48	48	4	0
Technical data (e.g., part number listings)	40	60	48	39	13	0
Trading partner conferences	12	88	46	34	18	0
EDI software	12	88	36	36	18	9
Visits with trading partners	48	52	33	64	3	0
Formation of EDI users group	12	88	18	54	27	0

Table 4. Types of Assistance Provided by Firms Who Initiate EDI - Percent of Respondents

	Contribution to Success of EDI			
	<i>Major</i>	<i>Minor</i>	<i>None</i>	<i>Inhibitor</i>
Implementation manual with transaction details	59	23	18	0
Help desk	41	36	22	1
Consulting, technical assistance	26	38	35	1
Background literature on EDI	21	45	33	0
Technical partner conferences or workshops	18	42	40	0
EDI software	16	18	64	2
Access to EDI user groups	12	35	52	1
Discounts on software or related EDI services	7	13	79	0

Table 5. Types of Assistance Provided by Trading Partners Who Request EDI - Percent of Respondents

Looking at the ratings of effectiveness, both agree that “implementation manuals” and a “help desk” are extremely important methods of assistance. Ranked just below the importance of the help desk is the related concept of “consulting and technical assistance”, which both groups also agree is important. While these tactics are effective, they are not universally used. In fact, the companies who initiated EDI reported surprisingly limited use of these assistance methods (help desk 35%, manuals 35%, consulting 30%).

Taken as a whole the data indicate that EDI assistance programs should include support for firms that plan to initiate EDI programs, but who may not realize the importance of particular implementation support activities, or who may recognize their importance but not know how to deploy them.

Recommendation 2: Programs Must be Able to Help Companies Who Are Operating At Many Different Levels of EDI Maturity

The appeal of EDI will differ depending on a company’s circumstances. Support programs must understand what that appeal is in different cases, and must be prepared to render context-appropriate assistance. Doing so has two advantages. First, it assures that assistance will be relevant. Second, it provides a powerful marketing orientation by which EDI support programs can sell themselves.

The greatest perceived benefit of EDI is that it improves a supplier’s relationship with its customer in terms of “customer good will” and “on-time” delivery. In terms of improved internal operations, (i.e., activities not directly observed by trading partners), the greatest benefits involve production planning and order processing time. Since EDI users see these issues as such an important outcomes, helping non-users apply EDI for these purposes must be a well developed capacity within support programs.

Over and above outcomes, it is also important to be sensitive to the reasons why companies choose to engage in EDI in the first place. While the most powerful motivator is a desire to please customers, an interest in just-in-time (JIT) ranks second. Therefore, support programs must be able to help their clients make the link between EDI and JIT.

As programs develop their offerings, they must include ways to help companies relate to EDI as a method of business improvement rather than a method of simply keeping a customer happy. This is because value from EDI is more likely when such an internal orientation is present.

Almost all companies are at a minimal stage of maturity with regard to the World Wide Web. If we believe the Web will play an increasingly important role in EDI or EDI-related activity, support programs must develop special approaches for moving companies from almost no experience with the Web to a state where they can exploit its functionality.

Supporting data

Respondents were asked to rate the value of a long list of possible EDI benefits. Those ratings appear in Table 6.¹²

	Major	Minor	None	Negative	Mean Impact
customer good will	64	27	8	2	1.52
on-time delivery	45	28	26	1	1.18
vendor ratings	45	24	30	2	1.12
time for delivery to customers	39	27	34	0	1.05
order processing time	36	32	32	1	1.02
production planning	33	35	32	0	1.01
hrs/week to send or receive information from customers or suppliers	35	36	21	9	.97
develop new business opportunities	30	34	36	0	.94
information sharing	35	22	43	0	.92
errors in business data	29	34	36	1	.90
shipment tracking	29	27	44	0	.85
expediting	23	39	36	1	.85
clerical personnel	26	40	26	8	.84
sales forecasting	24	26	48	0	.76
collection of payments	24	28	47	1	.75
paper and forms costs	17	41	38	5	.70
time for parts acquisition	23	24	54	0	.69
sales/customer service personnel	17	38	41	3	.69
partial shipments	14	38	47	0	.67
money/cash flow management	19	30	51	1	.66
transaction costs	16	36	43	5	.64
integration of other business applications	15	35	51	0	.64
deployment of workforce to more value-added activity	16	35	43	5	.62
material handling staff	18	29	48	5	.61

	Major	Minor	None	Negative	Mean Impact
back orders	12	32	55	1	.56
final goods inventory	13	27	60	0	.53
stock inventory	12	28	60	0	.52
freight cost savings - consolidation	12	22	66	0	.45
manufacturing time	9	27	64	0	.45
business process engineering	11	22	67	0	.44
machine utilization	8	28	64	1	.42
management personnel	5	33	57	4	.40
lost sales	3	13	81	2	.17

Table 6. EDI Impact Over the Past Year - Percent of Respondents

The importance of JIT emerges from our questions about prime motivators for engaging in EDI.¹³ While “pressure from customers” is the most important motivator, “necessary for JIT” is by far the second most important reason cited, with 44% claiming it was a “critical” reason for EDI, and 28% claiming it was “important”. (For comparison, the corresponding percentages for the next most important reason- “accurate information” were 31% and 51%.)

It is clear that EDI has greater benefit when motivated by needs for internal business improvement than it has when motivated by a need to meet customers’ demands (Table 7).¹⁴

	Correlation With Impact	Significance
External motivation to do EDI	.129	p = .327
Internal Motivation to do EDI	.539	p = .000

Table 7. Relationship of Motivation to do EDI and Impact of EDI

The challenge for EDI support programs is to address the underlying reasons for this difference. We doubt that a psychological construct such as “motivation” explains the impact of EDI. Rather, motivation is probably an indicator of an organizational culture, structure, history and personnel skill mix that supports the constructive use of information technology. If EDI support programs are to be effective, they must address those underlying issues, and must nurture the capability of a manufacturing company to embrace EDI as part of the use of information technology as a tool for business improvement.

There is a considerable amount of network use among small firms, but there is also a large disparity between “traditional” network use, and the use of World Wide Web networked, information resources. Table 8 provides a sense of what kinds of electronic communications are used by our sample. The sure indicator of Web use in the table is “network interface”, and it is clearly the least used of all available options. The picture of Web use is even bleaker if we assume that if Web use were available, the respondent

would at least know about that availability. The combined “never” and “don’t know” response for network interface is by far greater than it is for any other item in Table 8.¹⁵

	Frequency of Use				
	<i>Never</i>	<i>Few times per month</i>	<i>Few times per week</i>	<i>Daily</i>	<i>Don't know</i>
Electronic mail	11	28	29	29	6
Graphics, product data exchange or technical specifications	30	32	17	14	7
Network interface(e.g., Netscape)	60	5	6	5	23
Bulletin boards or mailing lists	25	30	19	15	11
Outside data bases	29	30	13	13	15

Table 8. Use of Electronic Communication - Percent of Respondents

Recommendation 3: EDI Support Programs Must Assist With Integration

The benefits of EDI are clearly tied to levels of EDI integration, even for small- and medium-sized manufacturers. While many companies have some form of integration, those existing levels are minimal. Therefore programs are needed to help move companies from states of lesser to greater integration.

Establishing movement toward integration may be a difficult sell for companies at the lower ends of the integration scale. Thus EDI support programs may need special tools or approaches to help such companies understand the business justification for integration.

Further, the benefits of EDI vary with a company’s stage of integration. Thus support programs must be able to assess that level of integration and be ready to offer assistance appropriate to that level.

Supporting data

Table 9 shows that many companies who do EDI are likely to have implemented some limited integration.¹⁶

	Level of Integration		
	No Manual Intervention	Some Manual Intervention	No Automated Data Transfer
Order Entry	36	44	21
Shipping/Receiving	32	49	19
Transportation	32	35	52
Materials Resource Management (MRP)	21	36	43
Accounting	20	44	36

	Level of Integration		
	No Manual Intervention	Some Manual Intervention	No Automated Data Transfer
Inventory	18	33	49
Production Scheduling	17	51	32
Finance	14	38	48
Purchasing	14	45	42
Manufacturing Process Control	9	30	62
Sales/Marketing	9	32	60
Quality Control	6	22	72
Catalogue Maintenance	4	16	80
Design Engineering	4	29	67

Table 9. EDI Integration Into Business Applications - Percent of Respondents

Within this context of existing integration, the greater the number of functions integrated into EDI the better, *and* the greater the extent of integration within functions, the better (Tables 10 and 11). This is an important finding because while plausible, it has not to our knowledge, ever been supported by more than the impressions of experts or case studies of selected success stories.¹⁷

	Functional Area					
	<i>Accounting</i>	<i>MRP</i>	<i>Order Entry</i>	<i>Production Scheduling</i>	<i>Purchasing</i>	<i>Shipping and Receiving</i>
Impact of EDI	.300	.412	.471	.399	.262	.494

(All correlations significant at $p < .001$ except for integration and purchasing, which is $p = .005$)

Table 10. Correlations: Degree of Integration (Full - None) With Impact of EDI

	Number of Functions that are Integrated				
	0	1 - 2	3 - 4	5 - 6	> 7
Mean Impact	.20	.41	.54	.62	.88
Number of cases¹⁸	12	10	15	21	30

$F = 7.62, p = .000$ ¹⁹

Table 11. Analysis of Variance, Impact of EDI by Numbers of Functions Into Which EDI is Integrated

That special help is needed for companies at the low end of the integration scale comes from two sources. First, companies that expect to do more integration also expect to do more organizational and business change in support of EDI.²⁰ (The correlation between these variables is .599, $p < .001$.) A complimentary view of this finding is that weakly integrated companies do not understand the magnitude of organizational or business

change required to do a good job of integration. EDI support programs will have to devise methods of providing that understanding.

The second source of information about special needs for weakly integrated companies comes from the findings presented in Table 12, which show that the less a company benefits from EDI, the lower its likelihood of doing more EDI in the future.²¹ (And conversely, that the more a company benefits from EDI, the greater its likelihood of expanding its EDI activity.)

	Present Level of Integration	Present Impact of EDI
Expected Increase in Level of Integration	.380	.492
Expected Increase in Number of Transaction Sets	.376	.476
Expected Increase, All Aspects of EDI	.372	.555

All correlations significant at $p < .001$ or better.

Table 12. Correlations - Present EDI with Plans for the Future

Effective program design requires a sense of why there is a correlation between present-day impact and plans for expansion. One possibility is that companies that “luck out” and derive value from EDI decide that they want more. We believe another explanation is more likely. From our experience, companies differ in their underlying ability to derive benefit from information technology, and it is that ability that drives present-day benefit and a desire for more. If this view is correct, assistance programs must be developed that go beyond help with technology adoption or the re-engineering of specific business processes. While including these topics, EDI assistance programs must also support the range of cultural, organizational, and human resource issues required to raise a company’s generic ability to use information technology to good advantage.

Table 13 provides a sense of how EDI assistance needs might vary with respect to level of integration. At all levels of integration EDI continues to provide great value in supporting good relationships with customers. (EDI impact ratings are high and do not vary across levels of integration.) Level of integration does not affect staff use or workforce level. (Only one of five “personnel” items are affected by levels of integration.) A great many aspects of internal business operations, however, are positively affected by integration. (Fifteen of twenty-three “impact” items vary significantly with level of integration.)

One implication of these data is that support programs can sell their services by helping companies use integration to move from improving customer relations to improving business operations. A second implication is that EDI support programs must in fact know how to help companies derive the greatest possible benefit from efforts at integration.

	Number of Functions that are Integrated				
	<i>0</i>	<i>1-2</i>	<i>3-4</i>	<i>5-6</i>	<i>>7</i>
Customer Interaction					
customer good will	1.10	1.47	1.57	1.53	1.64
develop new business opportunities	.61	.79	1.11	.79	1.08

	Number of Functions that are Integrated				
	0	1-2	3-4	5-6	>7
lost sales	.07	.23	.08	.12	.26
vendor ratings	.84	.67	1.35	1.16	1.25
Internal Operations					
back orders*	.29	.39	.42	.42	.84
business process engineering*	.27	.22	.44	.25	.70
collection of pay*	.41	.29	.76	.75	.98
errors in bus data*	.52	.40	.61	.97	1.31
hrs/week to send or receive information from customers or suppliers*	.45	.89	.93	.81	1.29
integration of other business applications*	.25	.39	.55	.51	.98
machine utilization*	.25	.11	.31	.20	.72
manufacturing time*	.19	.21	.41	.27	.70
money/cash flow management*	.31	.19	.57	.52	1.02
on-time delivery*	.71	.96	1.00	1.19	1.48
paper & form costs*	.39	.46	.75	.49	.96
partial shipments*	.35	.46	.51	.68	.94
production planning*	.71	.56	.88	.91	1.34
stock inventory*	.19	.40	.43	.35	.77
time for delivery to customers*	.47	.86	1.00	1.11	1.27
expediting	.59	.58	.70	.86	1.10
final goods inventory	.29	.52	.39	.34	.77
freight costs savings	.19	.43	.44	.27	.64
information sharing	.50	.76	.80	.91	1.21
order processing time	.56	.79	.95	1.15	1.21
sales forecasting	.44	.74	.63	.62	1.00
shipment tracking	.59	.64	.68	.77	1.14
time for parts acquisition	.35	.79	.52	.67	.89
Personnel					
management personnel*	.16	.27	.22	.29	.67
clerical personnel	.42	.92	.83	.86	.92
deployment of workforce to more value-added activity	.26	.57	.58	.60	.79
material handling staff	.26	.50	.55	.51	.81
sales/customer service personnel	.39	.74	.55	.64	.85

*significant at p=.01 using analysis of variance

Table 13. Mean EDI Impact as a Function of Integration

Recommendation 4: Programs Must Help Smaller Companies Establish EDI With Their Suppliers

We can expect an increasing number of smaller companies to attempt to establish EDI programs with their suppliers. These smaller EDI initiators, however, often do not have the experience needed to effectively mobilize and organize their supply base.

Supporting data

As the data in Table 14 show, we can expect a considerable increase over the next few years in attempts to implement EDI with suppliers.²² Further, many of those attempts are likely to come from smaller firms.

Type of Transaction	Company Size (1994 Revenue)							
	< \$20M		\$20M - \$100M		\$100M - \$500M		> \$500M	
	Customers	Suppliers	Customers	Suppliers	Customers	Suppliers	Customers	Suppliers
Order Related²³								
use now	92	17	97	14	95	29	94	71
use w/in 2-3 yrs	8	27	1	40	5	51	6	24
don't/won't use	0	56	1	47	0	20	0	6
Shipping and Receiving²⁴								
use now	75	11	92	7	89	24	73	35
use w/in 2-3 yrs	21	24	7	43	11	50	27	29
don't/won't use	4	65	1	50	0	27	0	35
Financial²⁵								
use now	53	4	55	7	71	9	93	24
use w/in 2-3 yrs	31	27	35	36	23	58	7	47
don't/won't use	16	69	10	57	6	33	0	29

Table 14. Types of EDI Transactions With Customers and Suppliers - Percent of Respondents

While many smaller firms may be attempt to establish EDI with their trading partners, there is reason to believe they may lack the capability of doing so. One reason for this belief is based on data concerning how EDI with suppliers is established. Tables 2 and 4 both show many EDI implementation tactics that are effective but under utilized. (As an example, the use of a “help desk” is rated as a “major contributor to success”, but is provided by only 35% of the sample.)

Who does and does not use these effective methods of assistance? Correlational analysis show that for many effective tactics there is a relationship between use and company size, i.e., the larger the company, the greater the likelihood that it will employ the method. Significant correlations ($p < .001$) appear for the following:²⁶

- Participation in pre-implementation planning
- Use of particular transaction sets
- Provision of implementation guidelines
- Target dates for implementation
- A help desk
- Implementation manuals

While the data just presented deals with “company size”, the critical question is why company size makes a difference. We believe the difference is that the larger a company, the greater its power relative to its suppliers. Companies with power will tend to exercise it to their advantage, and thus do have more experience with bringing about change with their suppliers. In other words, companies who know how to mobilize suppliers use tactics that inexperienced companies may not.

The above conclusion, i.e., that smaller firms do not use effective EDI implementation tactics, can also be reached by comparing firms who initiate EDI with those who comply with requests for EDI. In general, those who comply with requests see far more mandated activity than do those who initiate requests. We suspect this may be a function of differing experience in implementing complex systems. In general, our sample is of smaller companies. As a result, even those with the foresight to initiate an EDI program may be relatively unsophisticated in asking their suppliers to establish complex procedures. In contrast, the companies asking our sample to do EDI are likely to have considerable experience in establishing complex programs in a supplier base, and that experience may have taught them to be more directive.

Recommendation 5: Programs Must Help Companies Make Effective Use of Information System Expertise in Support of EDI

The impact of EDI increases with the number of information system (IS) personnel involved. 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. Because IS human resources tend to be limited in small firms, EDI support programs must assist in helping companies deploy IS expertise to best advantage.

Supporting data

Three analyses support this recommendation. First, Table 15 shows that the impact of EDI varies as a function of number of IS personnel involved.²⁷

IS Personnel - FTE's	Mean Impact of EDI
>= 1	.513
< 1	.886

F = 14.26 p = .0003

Table 15. Impact of EDI as a function of Number of IS Personnel

The second analysis tells us that the relationship between impact and human resources holds regardless of company size, i.e., that number of FTEs is a predictor of EDI impact even when we control for “size of firm”.²⁸ We reached this conclusion by conducting a multiple regression analysis which showed that the Beta 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.

Finally, even though EDI impact and FTEs are not 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 $p = .000$.)

This is a scenario of the rich getting richer. EDI impact is related to IS workforce. The relationship holds regardless of firm size. The companies that have the requisite IS workforce, however, tend to be large.

Recommendation 6: Programs Must Help Companies React To Requests For EDI

A large number of companies have no EDI and are being pressured by customers to implement such systems. EDI assistance programs are needed to help those companies move from no EDI to some EDI, and thus avoid being put at a competitive disadvantage.²⁹

Supporting Data

Basic assistance is needed because a significant number of manufacturers are not doing EDI, and are unprepared for the rapidly building pressures for electronic commerce. Two sources of information support this conclusion.

First, the TACOM sample, the only one not pre-selected for an interest in EDI, does considerably less EDI than the others (35% versus 88%.) Second, the ITI benchmarking study shows the following rates of EDI in its non-automotive group: invoices - 23%; releases - 30%; electronic mail for other than invoices or releases - 25%; and any of the previous or for electronic funds transfer - 53%. While we do not know the industry-wide EDI pressure felt by these companies, it is reasonable to assume that pressure is less than what is felt by first-tier companies in the automotive sector. Thus, EDI usage in manufacturing, in settings without extreme pressure to do EDI, seems to hover somewhere between 35%, the TACOM estimate, and 53%, the benchmarking estimate.

The notion that EDI implementation is coercive emerges from the question “Do you comply with requests to do EDI?”, to which 95% percent of the respondents answered “yes”. As Table 16 shows, a sense of “customer pressure” far outweighs all other motivations for acceding to these requests.³⁰

	Importance of Motivator			
	<i>Critical</i>	<i>Important</i>	<i>Minor</i>	<i>Negligible</i>
Customer pressure	75	20	5	1
Need for more timely information	38	42	12	8
Necessary for JIT	38	33	12	17
Need for more accurate information	31	43	17	10
Timely payment	20	37	23	19
Faster delivery	19	43	20	18
Scheduling stability	17	42	25	16

	Importance of Motivator			
	<i>Critical</i>	<i>Important</i>	<i>Minor</i>	<i>Negligible</i>
Reduce errors	17	45	27	11
More predictable product delivery	15	44	21	21
Reduced inventory	13	32	27	28
Electronic data for BPR	10	33	26	31
Decreased labor costs	9	28	35	27
Supplier pressure	9	19	22	50
Promote business process re-engineering	8	22	35	35
Fewer set-ups	7	24	37	31

Table 16. Motivators for Complying With Requests for EDI - Percent of Respondents

Recommendation 7: Support Programs Must be Prepared to Handle a Large Volume of Business

EDI support programs should be structured in a manner that will allow them to assist a large number of companies. This capacity is important because over the next few years manufacturers will engage in a great deal of activity to increase their numbers of trading partners, numbers of transactions sets, and extent of integration.

Supporting Data

Tables 17 and 18 make it clear that expansion is likely.³¹

	Number of Trading Partners				
	1 - 10	11 - 25	26 - 50	51 - 100	>100
Now	72	16	6	2	4
Within 2 yrs	32	38	17	5	7
Within 5 yrs	19	32	26	12	11

Table 17. Number of Trading Partners - Percent of Respondents

	Probability of Expansion				
	> 90%	60% - 89%	40% - 59%	10% - 39%	< 10%
Increased integration	36	30	20	10	5
More transaction sets	31	25	23	14	7

Table 18. EDI Expansion Within 3-5 years - Percent of Respondents

Assuring Viable EDI Support Programs

If proper choices are made about program design, the coming expansion of EDI will yield a ready client base for EDI support activities. To assure the success of those activities, program evaluation, using clear metrics of success, should be implemented. Doing so would provide guidance to developers for continuous improvement, and demonstrate value to funders and clients. The nature of that evaluation can be determined by the recommendations which emerged from the data.

One set of metrics must deal with the question of whether the assistance program is offering appropriate services and operating in a manner that allows it to meet customer needs. Well functioning programs will:

- Help their customers implement EDI support tactics that are known to be effective
- Determine what level of EDI maturity a client is at, provide services appropriate to that level of maturity
- Help clients integrate
- Offer special products and services to help small firms establish EDI with their suppliers
- Provide ways by which companies can lower the cost of deploying IS expertise in support of EDI
- Help companies efficiently react to trading partner requests for EDI
- Be able to manage a large volume of business

A program may function well, however, and still not have the desired impact on its clients. In order to track functioning against accomplishment, programs must assess how they influenced:

- Time and effort to implement EDI
- Deployment of tactics known to help EDI implementation
- Level of integration
- Business process change linked with EDI
- Client functioning in terms of :
 - customer relations
 - on-time delivery
 - order processing time
 - production planning
 - JIT

¹ Much of this section comes from the Phase One report.

² EDIFACT (EDI for Administration, Commerce and Transport) is an emerging international standard which is becoming more important in the world of EDI. Plans are in progress to harmonize X.12, EDIFACT, and a variety of proprietary EDI standards. Any long range planning for EDI use must consider the progress of these mergers. For immediate purposes however, each of these standards can be dealt with independently.

³ There are ways to send graphic and open-ended data within the EDI paradigm, but the process is difficult, potentially expensive, and unreliable. Considerable efforts are now being made to integrate, or at least accommodate, the coordinated transmission of EDI, electronic mail, and graphics data.

⁴ In industry this process is known as Evaluated Receipts Settlement, and is often a major motivating factor for doing integrated EDI.

⁵ In order to develop methods to facilitate such collective action, the AIAG (with sponsorship from ARPA) is running the "Manufacturing Assembly Pilot project with ITI as the primary technical. The objective is to pilot coordinated business practices within a segment of the automotive seating supply chain as the first step toward greater industry adoption of electronic commerce. The project will identify technologies and practices that optimize material flow, build business cases for adoption based on improvement measures, and disseminate results to a wide range of commercial and defense industries.

⁶ In interpreting the data, some cautions are in order. First, as a result of how the cooperating trade groups selected their mailing lists, the sample is biased toward companies that are already engaged in EDI. Whatever problems or difficulties we discovered regarding EDI may well be even worse for companies not already predisposed favorably toward electronic commerce. Second, the data are descriptive and correlational. The data provide a far better foundation for planning than would derive from conjecture or the narrow view of selected experts. On the other hand care should be taken not to assume that we have discovered causal relationships. For example, we have shown that more integrated companies derive greater benefit from EDI. Is this because integration provides benefits, or because the ability to implement integration is an indicator of a general ability to derive value from new technology or new business practice?

⁷ Question 3.4 and Question 4.3.

⁸ Unless otherwise noted, all percentages reported here are based on valid cases, i.e., they exclude missing data and "don't know/not applicable" responses. In this table we departed from our usual procedure. Rather, cases were included as "no impact" count *if* the respondent rated the tactic as used in the company, but still checked "don't know" in the impact rating column. This approach was taken on the assumption that if a tactic were used and had a positive impact, the respondent was likely to know about it. Thus "don't know" becomes reasonably equivalent to "no impact", and the combined ratings give us a more accurate picture of what is really going on.

⁹ No impact and "Don't know" responses are combined as in Table 2.

¹⁰ Questions 3.5 and 4.4

¹¹ "No impact" and "don't know" are combined.

¹² Question 6.3

¹³ Question 4.2

¹⁴ Data from question 4.2. "External" = pressure from suppliers and customers. "Internal" = all others.

¹⁵ Question 1.11

¹⁶ Question 5.5

¹⁷ To test for "degree of integration" within functional areas, we first mapped each type of integration into the domain of impact where that integration might make a difference. For example, EDI integration into MRP would be unlikely to affect "paper and forms costs", but it would probably affect "back orders". The next step was to create scales for impact items within selected areas of integration. To continue the MRP example, elements of EDI impact included: back orders, final goods inventory, on-time delivery, manufacturing time, production planning, information sharing, and time for parts acquisition. The "MRP impact scale" was an average of ratings on these items. Finally, we computed correlation's between two variables: 1- Degree of integration (full, partial, none), and 2- Associated domain of impact.

To test integration across functional areas we measured integration by the number of different functional activities into which EDI was integrated. For example, one company might be integrated only into accounting, while another might be integrated into both accounting and order entry. For this analysis, we would consider the second company more integrated than the first. An ANOVA was then performed, using “mean EDI impact” as the dependent variable.

¹⁸ The number of cases is so much smaller than the overall sample size because we used a conservative procedure in determining who to include in this analysis. Any missing data for any item in the analysis resulted in the exclusion of that case.

¹⁹ Sources of variation: Main effect sum of squares = 4.7, DF = 4, mean square = 1.18; explained sum of squares = 4.7, DF = 4, mean square = 1.18; residual sum of squares = 12.99, DF = 83, mean square = 1.78.

²⁰ Question 8.1

²¹ To conduct this analysis, five scales were developed, each from a variety of items in the questionnaire. Those scales were: 1- total projected increase in EDI integration (Q 8.1), 2- total projected increase in EDI transaction sets (Q8.1), 3- total projected increase in EDI, 4- number of functions into which EDI is either completely or partially integrated (Q 5.5), and 5- total impact of EDI (Q6.3)

²² Questions 2.5 and 2.6

²³ E.g., purchase orders (850), shipping schedules (862)

²⁴ E.g., ship notices (856), receiving advice (861)

²⁵ E.g., invoice (810), payment advice (820).

²⁶ To calculate these correlations we used the following scales. For firm size (question 1.3) we assigned values as follows: less than \$1M = 1, \$1M - \$5M = 2, etc. For “tactics” (question 3.4) mandate = 3, suggest = 2, and do not use = 1. For assistance methods (question 3.5), yes = 1, no = 2.

²⁷ Impact as measured by question 6.3 with a four point scale ranging from 3 (major positive impact to -1, negative impact.) Workforce as measured by FTEs, question 6.1.

²⁸ Question 6.1.

²⁹ An excellent model for providing such assistance can be found in the activities of the Western Michigan Office Furniture Council and the Michigan Manufacturing Technology Center, who have been working to help OEMs and their suppliers to agree on common implementation guidelines and to provide assistance with technology implementation. Office furniture is an industry that has been making only minimal use of EDI, and is rapidly moving to an industry-based approach to greatly expanded use of the technology.

³⁰ Question 4.2

³¹ Question 2.8 and Question 8.1

APPENDIX A

QUESTIONNAIRE:

IMPROVING THE IMPACT OF ELECTRONIC DATA INTERCHANGE

