

# EDI Adoption and Implementation: A Focus on Interorganizational Linkages

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*This paper explores the role of interorganizational distributions of power in EDI adoption. It reports findings of a vendor survey of a Fortune 1000 company that wants to adopt EDI. As hypothesized, perceived costs are negatively and significantly related to EDI adoption. However, perceived benefits, trust in trading partners, and net dependency do not significantly affect the intent to adopt EDI. Implications of the findings are discussed.*

The use of information technology -- such as American Hospital Supply's ASAP and American Airline's Sabre system -- to gain competitive advantage has heightened interest in technologies that link organizations. EDI (Electronic Data Interchange) is one of these technologies. It is experiencing steady growth. There are currently an estimated 10,000 corporate users, and annual growth is anticipated at 40 percent for the next five years. Thus, there may be as many as 75,000 corporate EDI users by the end of 1995 (Dreyer, 1989). From sales of \$200 million in 1988, the EDI market is expected to jump to \$1.9 billion by 1992 (Seither, 1988; TDCC:EDIA Conference, 1989).

EDI allows buyers and sellers to transmit

standard business documents, such as purchase orders and invoices, directly from one company's computer to the computer of another company. EDI has the potential to reduce order turnaround time, minimize human intervention errors, limit inventory levels, and increase productivity, customer service, and cash flows. However, while EDI clearly provides benefits, it may be costly to implement if a company does not have the appropriate hardware or software. Security becomes an important issue as controls associated with paper flows become inoperable. Further, benefits derived from EDI may be limited if information systems are not substantially modified to integrate EDI into organizational processing. They may also be limited if high-volume trading partners do

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not participate.

Because multiple organizations must participate, the adoption process for EDI technology provides a unique opportunity to study interorganizational power. Unlike the procedure for implementing many other technologies, the decision to adopt EDI is not exclusively individual or organizational. For its benefits to be realized, multiple organizations must accept and implement it. Power may play a role in establishing the interorganizational linkages. In a recent study by Link Resources Corp., 40% of the surveyed EDI users indicated that the impetus to install EDI came from customers. Moreover, 15% of the users installed EDI only because they felt they had to (Keefe, 1988). Sixty-nine percent of the respondents in a survey by Kavan and VanOver (1990) reported their customers mandated the use of EDI as a condition for future business. Improving, or at least sustaining, relationships with customers was their dominant motivation for EDI adoption. Thus, EDI offers the opportunity to study how far a company can apply its power to persuade a trading partner to adopt a new technology.

The purpose of this paper is to explore the extent to which interorganizational power, as well as EDI benefits and costs, influences the decision to adopt EDI. Two critical types of interorganizational power are incorporated into a model of EDI adoption. Hypotheses derived from the model are tested in a study described in the second major section. Study results are reported in the third major section, and implications of the findings are addressed in the last section.

## **Interorganizational Power**

Frequently, power studies have focused on two types of power: potential and enacted (Provan, 1980). Potential power "is the capacity of one social actor to influence another" (Provan, 1980, pp. 550). It has been studied using subjective measures of perceptions of power and objective measures of formal position and net dependence. Net dependence is an approach to measuring potential power in a two-party relationship: A

is said to have power over B to the extent that B is dependent on A (Blau, 1964; Emerson, 1972). In the net dependence approach, the weaker party's actions are influenced by the assumption that the stronger party can and will control its rewards and sanctions. This approach has been used in studies of agency power exerted by United Way organizations (Pfeffer & Leong, 1977; Provan, Beyer & Krytbosch, 1980) and in a study of the power-dependence relationship between farm and power equipment dealers and their primary suppliers (Provan & Skinner, 1989). Oliver (1990), Wey and Gibson (1991), Meier and Chismar (1991), and Cheng and Bozeman (1990) suggest that interorganizational relationships may be prompted by the potential to exercise power or control over another organization.

Clearly, an organization may possess potential power without actually using it. It thus becomes important to consider enacted power as well. With enacted power, the power holder must make an explicit attempt to influence behavior. In this approach, specific organizational outcomes are measured which the researcher presumes are affected by the exercise of power. By studying enacted power in conjunction with potential power, researchers explore when, in what way, and to what extent organizations use their capacity to influence others.

Many studies of enacted power focus on the issue of interorganizational resource acquisition in nonprofit organizations and universities (Lodahl & Gordon, 1973; Pfeffer & Leong, 1977; Provan et al., 1980; Salancik & Pfeffer, 1974). Measuring power solely in terms of an organization's ability to acquire funding does not mean that it is also powerful in its capacity to influence decisions in other areas (Tushman, 1977). Further, these studies of interorganizational power have not addressed the extent to which power is associated with influencing another organization to do something it would not have done otherwise. That is, if an organization would have taken a certain action anyway, power was not the cause for the action's occurrence. For instance, the action may have been taken because

of perceived benefits to the organization. It would thus be helpful to augment interorganizational power studies by examining an issue other than resource acquisition in which perceived benefits can be assessed and in which both potential and enacted power can be explored. Studying the diffusion of EDI offers this opportunity.

## Perceived Benefits in an EDI Setting

Meier and Chismar (1991) divide EDI benefits into two major categories: efficiency and process. EDI provides faster and more accurate communication and coordination between vendors and their customers. The improved speed and accuracy of communication and coordination translates into such efficiency benefits as eliminating paper, cutting postage premiums for fast delivery, reducing contracting costs, generating data entry labor savings, and reducing data entry keying errors. Meier and Chismar (1991) argue that efficiency benefits are proportional to the volume of transactions between vendors and customers. 'Big' vendors with a high volume of transactions will realize higher absolute efficiency benefits from joining the EDI system than will 'small' vendors with a handful of transactions.

A second category of benefits, process benefits, yields improved effectiveness due to the changes in processes made necessary and possible by the EDI system. EDI may change the way a company does business and, as a result, reduce inventory costs and improve response to market demands.

Whereas both the customer and vendor may realize efficiency benefits by adopting EDI, only the initiating trading partner tends to receive process benefits from the revised internal operations. The initiating partner is typically the customer. Thus, benefits from EDI may be more pronounced by the customer initiating an EDI relationship than by the vendor acceding to the customer's request.

This imbalance in benefits may be viewed from three perspectives. First, the vendor is typi-

cally required to 'fit' into the customer's new 'just-in-time' manufacturing process (O'Neal, 1987; Bakos, 1991). The customer's reduced inventory costs are often made possible by increasing vendor inventory costs and reducing vendor flexibility and control. Second, process benefits tend to accrue only when EDI replaces manual processes, such as order processing. The electronic replacement of a customer's manual processes typically can occur only when all vendors communicate with the customer via EDI. Although a vendor may have switched to EDI, process benefits may not be realized because the vendor most likely has not integrated internal operations or converted its vendors to EDI use (Meier & Chismar, 1991). Third, when all vendors have switched to EDI, the customer may realize an additional benefit. The customer may be able to review vendor price information more easily. This capability reduces the customer's search costs. However, the vendors may suffer adversely, since the customer's new ability to compare may (1) allow the customer to enjoy lower prices because of increased competition among vendors, and (2) better inform the customer about more suitable substitute products. Thus, reduced buyer search costs result in lower market prices and smaller vendor profits (Bakos, 1991). These multiple perspectives juxtaposition the initiating trading partner's gain against acceding trading partners' losses.

## EDI Costs

On the other hand, EDI costs exist for both the customer and vendor. These include setup costs for acquiring necessary hardware. A substantial setup cost is system development, especially if internal operations are integrated to realize process benefits. The establishment of an EDI interface between the customer and vendor is also included in EDI setup costs. In addition, there are operational costs that vary with the volume of transactions. These include training costs, security-related losses, transmission costs, and, possibly, contracting costs. Although smaller trading

partners may experience lower EDI operational costs than larger partners, transaction volume may be inadequate to generate benefits to cover their setup costs.

### Model of EDI Adoption Based on Interorganizational Power

Previous research on interorganizational power has not investigated the relationship between enacted power and perceived benefits and costs. The model in Figure 1 may provide a more comprehensive approach to understanding interorganizational power relationships. It suggests that enacted power is strongly influenced by the potential power of one organization over another. Potential power exists because of dependency relationships. However, enacted power is also affected by the perception that an organization will gain from a particular action and is inhibited to the extent that the organization responding to power perceives that the action will be harmful to it.

Oliver (1990; also, Wey & Gibson, 1991; Meier & Chismar, 1991) argues that interorganizational linkages may not only be motivated by asymmetrical power relations. Organizations may also form them to improve efficiency through increases in return on assets or reductions in unit costs, waste, downtime or cost per patient or client. Oliver (1990; also Wey & Gibson, 1991), using Williamson's transaction cost perspective, suggests that interorganizational linkages may result from attempts of organizations to economize on the cost of transactions. Thus, costs and related benefits may be critical in organizational decisions to adopt interorganizational relationships.

Recent works suggest a trust component may also be involved (e.g., Hart & Estrin, 1990; Nidumolu, 1989; Provan & Skinner, 1989). The extent of trust present in a buyer-seller relationship influences an organization's expectation that its trading partner will behave opportunistically. For example, in relationships between farm and

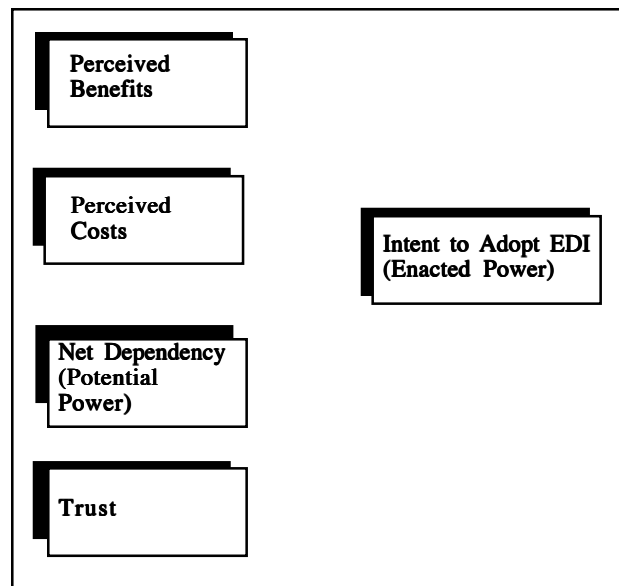


Figure 1: Model of EDI Adoption

power equipment dealers and their primary suppliers, opportunistic behavior was more likely to occur when the dealer was less dependent on the primary supplier or when the supplier controlled dealer decisions (Provan & Skinner, 1989). Trust counteracts opportunistic behavior since it fosters the enactment of strong informal norms of behavior to ensure that trading partners do not shirk their responsibilities (Nidumolu, 1989). Trust among the participants thus decreases the need for contractual safeguards which are typically reduced with EDI usage.

In an EDI environment, enacted power may be considered the intent to adopt EDI. A vendor may not wish to adopt EDI because it perceives the adoption to be costly, difficult to implement or subject to other limitations. However, it may feel forced to do so because a major customer wants it to convert to EDI. The customer exerts potential power over it in the form of sales. The greater the reliance of the vendor on sales to this customer, the greater is the potential power of the customer over the vendor. Counteracting the impact of potential power is the trust of the vendor in the customer. This is especially important with EDI since it causes the nature of the business exchange to differ. There is no longer a paper trail to record transactions and provide control. Previ-

<b>FACTOR</b>	<b>MAJOR CUSTOMER</b>	<b>DEPENDENT VENDOR</b>	<b>TRADING PARTNER WITH EQUAL POWER CUSTOMER/ VENDOR)</b>
Perceived Benefits	Primary	Primary	Primary
Perceived Costs	Primary	Primary	Primary
Net Dependency	Primary-High Potential Power Position	Primary-Low Potential Power Position	None
Trust in Trading Partner	Secondary	Secondary	Primary

**Table 1: Examples of Variance in Importance of Factors in EDI Adoption Depending on Relational Perspective**

ous control mechanisms may no longer be operable. In addition to customer urging, and despite potential costs, the vendor may be favorably influenced to adopt EDI because of benefits it offers.

Table 1 contrasts the importance of factors to the EDI adoption decision according to the trading partner's perspective and relative interorganizational power. For vendors, customers, or other parties in an EDI relationship, costs and benefits play a primary role in determining whether or not to adopt EDI. For vendors, another very important factor might be a major customer's requirement to adopt. Thus, potential power is a very important factor for dependent vendors because parties low in power may be forced to begin using EDI. Conversely, customers upon whom vendors are dependent may leverage their high level of potential power to force vendors to adopt EDI. For powerful customers, dependency relationships are of primary importance in accomplishing their EDI objectives.

Net dependencies will not play a role in the EDI adoption decision where no power differentials exist between the parties. Instead, trust becomes an especially important factor. Two large companies not highly interdependent may participate with one another in EDI only if they think they

can trust one another. Typically, these organizations have a history of prior cooperative trading relationships.

Based on their study of interorganizational computer networks for manufacturing and design in the semiconductor industry, Hart and Estrin (1990) predict that negotiated arrangements will evolve for accessing vendor production control systems using these networks. However, these arrangements will only be undertaken in a climate of trust. In his study of insurance agencies, Nidumolu (1989) found that specialized investment in an interorganizational information system leads to a more positive transactional climate between two organizations when the system did not alter the balance of power significantly. While trust is also a concern in imbalanced power relationships, it is probably secondary to the leveraging situation created by net dependencies.

Based upon the model in Figure 1, the following relationships are hypothesized to exist:

**Hypothesis 1.** Intention to adopt EDI by a vendor organization is positively related to

- a. the potential power the customer organization exerts over the vendor organization



- b. the perceived benefits of EDI
- c. the trust the vendor organization has for the customer organization.

**Hypothesis 2.** Adoption of EDI is negatively related to the perceived costs of EDI.

## Description of Study

The hypotheses were tested using the questionnaire responses of vendors of Chaparral Steel, a Fortune 1000 company. Chaparral Steel currently wants to implement EDI. It is cognizant of the need to have trading partners who also implement EDI. Most of Chaparral's 2700 trading partners are smaller companies that do not currently have EDI. Only about thirty of its partners cooperate with Chaparral in using electronic funds transfer (EFT), which is sometimes considered a precursor of EDI adoption. Thus, Chaparral is interested in the extent to which its trading partners are considering EDI adoption. It is also concerned with the perceptions of these partners about the costs and benefits of EDI.

### Procedures

The questionnaire and a letter from Chaparral's controller inviting participation were mailed to 600 randomly selected Chaparral vendors. Responses were received from 192 companies, for a response rate of 32%. Questionnaires were returned to the researchers -- not Chaparral personnel. Responding organizations were not identified and confidentiality of individual responses was guaranteed.

The questionnaires were mailed to the vendor's major contact person for Chaparral. Many of the respondents were high-level general managers in their companies: 1 CEO, 35 presidents, 15 owners, and 22 general managers. Another 24 were technically oriented. The remainder were in sales, purchasing, clerical, and other positions.

Eighty-five percent of the responding companies had annual revenues of less than \$100 million and sixty-six percent had 800 or fewer

customers. Sixty-four percent (123 companies) were not currently using EDI, and only 10 companies were using it to a great or very great extent. Seventy-nine percent (152 companies) had PCs and half (96 companies) had modems.

### Measures

A questionnaire was designed to measure vendor net dependency (potential power), perceived EDI benefits, perceived EDI costs, trust in trading partners, and intent to adopt EDI. The items for each variable were factored, and the coefficient alphas were calculated to assess the reliabilities of the operationalizations.

Net dependency is based upon the number of the vendor's customers and the proportion of its revenues attributable to Chaparral Steel. The inverse of the questionnaire response concerning the number of customers the vendor company has was one measure of dependency. A second measure was calculated by dividing the dollar volume of the company's sales to Chaparral Steel in the preceding year by the company's annual revenues last year. These two calculated amounts were then factored with a third item that placed Chaparral Steel (in terms of sales) as in the group of the company's top 5 customers, in the top 20% of the company's customers, in the top half, or in the category of a low volume or infrequent customer. The coefficient alpha is .71.

The perceived benefits and costs to the vendors were derived from previous EDI studies (Dreyer, 1989; EDI Education Canada, Inc., 1988; Ferguson & Hill, 1988; Keefe, 1988; Monckza & Carter, 1988; Robins, 1988; Seither, 1988; TDCC:EDIA Conference, 1989). Twelve items are used to measure perceived benefits, and fourteen items measure perceived costs. Perceived benefits include: (1) efficiency benefits, such as reduced data keying, paper reduction, increased productivity, reduced error rates; and, (2) process benefits, such as reduced inventory costs, improved customer service, faster response to orders and enhanced ability to compete. Perceived cost

VARIABLES	NO. OF ITEMS	MEAN <sup>a</sup>	STD.DEV. <sup>a</sup>	N	COEFFICIENT ALPHA	INTERCORRELATIONS			NET DEPENDENCY
						PERCEIVED BENEFITS	PERCEIVED COSTS	TRUST	
Perceived Benefits	12	41.53	10.28	147	.92				
Perceived Costs	14	45.10	15.93	160	.96	.50**			
Trust in Trading Partners	5	20.47	4.12	159	.84	.18*	.34**		
Net Dependency	3	2.48	1.14	110	.71	.18*	.26**	.14	
Intent to Adopt EDI	4	11.74	4.60	125	.82	-.12	-.40**	-.19*	-.09

\*p ≤ .05    \*\*p ≤ .001

<sup>a</sup> based on item totals - not factored variables

**Table 2: Summary of Means, Standard Deviations, Coefficient Alphas, and Pearson Coefficients of Correlation of Variables**

barriers include lack of hardware, software, security in transmission, and trained personnel for implementation. The coefficient alphas, .92 for benefits and .96 for costs, are very high.

The questionnaire included five items to measure the extent to which trust in their trading partners influenced their decision to adopt EDI. For example, respondents were asked to evaluate on a 5-point Likert scale whether the trading partner always promises to do things without actually doing them later. The coefficient alpha for trust is .84.

The vendor's intent to adopt EDI is designated as a surrogate measure of enacted power. Four items were used to measure the vendor's intent to adopt EDI. A sample item addressed the willingness of the respondent's company to be involved in EDI with Chaparral Steel. The coefficient alpha of this variable is .82.

### Results

The means, standard deviations, coefficient alphas, and intercorrelations of all variables

are displayed in Table 2.

### Factors Influencing the Intent to Adopt EDI

The Pearson coefficient of correlation between intent to adopt EDI and perceived costs is negative and significant as hypothesized ( $r = -.40$ ,  $p = .000$ ). However, the relationships between intent to adopt EDI and perceived benefits, trust in trading partners, and net dependency are also negative and in the opposite direction from the one hypothesized. Yet of these three, only the correlation between intent to adopt EDI and trust in trading partners is significant at the .05 level or better ( $r = -.19$ ,  $p = .026$ ).

A stepwise multiple regression was performed to determine the extent to which costs, benefits, trust in trading partners, and dependence upon Chaparral Steel's sales were perceived to influence its intent to adopt EDI. A stepwise, rather than a simultaneous, multiple regression was employed because of the moderate multi-

<b>VARIABLE IN EQUATION</b>	<b>B</b>	<b>STANDARD ERROR B</b>	<b>BETA</b>	<b>T</b>	<b>P</b>
Perceived Cost (constant)	-.56 .41	.12 .12	-.53	-4.62 3.58	.000 .001
Adjusted R <sup>2</sup> =	.27	F(1,55) = 21.32	p = .000		
<b>VARIABLES NOT IN EQUATION</b>	<b>BETA IN</b>	<b>PARTIAL</b>	<b>MINIMUM TOLERANCE</b>	<b>T</b>	<b>P</b>
Perceived Benefits	.15	.15	.70	1.13	.26
Trust in Trading Partner	-.10	-.12	.94	-.86	.39
Net Dependency	.02	.03	.96	.20	.85

**Table 3: Results of Stepwise Regression of Factors on Intent to Adopt EDI**

collinearity among the variables (Cohen & Cohen, 1975). Only EDI costs contributed significantly to the intent to adopt EDI. This relationship was negative, as hypothesized. Although highly significant ( $F(1,55) = 21.32$ ,  $p = .000$ ), only 27 percent of the variance was explained by the regression equation. The results of the stepwise regression are displayed in Table 3.

## A Focus on Costs

Respondents indicated on a scale from 1 to 4 (ranging from not important at all to extremely important) the extent to which a set of 14 factors served as barriers to their company's use of EDI. The most important factors were lack of cost justification (mean = 3.48), compatibility problems with hardware and software (mean = 3.44), and lack of standard formats (mean = 3.42). Approximately 20 percent of the people answering these questions indicated with a "Don't Know" response that they were unaware of the barriers.

The sample was split into two groups: (1) those organizations that had limited or no use of EDI (a response of 1 or 2 on item 1), and (2) those that used EDI to a moderate or great extent (a response of 3, 4 or 5 on item 1). Organizations that did not use EDI, or used it to a limited extent, are

significantly more concerned with perceived costs ( $t=4.36$ ,  $df=157$ ,  $p \leq .000$ ). The mean of the perceived cost factor is .13 for organizations with limited EDI use ( $n=136$ ) and -.80 for organizations with moderate to great EDI use ( $n=23$ ). There are no significant differences between the two groups on the benefits, dependency and trust factors.

## Implications

The findings of this study fail to provide support for the hypothesis that there is a positive relationship between the intent to adopt EDI and perceived benefits, net dependency, and trust in trading partners. Support exists for the second hypothesis: perceived costs are negatively and significantly related to intent to adopt EDI.

## Concern with Costs

The small companies considering EDI adoption in this sample are clearly concerned with costs. Power, benefits, and trust issues are not currently important to them in their EDI adoption decision. Their focus on cost suggests that EDI is not a strategic issue for them. They apparently do not perceive EDI as a means of gaining competitive advantage. Rather, EDI is perceived as a



vehicle for increasing their internal efficiency. The reliance on third parties, like GEISCO, acting as intermediaries in EDI transactions further supports the argument that EDI is not a strategic issue for many companies. Without the consideration of strategic advantage to be derived from EDI, cost appears to be the paramount issue.

Interestingly, the cost factor is rated significantly less important by organizations actually using EDI than those with little or no EDI experience. Perhaps, trust, power, and perceived benefits assume importance only when a company is actually pressured to adopt EDI by a major trading partner or when it perceives benefits, or even a strategic advantage, from doing so. As an organization gets closer to making an EDI adoption decision, factors other than cost may be more carefully scrutinized.

However, these findings must be interpreted tentatively. Almost two-thirds of the respondents did not have EDI, and they indicated a lack of familiarity with its benefits and costs. Eighty-five percent were smaller companies with annual revenues of less than \$100 million. Unlike many other technological innovations, EDI requires cooperation among high-volume trading partners. Estimates are from 75 (TDCC:EDIA Conference, 1989) to over 97 percent (Seither, 1988) of Fortune 100 companies participate in EDI. On the other hand, a substantially lower percentage of smaller companies are doing so. Perhaps smaller companies, such as those represented in this sample, do not currently have the volume of business to justify EDI use. One estimate is that approximately 10,000 transactions a year are needed to justify EDI economically (Shaw, 1988). Because of low transaction volumes, these companies may have not experienced the need to explore EDI's feasibility. However, vendor companies, forced into EDI by their larger customers, will in turn push down the procurement chain to their vendors, and the trend in the 1990s will be toward involvement of medium- and small-sized businesses in EDI (Lavery, 1990).

The concerns of our sample about EDI

costs are probably representative of other small companies with transaction volumes too low to reap efficiency benefits. To overcome these concerns it may be necessary for initiating companies to sponsor the EDI system (Meier & Chismar, 1991). The initiating company, most typically the customer, can share the setup costs with smaller trading partners by providing them with necessary hardware, software and/or training. The initiating company also can pass on higher efficiency benefits through appropriate pricing schemes for the use of the system. That is, the initiating company may not charge for supplying the system or may absorb communication and transaction costs for smaller trading partners. By sponsoring the system for smaller trading partners, the initiating company may reduce trading partner EDI costs to the extent that they are less than the benefits derived from the system. As a result, smaller trading partners may be more likely to adopt EDI.

## Longitudinal Designs

Studying the diffusion of EDI technology may be virtually impossible without using a longitudinal design. At any particular time, perspective adopters, especially smaller organizations, may be unfamiliar with EDI. Once they become acquainted with the benefits offered by EDI or the requirements made upon them by their trading partners, the period in which they consider and make the adoption may be relatively short. So unless organizations are studied over a period of time, the results may be very similar to those obtained in this study -- characterized by a high percentage of organizations that are unfamiliar with EDI and have no intent of adopting it.

A longitudinal design could also provide the opportunity to improve upon the operationalization of enacted power. In this study, intent to adopt was used as the surrogate measure of enacted power. Enacted power was operationalized in this way because Chaparral Steel was in the early stages of EDI participation. Its trading partners would not have had the time to implement

EDI even though Chaparral Steel had exerted potential power over them to do so. A better measure of enacted power is the actual adoption of EDI: EDI adoption is a measurable outcome of an explicit attempt to influence a trading partner. Further, this objective measure of enacted power avoids common method bias by augmenting the questionnaire measures used in this study.

## EDI Training

In more practitioner-oriented terms, a company wishing to persuade its trading partners to adopt EDI will probably need to offer them a systematic EDI training program. Organizations unfamiliar with EDI are unlikely to adopt it, no matter how much pressure is exerted by trading partners. Training combats unfamiliarity. In this study, respondents were especially concerned with costs. Thus, a major training emphasis should be placed upon EDI costs and its offsetting benefits. A training program could also convince trading partners of a company's level of commitment to EDI and to them.

In summary, benefits, interorganizational power, and trust all may eventually be important in persuading trading partners to adopt EDI. However, in this sample of small companies, perceived costs are the overriding concern.

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