THE IMPACT ON THE BUYER-SELLER RELATIONSHIP OF FIRMS USING ELECTRONIC DATA INTERCHANGE

DISSERTATION

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

Robyn R. Poole, B.S., M.S.S.M.

Denton, Texas

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This research investigated whether the buyer-seller interorganizational relationship (IOR) differed between a firm and two classes of customers. The first class used electronic data interchange (EDI) with the firm and the second class used the traditional paper-based purchasing system. IOR characteristics included reputation, skill, direct power, indirect power, reciprocity, and efficiency.

The investigation used the paired t-test to compare how firms evaluated their relations with the two classes of customers. The results suggested that customers using EDI with firms had significantly higher levels of reputation, skill, direct, and indirect power than did the trading partners using the traditional system. The use of EDI was significantly more efficient than traditional systems as measured by cost-of-handling a typical purchase order; however, the cost of handling was dependent upon the number of electronic users. Firms reported a higher cost when they used EDI with 10 or fewer partners; with 11 or more partners, firms reported that using EDI was cheaper.

The level of buyer-seller reciprocity was not significantly higher for firms using EDI than with the traditional paper-based purchasing system. Companies planned future operations with their customers and responded to their partners' extraordinary requests at similar rates for firms using EDI or paper-based systems. Firms reported joint actions (such as synchronizing their operational schedules with those of their partners') at a significantly higher rate with customers using EDI than with traditional systems.

The overall skill levels, and overall indirect power and service of indirect power were moderated by the company that managed the EDI network. The results suggested that firms should endeavor to control the EDI network they use to avoid losing power to another company. Further, the results provided lessons in the way firms should relate to their customers in the future. Firms differed in their relationships with customers using EDI compared to the traditional paper-based purchasing systems. EDI represented a separate channel of distribution that is becoming increasingly important. Thus, firms should try to relate to all their customers in the way they do with those using EDI.

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CHAPTER I

INTRODUCTION

The topic of electronic data interchange (EDI) is introduced in this chapter. Other items presented in this chapter include the following: the statement of the problem, purpose of the research, significance of the research, organization of the study, and scope of the study.

Electronic Data Interchange

Electronic data interchange (EDI) is a computer-based logistics system in which companies enter product data in their computers without having their trading partners reenter the data. Analysts have touted EDI as a technology to transform the purchasing environment ever since it emerged in the 1950's; however, only in the last five to ten years have companies begun to realize its transformation potential (Payne 1992).

This transformational effect has been largely anecdotal. While many companies have proclaimed the usefulness of the technology, few researchers have conducted a rigorous examination of EDI. Based upon a review, the literature involved few research-based referenced articles concerning EDI. The major articles included La Londe and Emmelhainz 1985, Emmelhainz 1987, Carter, et al. 1987,

Monczka and Carter 1989, Benjamin, et al. 1990, and Sriam and Banerjee 1994. The major authors and the concepts developed by them are shown in table 1. The full significance of these articles is explained in chapter two.

TABLE 1

MAJOR ACADEMIC WRITERS ON
ELECTRONIC DATA INTERCHANGE

CONCEPTS	AUTHORS
Purchasing departments differ in the future	La Londe and Emmelhainz 1985
EDI improves relationships	Emmelhainz 1987
EDI is the preferred method of communication	Carter, et al. 1987
EDI affects relations	Monczka and Carter 1989, Sriam and Bannerjee 1994
EDI is linked to IOR	Benjamin, et al. 1990

Firms that use EDI change their internal organizations and alter their external relationships with other companies. Monczka and Carter (1989) developed a model for implementing EDI. They noted that EDI affected the internal systems of the company, and the business relationships between a buyer and his or her suppliers. The following sections describe how the authors have described these internal and external relationships.

Internal Changes

In their study of EDI, La Londe and Emmelhainz (1985) predicted major changes in the purchasing departments of the future. The functional area of purchasing "will look far different from the typical purchasing department of 1985," (La Londe and Emmelhainz 1985, 9). As firms handle more computer-generated purchase orders, purchasing departments equipped to process orders electronically spend less time on purely administrative tasks, such as generating requirements. Purchasers then can devote more time to reviewing service histories and requests for proposals from a strategic point of view.

La Londe and Emmelhainz (1985) assessed the planned and current use of EDI in their study of 4,800 purchasing executives. They noted that firms had already allocated money in their budgets for additional computers which would allow companies to change their internal operations. La Londe and Emmelhainz expected the use of EDI to increase and that using EDI would change the way companies interact with others.

External Changes

Beyond providing a view of internal changes, the results of the La Londe and Emmelhainz study also laid the foundation for observing how purchasing departments change their relations with external organizations, such as their customers. In a follow-on study, Emmelhainz (1987)

conducted in-depth case analyses of fifteen organizations in the various stages of EDI implementation. Emmelhainz argued that EDI improves external relationships.

The time and effort required to get the EDI network functioning forces buyers and sellers to talk to each other about mutual goals and other related purchasing experiences. Carter, Monczka, Clauson, and Zelinski (1987) studied twenty-five firms that used EDI and a group of third-party network providers. They pointed out that gaining the commitment of the firm's trading partner was essential and outweighed any technical factor. They said that EDI "has evolved into the preferred method of business communication between buying and supplying firms," (Carter, Monczka, Clauson, and Zelinski 1987, 13). These researchers also predicted that firms would increase their use of EDI.

As companies interact with their customers, they in essence form a network of relationships. Management researchers, such as Whetten and Aldrich (1979), Whetten and Leung (1979), and Aldrich (1971, 1976), have used the term interorganizational relationship (IOR) to describe the formal and long-term interactions of these companies that form such a network.

Although the research on EDI was scarce, researchers connected the ideas of EDI and IOR, and IOR has a long stream of research. Benjamin, de Long, and Morton (1990) explicitly described EDI as a special case IOR. They state

that "EDI represents a specific class of interorganizational systems," (Benjamin, de Long, and Morton 1990, 29).

> EDI is the interorganizational exchange of business documentation in a structured, machine-processable form (Emmelhainz 1990). This definition was chosen because it describes the interorganizational nature of EDI. (Williams 1994, 173)

Others that discuss EDI as a form of IOR include Banerjee and Golhar 1994, Vlosky, Smith, and Wilson 1994, and Teo, et al. 1995.

Statement of the Problem

This research examines the impact EDI has on relations between the firms involved in a purchasing arrangement. The purchasing arrangements have specific characteristics that the literature describe as IOR. Elements of the IOR characteristics that are found in all purchasing arrangements include the firm's level of skill and reputation, the amount of the firm's direct power and indirect power over their customers, the firm's reciprocity with their partners, and the firm's efficiency of conducting transactions.

Although the use of EDI is growing, it is rare that a firm uses EDI with all of their customers (Payne 1992). Thus, the customers with which firms use EDI may be considered a class separate from those that use the traditional paper-based purchasing systems.

As the number of customers using EDI with the firm increases, firms have incentives to alter their customer

relationships (Emmelhainz 1987). Further, the company that initiates the EDI network takes the lead in the buyer-seller relationship and the company that manages the on-going network may set rules that govern the relationship (Galaskiewicz 1979).

This study tested for differences in the IOR between customers that use electronic data interchange (EDI) with the firm and the IOR of customers that use the traditional paper-based purchasing systems with the firm. The firms studied in this research were all users of EDI with at least one customer while at the same time using the more traditional paper-based purchasing arrangements with all other customers.

This research examined the effect on characteristics of the interorganizational relationship (IOR) formed between industrial distribution firms and two classes of their customers as moderated by three circumstances: (1) the company that initiated the EDI network, (2) the company that manages the EDI network, and (3) the number of customers that use EDI with the firm. The following two sections discuss the purpose of the research and its significance.

Purpose of the Research

This study investigated the purchasing relationships of industrial distribution firms using EDI within a framework of IOR. As firms typically use EDI with only a fraction of their trading partners (Payne, 1992), the customers with

which firms use EDI may be considered a class separate from those that use the traditional paper-based purchasing systems.

Examining the differences in the IOR characteristics between customers using EDI with the firm and those that do not may lead to a greater understanding of the current buyer-seller interorganizational relationship. Further, Whetton (1981) said that understanding characteristics of the linkage is required to describe long-term dynamic relationships. Thus, inferences concerning future purchasing relationships of industrial distribution firms and the benefits of EDI are drawn.

Significance of the Research

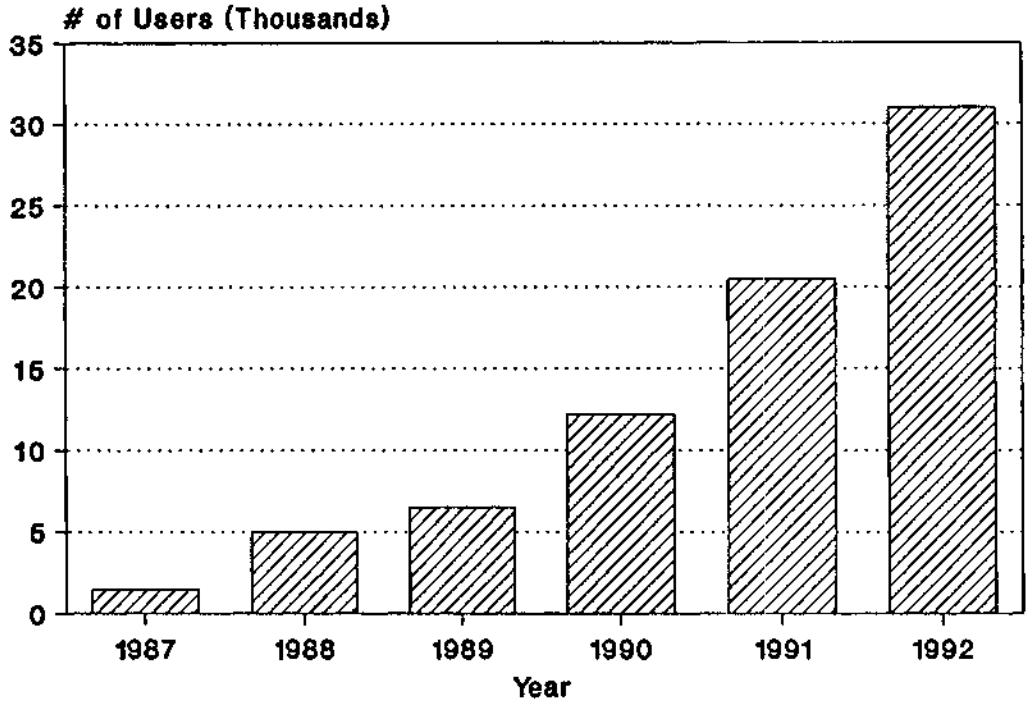
This study was significant because of the growth rate of firms using EDI. The use of EDI has increased in the last several years. The number of domestic companies using EDI has grown from 1,400 registered users in 1987 to 21,148 in 1992. This is a 72 percent annual compound growth rate.

Payne (1992) described the world-wide EDI usage as shown in figure 1. Bowles (1996), updated the number of EDI users worldwide to over 100,000 as of 1995.

The cost of hardware and the lack of standardized software has limited the use of EDI until recently. In addition, recent increases in computer power have enabled smaller companies to begin using EDI. Similarly, industry standards have emerged that allow smaller firms to use EDI

FIGURE 1

NUMBER OF REGISTERED EDI USERS WORLDWIDE



Adapted from Payne, R. EDI Yellow Pages. Dallas: EDI, Spread the Word!, 1992.

software. Payne in 1992 predicted that lower costs and standardized software will increase the number of EDI users exponentially.

Researchers have not yet explored the effects of this growth in the number of EDI users. Indeed, rigorous research concerning EDI is limited as practitioners have written the vast majority of the articles about EDI. La Londe and Emmelhainz (1985) provided the original basis for most research-based EDI studies. Since then, virtually all

researchers have used the same approach (Emmelhainz 1987, Carter et al. 1987, Monczka and Carter 1988, Carter and Frendenall 1990, Dion et al. 1990, and Banerjee and Golhar 1994).

La Londe and Emmelhainz asked 4800 purchasing managers of companies in a variety of fields about their use of EDI; however, only 9 percent of the 278 responding firms reported transacting purchase orders via computers. These twenty-five companies that used EDI were then investigated for factors that differentiated them from non-users. These other factors may have caused the resulting differences instead of the use of EDI. For example, the environment of firms that used EDI may have been dissimilar enough from those companies that did not use EDI to cause differences.

The approach taken by La Londe and Emmelhainz can be contrasted with the design of this study. In this research, every company surveyed used EDI and each firm rated two classes of customers. The two classes were customers using EDI with the firm and customers that used the traditional paper-based purchasing system with the firm. Thus, the population of this investigation was more homogeneous than La Londe and Emmelhainz's population; the homogeneity increased the control of the research.

The use of matched pairs increased the control of this research. After all, Kerlinger (1986, 289) asked "How much better on all possible variables than by matching a subject

with himself?" This method minimized bias or confusion caused by the respondent misunderstanding or misinterpreting a question. The individuals rated each of the two classes by the same method according to their understanding of the question.

This study better controlled the research environment by matching each of the two classes of customers to a single firm. Each company rated both of the classes and the paired t-test was used to measure differences between users and non-users of EDI. This section has discussed the significance of the research. The next section provides the theoretical framework for the study.

Theoretical Framework

Researchers prefer to study IOR in a network setting. Networks are dynamic and require an understanding of the contextual factors and the strength of the linkages. Networks provide richer research environments that are more realistic than comparing individual dyads. Dyadic settings tend to be short-term in nature with informal linkages (Whetton 1981).

Authors have tried several methods to determine what constitutes the focal network. These included: path analysis (Boje and Whetten 1981), blockmodeling (Breiger, et al. 1975, Ghoshal and Bartlett 1990, Knoke and Rogers 1979, Van de Ven and Walker 1979), LISREL V (Van de Ven 1976), and other logistic regression models (Benson 1975, Cook 1977,

Provan 1983, Pearce and David 1983, Rao and McLaughlin 1989, Thorelli 1986). A simplified process of determining the focal network would ease the study of IOR considerably. Fortunately, the relationships formed by buyers and sellers provide a classic IOR network environment. Nidumolu (1995) stated that an IOR information network links sellers and buyers in a distribution channel. He says that the use of such a network can be considered "the most significant technological breakthrough in distribution channels in recent years," (Nidumolu 1995, 89).

The study of networks requires defining the membership set and determining the degree of interaction among the members. The membership set includes individuals who share a defining characteristic and the network consisted of those members who have a high degree of interaction (Whetton 1981).

The interaction of firms and their customers form a recognizable network that can be documented by their communications. The format of this communication may done electronically through EDI or through the traditional paper-based purchasing system. Thus, a researcher who differentiates users of EDI from non-users and evaluates the extent of the EDI use, could clearly define the relationships among the subsets of a network.

This section discussed why researchers prefer to study IOR in network settings. The section described EDI as an easily-defined network and served as the basis for research.

Organization of the Study

The researcher organized this study into five chapters. Each chapter is summarized below.

Introduction

The investigation is introduced in chapter one. This introduction includes the (1) statement of the problem, (2) purpose of the research, and (3) significance of the research.

Literature Review

The electronic data interchange (EDI) and interorganizational relationship (IOR) literature are reviewed in chapter two. Major schools of thought for IOR are discussed and a conceptual model of the use of EDI is drawn from the review of literature. The research model involves contrasting the IOR of the firm with two classes of customers. The first class of customers used EDI with the firm and the second class used the traditional paper-based purchasing system.

Methodology

The research procedure and the methodology employed are discussed in chapter three. The instrument used to collect

data to answer the research questions is described. The description includes validity and reliability issues. The plan to select a sample is presented. Finally, the statistical methodology used to test the hypotheses is described.

Results

The results and findings of the research are discussed in chapter four. Each research question is addressed based on the results of hypotheses.

Implications and Future Studies

The results that did not support the hypotheses are discussed in chapter five. The findings associated with each research question are summarized individually and the implications of the results and future areas for investigation are provided. The managerial and theoretical implications of the research are described.

The research was organized into five chapters. The following section describes the scope of the study.

Scope of the Study

The design of the research limits this study in three ways. First, throughout this investigation, unless quoted from cited sources, the "firm" refers to the focal company of analysis in the buyer-seller interorganizational (IOR) relationship. The seller's point of view is the focus of this study of EDI.

The seller's position in the distribution chain can be complex. The distribution chain involves companies from the ultimate maker of products to the ultimate user. This chain may involve more than just two companies buying and selling from each other. Any company may be simultaneously a buyer of products, from companies closer to the ultimate maker, and a seller of products to its customers, who are closer to the ultimate user.

Further limits to this research are discussed in the following section. The research is limited by defining the terms used throughout the study.

Definition of Terms

This section defined terms used in the study. These terms are amplified in the methodology section. Additional terms that operationalized concepts into measurable variables are listed in chapter three.

1. Asymmetry - the potential to exercise power or control over another organization or its resources (Oliver 1990)

2. Direct power - a direct indicator of the relative economic influence of a buyer and the firm on each other measured by the: (1) amount of purchases in dollars by the buyer from the firm and (2) percentage of the buyer's purchases from the firm compared with the total amount of products bought (Porter 1980)

3. Distribution chain - the linking of buyers and sellers from the ultimate producer to the ultimate user of a product (If the distribution chain involves at least three members, a firm may be both a buyer from one side of the chain and a seller to the other side of the chain.)

4. Electronic data interchange - a computer-based purchasing system in which a buyer enters data in a standard format on its own computer so the firm can perform the intended transaction without reentering the data (Sokol 1989)

5. Firm - the focal company providing the comparison with its trading partners. (Generally, this is the seller in the buyer-seller dyad)

6. Indirect power - an indirect indicator of the economic influence of a buyer and the firm on each other due to the market conditions of the firm's industry measured by: (1) ease to enter the market by potential suppliers, (2) ability to substitute products by the buyer, and (3) intensity to compete by existing suppliers (Porter 1980)

7. Interorganizational relations - the enduring transactions, flows, and linkages occurring between an organization and one or more organizations in its environment (Oliver 1990)

8. Network - all interactions between organizations in a population as the population is placed into dyads, organization sets, or action sets (Whetten 1981)

9. Reciprocity - cooperation, collaboration, and coordination among organizations rather than domination, power, and control (Oliver 1990)

10. Third party - another member of the distribution chain situated between the buyer and seller, such as a value-added network provider

11. Trading partner - the other company of the buyer-seller relationship with the firm

12. Value-added network provider (VAN) - an independent provider of EDI services that adds value to the network by translating between standards and updating the computer software and hardware, as necessary, relieving the firm of those expenses

Chapter Summary

A general overview of the study was presented in this chapter. Electronic data interchange (EDI) was defined as a computer-based purchasing system. Firms employing EDI enter

product data in their computers without having the trading partners reenter the data.

As buyers and sellers interact, they use transactions, information flows, and establish linkages that support the buyer-seller relationship. This transaction flow was described in the management and marketing channels-of-distribution literature as interorganizational relations (IOR). The IOR literature provided a theoretical basis for describing the buyer-seller relationship.

The purpose of this research was to examine the differences between the firm and two classes of customers. The two classes of customers were those that used electronic data interchange (EDI) with the firm and customers that used the traditional paper-based purchasing systems. As the number of firms using EDI is growing, implications for future buyer-seller relations may be inferred.

CHAPTER TWO

LITERATURE REVIEW

Electronic data interchange (EDI) is a computer-based logistics system. Firms enter product data in their computers without having the trading partners reenter the data. EDI can be defined in the following statement.

> EDI is the inter-company computer-to-computer communication of standard business transactions in a standard format that permits the receiver to perform the intended transaction. (Sokol 1989, 12)

Williams (1994) defined EDI in another way.

> EDI is the interorganizational exchange of business documentation in a structured, machine-processable form (Emmelhainz 1990). This definition was chosen because it describes the interorganizational nature of EDI. (Williams 1994, 173)

EDI is linked to an existing stream of literature called interorganizational relationships (IOR). This IOR serves as the theoretical framework for this study. This chapter contains a discussion of several IOR schools of thought which support selecting characteristics used in the research model.

Networks are described as the best way to study IOR. The use of EDI forms specific IOR networks involving firms and their customers. Those customers that use EDI with the firm may be considered separate from those that use the traditional paper-based systems.

Interorganizational Nature of EDI

Analysts have touted EDI as an upcoming technology ever since it emerged in the 1950's, though companies have only begun to realize its potential in the last five to ten years (Payne 1992). Few researchers have conducted a rigorous examination of EDI and the literature includes few research-based referenced articles concerning EDI; however, Benjamin, de Long, and Morton (1990) explicitly linked EDI to interorganizational systems (IOS), a subset of interorganizational relationship theories.

Benjamin, de Long, and Morton (1990, 29) refer to "a special class of interorganizational systems, known as electronic data interchange." Interorganizational information systems (IOS) are "systems based on information technology which crosses organizational boundaries," according to Bakos (1991, 295) and IOS technology "impacts inter-and intra-firm management and business practices," (Vlosky, Smith, and Wilson 1994, 5). Teo, Tan, Wei, and Woo (1995, 185) also called EDI "an important subset of IOS."

> IOS automates routine transactions by integrating tasks and functions across a predetermined set of organizational boundaries. Such an IOS, commonly known as EDI, has received widespread attention in recent years. (Banerjee and Golhar 1994, 65)

Thus, authors have linked EDI to the cross-functional transactions between a buyer and seller. As buying and selling companies interact, they use transactions, information flows, and establish linkages that support the

buyer-seller relationship. The management literature referred to this concept as interorganizational relationship (IOR) (Whetten and Aldrich 1979, Whetten and Leung 1979, and Aldrich 1971, 1976).

The channels-of-distribution literature provides further information from the marketing point of view (Gaski 1986). IOS can be considered "the most significant technical breakthrough in distribution channels in recent years," (Nidumolu, 1995, 89).

The study of IOR has a relatively long history. This includes several literature reviews (Finley 1970, Oliver 1990, Olshansky 1961, Schermerhorn 1974, 1975, Vacin 1972, Van de Ven 1976, Warren 1967, Whetten, 1977, 1981). The latest of these studies, Oliver (1990) reviewed articles since 1960 and listed over one hundred primary sources, which in turn specified many more.

The IOR literature provided several theories to describe the relationship between a firm and its customers. The following section discusses six schools of thought that provide the theoretical basis to understand why specific characteristics are chosen for the research model. These included the population ecology, resource dependence, exchange, transaction cost, political economy, and contingency models.

Population Ecology Model

The population ecology model used a macro perspective, and had its origins in the biological sciences. Over time, those companies best suited to the environment will survive and those not suited will wither. The theory tracked the success of the industry. The specific application to particular firms was limited. Only by using a retrospective approach could one determine if a particular firm's strategy was correct. Supporters of this school of thought included Astley and Fombrun (1983), and Hannan and Freeman (1977).

Resource Dependence Model

The resource dependence model used a micro perspective and thus was more useful in studying particular companies. In this model, firms seek trading partners to ensure an adequate supply of critical resources. Money and authority are the basic resources that can be exchanged for other needs, such as personnel, information, goods, etc. (Benson 1975).

The main proponents of the resource dependence model included Benson (1975), Aldrich (1976), and Lauman, et al. (1978). Whetton (1978) noted the major weakness of the resource dependence model is its failure to account for a company's efficient use of assets.

Exchange Model

The exchange model also used a micro perspective and expanded the resource dependence model to include other resources. The exchange model came from economics and focused on the items to be exchanged and the companies involved. Each of the interacting companies will trade something of comparable value. Major supporters of the exchange model included Levine and White (1961), Aldrich (1974), and Huppertz, Arenson, and Evans (1978).

Aldrich (1974) argued that the exchange model focused attention upon relations between organizations of equal power or control over resources. This de-emphasized the dominance and vertical relationships among organizations. Companies will try, if possible, to avoid dealing with others who have a stronger position.

Transaction Cost Model

The transaction cost model used a micro perspective approach. This model also came from economics and emphasized the form of the deal or governance structures. Companies attempt to minimize the cost of the transaction given bounded rationality and opportunistic behavior. This approach noted the costs of transacting the deal. Williamson (1975) was the primary proponent of the transaction cost approach. Other supporters included Klein, Crawford, and Alchian (1978), Heide and John (1988), and Noordewier, John, and Nevin (1990).

Political Economy Model

The political economy model was the first integrated approach and noted the exchange and the focal social units involved. The political economy model included both economic and political factors, both internal and external to the firm.

Economic factors included the structure of the unit, exchange processes, allocation rules, and incentive systems internal to the firm. Economic relations between the firm and trading partners involved competitive markets and integrated and quasi-integrated marketing systems (Arndt, 1983).

Political factors included what constituted power bases and the distribution of power within the firm. The goals of the firm, mechanisms for managing conflicts, and the use of boundary-spanning positions are also involved within the firm (Arndt, 1983).

Political factors between the firm and trading partners involve dependence relationships. The inter-organizational form of the relationship and control mechanisms used are also involved (Arndt, 1983).

The political economy model, shown in table 2 involved the interplay of power, the goals of the power wielders, and the productive economic exchange systems (Arndt 1983). Primary supporters of the political economy model included

TABLE 2

THE POLITICAL ECONOMY MODEL

RELATIONS TO THE ENVIRONMENT	INTERNAL STRUCTURE AND PROCESSES
POLITICAL RELATIONS Dependence relations Inter-organizational form Control mechanisms	INTERNAL POLITY Goals of the focal unit Distribution of power Power bases Boundary-spanning positions Mechanisms for managing conflicts
ECONOMIC RELATIONS Competitive markets Quasi-integrated systems Integrated marketing systems	INTERNAL ECONOMY Structure of the focal unit Internal exchange processes Allocation rules Incentive systems

Ardnt (1983), Benson (1975), Stern and Reve (1980), and Zald (1970b).

The formal contacts between a focal firm and its partner companies are conducted in its environmental context. Political economy theory provided an enhanced model by linking the economic and political contexts of the firm's environment.

Contingency Model

Oliver (1991) used a contingency-based context. She integrated the previous IOR literature into six separate contingencies: necessity, asymmetry, reciprocity, efficiency, stability, and legitimacy.

Necessity is the meeting of necessary legal/regulatory requirements. This action is based on resource dependence and exchange approaches and emphasizes involuntary interaction.

Asymmetry is the potential to exercise control over relationship formation. This requirement necessitates the loss of decision-making latitude.

Reciprocity is the cooperation, collaboration, and coordination among relationships. This contingency is based on exchange theory and assumes (1) resource scarcity induces cooperation rather than competition, (2) balance and equity, and (3) gains by linkage exceed decision losses.

Efficiency is the internal orientation to improve productivity. This concept is consistent with the transaction cost perspective.

Stability is the desire to increase predict-ability or reduce uncertainty and legitimacy is the justification for the organization's activities/outputs. Both of these contingencies are based on the strategy of the firm. Oliver's contingencies are summarized in table 3.

The six schools of thought have evolved over time, from the relatively simple relationship of a firm to its environment to the more complex relationship between a firm and its customers. The first three models were strictly economic in nature. Greater attention was placed on the latter three models, as these refined earlier approaches.

TABLE 3

OLIVER'S CONTINGENCY MODEL

CONTINGENCY	MAJOR COMPONENTS
Necessity	The meeting of necessary legal/ regulatory requirements, this is based on resource dependence and exchange approaches and emphasizes involuntary interaction.
Asymmetry	The potential to exercise control over relationship formation, this necessitates the loss of decision-making latitude.
Reciprocity	The cooperation, collaboration, and coordination among relationships, it is based on exchange theory and assumes (1) resource scarcity induces cooperation rather than competition, (2) balance and equity, and (3) gains by linkage exceed decision losses.
Efficiency	The internal orientation to improve productivity, it is consistent with the transaction cost perspective
Stability	The desire to increase predict-ability or reduce uncertainty.
Legitimacy	The justification for the organization's activities/outputs. This is based on institutional theory.

The political economy model added political aspects, and Oliver's contingency model looked at the relationships through several aspects. Each school of thought is

discussed and the principal supporters and major concepts of each are summarized in table 4.

TABLE 4

RESEARCH SCHOOLS OF THOUGHT THAT DESCRIBED INTERORGANIZATIONAL RELATIONSHIPS

SCHOOLS	AUTHORS
Population ecology	Hannan and Freeman 1977, Astley and Fombrun 1983
Resource dependency	Benson 1975, Aldrich 1976, Lauman, et al. 1978
Exchange	Levine and White 1961, Aldrich 1974, Huppertz, Arenson, and Evans 1978
Transaction cost	Williamson 1975, Klein, Crawford, and Alchian 1978, Heide and John 1988, Noordewier, John, and Nevin 1990
Political economy	Zald 1970b, Benson 1975, Stern and Reve 1980, Arndt 1983
Contingency	Oliver 1990

Based on these schools of thought, the research model involved testing several relationships between a firm and its customers. These included reputation, skill, indirect power, direct power, reciprocity, and efficiency. These relationships are grouped for discussion in the section on the research model. The research model is discussed after an introduction to networks. Firms and their customers using EDI form a particular IOR network.

Networks

The earliest focus of IOR was the focal organization and its organization set (Evan 1966). The units of the organization set match with the focal organizations to form dyads. Dyadic settings tend to be short-term in nature and have informal linkages.

Researchers prefer to study IOR in a network setting. Networks are dynamic and require an understanding of the contextual factors and the strength of the linkages (Whetton 1981). Network analysis has since replaced the early focus on dyads in the study of IORs (Benson 1974, Boje and Whetten 1981, Cook 1977, Ghosal and Bartlett 1990, Provan 1983, Pearce and David 1983, Thorelli 1986, Van de Ven and Walker 1979).

A network is designated by its membership set and determined by the degree of interaction among the members. The membership set includes individuals who shared a defining characteristic; the network consists of those members who had a high degree of interaction (Whetton 1981). Provan (1983, 79) defined a network as "a group of organizations that share common organizational ties and can be recognized as a bounded interorganizational system."

Terreberry (1968) and Miles (1989, 1992) studied networks for their effects upon a focal organization, while Provan (1983) described the following factors as precursors of federations of organizations into networks:

1. Interdependence (as well as recognition of this interdependence) among members
2. A large number of involved organizations
3. A large discrepancy between the prime expertise and goal orientations of potential affiliates and the anticipated role of the network's management
4. Substantial external pressure from elements of the general environment

Interorganizational systems are often competitive entities in themselves (Goodman 1979). The following sections contain a discussion of the characteristics of membership, relationships among members, and the limits of networks.

Characteristics of Membership

Potential affiliates join when they expect to receive greater benefits as a larger organization than as separate units. This larger organization has defined members and non-members. Members try to reduce the number of direct linkages required to interact with other members and reduce their linkages to the external environment.

Lawrence and Lorsch (1967) noted that successful organizations tend to have structural characteristics that match their environment. Thorelli (1986) expanded this idea and introduced the term "network shock" to discuss the impact of outside forces on the network. These forces included such examples as deregulating the air and trucking industries and opening individual countries to world markets.

Relationships of Members in Networks

Thorelli (1986) described four dynamic processes that characterize network membership. These included entry and exit, and positioning and repositioning.

Entry and Exit

Thorelli (1986) noted network barriers to entry and exit by members that are similar to market barriers (Porter 1981). These network barriers include special emphasis on "transaction costs as facilitating or retarding joining or leaving networks" (Thorelli 1986, 42).

Members reduce the number of direct linkages to other members throughout the network and reduce external linkages with the environment, such as resource suppliers, by dealing with the federation management. Federations are networks that provide a superset of rules to describe how units may interact with each other and members are free to join as they wish.

Positioning and Repositioning

The positioning and repositioning of companies in a network involved the relative influence they have among the other members. This influence is affected by the governance structure of the network. Miles (1992) listed the following four governing structures of networks:

1. Different functions such as product manufacturing and distribution are performed by independent organizations along the value chain.

2. Brokers play a lead role in linking the functions conducted by separate organizations.

3. Major functions are held together by voluntary market mechanisms rather than by plans and controls.

4. Computer-based information systems are used as substitutes for trust-building processes.

Governance structures vary in their ability to support the different strategic aims of the members (Ruekert, Walker, and Roering 1985). Organizations may form coalitions for mutual support of specific issues. Another structure, involving formal requirements for entry and continued membership, is the federation. Federations can be voluntary or mandated and may "evolve because of the difficulty of coordinating more independent linkage arrangements" (Provan 1983, 8).

Voluntary groups set up by manufacturers and buyer cooperatives fit the social choice pattern. Such groups may extract commitments based on goal congruence. These groups having "moderate up-front investment, vested supplier-based store identity, and end-of-year rebates on purchases, combine to make for non-trivial exit barriers" (Dwyer and Oh 1988, 24).

Positioning involves challenging preexisting members of the network. Domain and power considerations normally rule. This shifting of power is normally an ongoing process, which constantly causes repositioning among members. Networks require a coordinative effort called network management or else the networks tend to disintegrate under the impact of

entropy (Thorelli 1986). Thorelli (1986, 43) stated, "It is not by accident that classic theory about vertical distribution systems talks about channel captains."

Limitations of Networks

Networks have several limitations. These limitations included a new emphasis on personnel, heightened reliance on quality and reliability, and diseconomies of scale.

Thorelli (1986) wrote that the bonds between the companies are often people-specific. If certain individuals leave a company, they take the perceived trust and expertise of the firm with them. For example, account executives may take clients with them when they move to new companies.

Suppliers, producers, distributors, designers, and others who are available for the creation of a network have every reason to be concerned about both the quality and timeliness of the product or service they provide. A failure to deliver as promised results in an immediate contractual loss and potentially widespread future losses as news of the failure circulates (Miles 1989).

Diseconomies of scale limit the size of networks (Levine and White 1961, and Galaskiewicz 1979). These diseconomies of scale are noted as follows:

> Because arithmetic increases in the number of organizations involved in a linkage network result in exponential increases in the number of possible ties, coordination among organizations in a large network tends to be a complex and highly problematic activity (Litwak and Hylton 1962, Pfeffer and Salancik 1978). (Provan 1983, 8)

Additionally, networks may grow too large geographically. Locally administered organizations will be more responsive to local conditions. Rogers and Maas (1979) saw that proximity enhanced communications.

Whetton (1983) observed that IOR is best studied in networks. Organizations in a network share some common organizational ties that define the IOR (Provan 1983). The extent of the ties, the reasons for their existence, and the arrangement of the organizations within them, formed the basis for analysis. Network concepts are summarized in table 5.

The purpose of this study was to investigate the purchasing relationships of industrial distribution firms using EDI within a framework of IOR. As firms typically use EDI with only a fraction of their trading partners (Payne 1992) those customers that use EDI with the firm can be considered a separate class from those that do not. Examining the differences in the IOR characteristics between customers using EDI with the firm and those that do not may lead to a greater understanding of the current buyer-seller relationship. This relationship was tested by a research model described in the following section.

TABLE 5

NETWORK FOCUS CONCEPTS

CONCEPT	AUTHOR
Effect on organizations	Terreberry 1968, Miles 1989, Miles 1992
Interdependency context	Warren 1967
Governance structures	Ruekert, Walker, and Roering 1985
Wholesaler structures	Anderson and Weitz 1986, Dwyer and Oh 1988
Federations	Provan 1983
Competition	Goodman 1979
Relate power to communication	Hinings, et. al. 1974, Emerson 1962, Cook 1977, Boje and Whetten, 1981
Diseconomies of scale	Levine and White 1961, Galaskiewicz 1979
Numbers increase complexity	Provan 1983, Litwak and Hylton 1962, Pfeffer and Salancik 1978
Proximity helps communications	Rogers and Maas 1979
Characteristics	Miles and Snow 1986, Lawrence and Lorsch 1967
Network/structure	Pearce and David 1983
Outside forces impact on the dynamic process	Thorelli 1986

Research Model

A model provided the structure for research design. In this study, customers were classified by two methods of purchasing. The first class involved customers that used EDI as the means of purchasing products from a given firm. The second class used the traditional paper-based system to purchase items from the firm.

Other factors complicated the buyer-seller relationships. One set of constructs involved centrality defined by the firm's position in the buying network. Galaskiewicz (1979) said that companies in the center of the network have more power than those on the fringe of the network. Leaders tend toward the center of a network. Factors of centrality for the research model included the company that initiated the EDI network and the company that managed the EDI network (Boje and Whetten 1981).

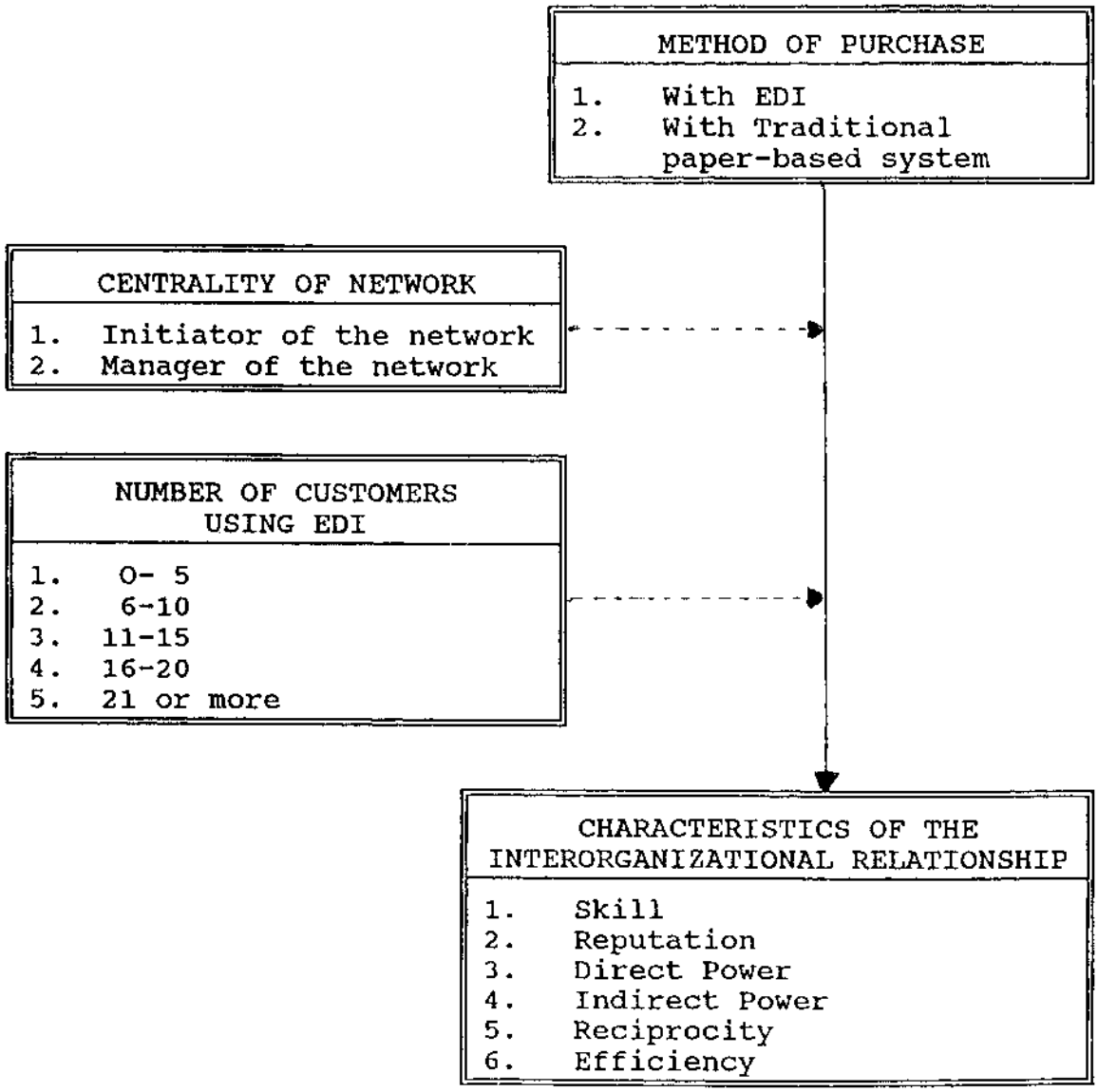
Another construct was the number of companies with which a firm used EDI. As a firm interacted with more users of EDI, it had an incentive to optimize its operations with the network (Emmelhainz 1987).

The IOR between the focal firm and each of the two classes of customer was investigated. It was hypothesized that there would be a difference between the two classes of customers in their buyer-seller relationships. The literature provided the basis for determining the IOR relationships examined.

The differences in the IOR between firms and two classes of customers formed the basic model. Measures of centrality and the number of customers using EDI with the firm expanded the research model. The relationships of this research are shown in figure 2.

FIGURE 2

RESEARCH MODEL



The research model included the following: (1) classes of customers, (2) measures of centrality, and numbers of users of EDI, and (3) characteristics of the interorganizational relationships between the buying and selling companies. These factors are discussed further in following sections.

Classes of Customers

The relationship of the firm and its customers form a network and are discussed in this section. Few companies conduct all their business using EDI (Payne 1992). Thus, the customers with which the firm use EDI may be considered a class separate from those that use the traditional paper-based purchasing systems.

The focal firm interacted with its customers in two ways and these links defined two classes of customers. The first class of customer used EDI as the means of purchasing products from a given firm. The second class of customer used the traditional paper-based purchasing system.

The literature on the use of EDI focused on benefits and cost and the potential benefits of EDI were more descriptive than prescriptive (Teo, et al. 1995). Teo, et al. (1995) claimed that using EDI benefitted firms by increasing sales, improving customer service and data control through reducing errors and administrative costs.

These benefits were offset by the additional cost of EDI. Sokol (1989) noted the cost of the hardware and software, and the lack of standards have hindered the adoption of EDI until recently. The systems lacked proper security and required additional training and a change in the attitudes of firms. The benefits and costs of using EDI are summarized in table 6.

TABLE 6

BENEFITS AND COSTS OF EDI

BENEFITS (Teo et al. 1995)	COSTS (Sokol 1989)
Improved customer service Improved data control Increased sales Reduced clerical errors Decreased administrative costs	System cost Lack of security Lack of standards Float loss Training requirements Attitude adjustments

Carter, Monczka, Clauson, and Zelinski (1987, 13) stated, "EDI is quickly gaining acceptance in the purchasing environment and has evolved into the preferred method of business communication between buying and supplying firms." They expected firms to increase using EDI as did La Londe and Emmelhainz (1985), and Emmelhainz (1989).

La Londe and Emmelhainz (1985, 9) expected most purchasing departments of the future "will look far different from the typical purchasing department of 1985." EDI is a factor in deciding which vendor is best positioned

to contribute the greatest value to the buying organization (Emmelhainz 1987). Buys (1990) said that manufacturing systems, such as EDI, cross functional and organizational boundaries through data exchange. Thus, EDI is a factor that cause the using firm to change their organizational structure. The class of customers is discussed further in chapter three as the independent variable for this research project. Although formal research questions are discussed later, the following proposition is made.

P1: There is a difference is the IOR characteristics between firms and their customers that use EDI compared to the IOR between firms and their customers using the traditional paper-based purchasing systems.

Moderating Factors

Other concepts affect the IOR between a firm and its customers. The measures of centrality and number of customers are discussed in the following sections.

Measures of Centrality

Bavelas (1948, 1950) wrote about the power of the central actor in a network and Hinings, et al. (1974) measured centrality by the number of links a member had with other work units. The relationship of centrality to networks is summarized in table 7.

TABLE 7

RELATIONSHIP OF CENTRALITY TO NETWORKS

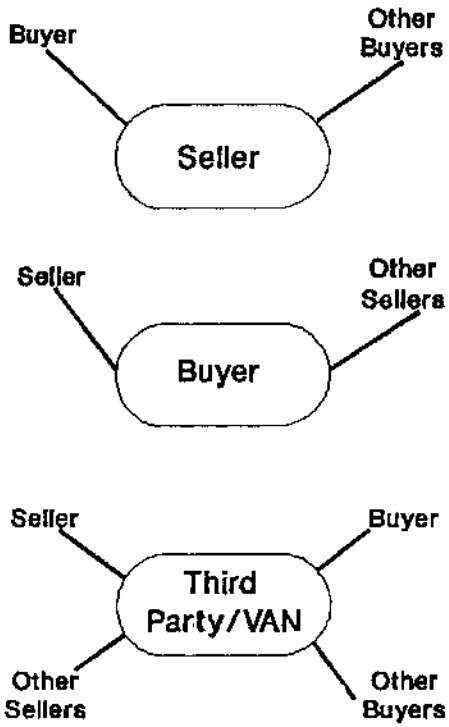
CONCEPT	AUTHOR
Power of centrality	Bavelas 1948 and 1950
Measure by links	Hinings, et al. 1974
Centrality vs. size	Galaskiewicz 1979
Leaders tend to center	Boje and Whetten 1981
Central actors control resources	Emerson 1962, Cook 1977, Boje and Whetten 1981
Dissimilar groups less central	Boje and Whetton 1981

Galaskiewicz (1979) found network centrality to be a better predictor of attributed influence than size of resource base and Boje and Whetten (1981) found aggressive leaders move toward the central position in a network. Centrality can be an important source of power if it implies the capacity to control resources (Boje and Whetten 1981, Cook 1977, Emerson 1972). The location of the focal firm in the distribution network is a measure of centrality of the network as shown in figure 3.

Boje and Whetten (1981, 385) proposed that organizations that have "dissimilar ideologies to the ideologies of other network organizations will be less central and will have less attribute influence."

FIGURE 3

CENTRALITY



Adapted from Galaskiewicz, J. Exchange Networks and Community Politics. Beverly Hills: Sage, 1979.

Galaskiewicz (1979) noted that companies in the center of a network are more powerful while companies on the fringes are less powerful. The respondents of the survey (the focal firms) may not be in the center of the EDI network. The model thus compensated for the position of the focal firm.

The research involved investigating the centrality of the firm in two ways. The first way involved the company that initiated the EDI network which company managed the EDI network. Initiation referred to the company that first

started the network or provided the initial impetus to the firm to use EDI. This leads to the following proposition.

P2: The company that initiates the EDI network will moderate the difference in the IOR characteristics between a firm and its customers.

Similarly, the company that manage the EDI network is an indicator of the centrality of the firm to the network. This leads to the following proposition.

P3: The company that manages the EDI network will moderate the difference in the IOR characteristics between a firm and its customers.

Number of Customers Using EDI

There are certain start-up costs associated with using EDI. These include acquiring the necessary hardware and software, training, and adjusting the attitudes of the firm's personnel. These costs have been increased because of the proprietary nature of the EDI networks. Consequently, firms start using EDI with only one or two of their best customers and over time incorporate the use throughout their operations (Sokol 1989).

It is expected that as firm uses EDI with more customers, the firm will gain additional expertise in EDI with the resulting gain in power (Porter 1980). The number of customers may also affect the resulting reputation and asymmetries of power between a firm and its customers, leading to the following proposition.

P4: The number of customers that use EDI with the firm will moderate the difference in the IOR characteristics between a firm and its customers.

The firms that initiated the EDI network and those that managed the network are further discussed in the next chapter. These measures of centrality and the number of customers using EDI with the firm were treated as a moderator variables in this model.

Characteristics of the IOR

Oliver (1990) noted several characteristics to describe the way companies interact with their trading partners. These characteristics included asymmetry of power, and reciprocity and efficiency.

Asymmetrical approaches refer to the relative amounts of power associated with given firms compared to their trading partners; reciprocal approaches, on the other hand, refer to firms that tend to have similar power levels and thus share power with their partners. Efficiency referred to the ease and cost of conducting business. Asymmetry of power, reciprocity, and efficiency characteristics are discussed in the following sections.

Applications that test both asymmetrical and reciprocal contingency approaches in IOR are rare (Oliver, 1990). Several studies have bemoaned the single-minded approaches of various papers (Baker and O'Brien 1971, Melcher and Adamek 1971, Oliver 1990, Schermerhorn 1975, Warren 1967). Researchers tended to study one approach or the other. Gasky (1984) studied asymmetry, while Anderson, Lodish, and Weitz (1987) researched reciprocity.

Asymmetrical Approaches

The government has encouraged the use of EDI and have required companies to use EDI for some contracts. The Department of Commerce adopted EDIFACT, an international version of EDI. The Department of Defense, the largest buying organization in the world, is an extensive user of EDI (Stevens 1988). Trading partners of these organizations are expected to use EDI. Senn (1989) wrote how General Motors told its suppliers they must link up through EDI or risk losing significant levels of business. This requirement to use EDI is an attempt to control the buyer-seller relationship.

> When direct control of the input or output environment is impossible to attain, approximation to control can be achieved through the development of an elaborate information system to monitor the relevant sectors of the task environment. The successful development of such an information system about uncertain input or output can alter the power structure in channel dyads in favor of the administering system. (Achrol, Reve, and Stern 1983, 64)

Williams (1994) stated that increased channel power is a reason to adopt EDI. He noted that more powerful firms adopt EDI quicker than weaker firms. Further, EDI networks could be proprietary or standard systems. The benefits of using proprietary networks accrued to the initiator of the system more than to its trading partners (Neo 1994). This advantage is evident as the initiator designed and optimized software.

Third parties have acted as intermediaries and reduced the advantage of the initiator. Third parties translated proprietary transactions into standardized networks (Sokol 1989).

Porter (1980) described the comparative advantage of companies over their trading partners as a source of power. The five sources of power can be shown as direct or indirect power.

Direct Power

The first two effects described the direct relationship between two parties. Direct relationships suggested a power differential between buyers and sellers. These effects included the following: (1) relative bargaining power of buyers over their suppliers, and inversely (2) relative bargaining power of suppliers over their buyers.

Indirect Power

The remaining three effects described the seller's competitive environment, which affected the buyer-seller relationship indirectly. These indirect effects included the: (1) threat of new suppliers entering the market, (2) intensity of rivalry among existing firms, and (3) ability of the buyer to substitute products.

In addition to the concepts of direct and indirect power developed by Porter (1981), the research model for this study measured firms' skills and reputations. These

two concepts were based on the writings of French and Raven (1959) and are discussed in the following sections.

According to Gaski (1986), French and Raven provided a theoretical basis for other conceptual frameworks of power topics used in related literature. French and Raven's material has been found often in the marketing literature.

French and Raven (1959) explained that power takes five forms: legitimate, expert, referent, coercive, and reward powers. Legitimate power was derived from the formal position of authority (French and Raven 1959). Legitimate power referred to an ownership position and will not be included in this study of interorganizational relationships.

Expert power was encompassed by skill in using EDI and knowledge of the product line in this study. French and Raven (1959) described referent power as the personal respect of individuals for leaders and was noted by reputation. Raven and Kruglanski (1970) suggested that expert, referent, and legitimate bases of power reinforce each other.

Coercive and reward powers in a buying and selling environment included the power to increase or decrease sales to a particular company. Coercive power was the ability to force action by instilling fear, and reward power shows that people work for gain (French and Raven 1959). Both cases were similar to the asymmetry described by Porter (1980).

Skill

Skill was the expertise of a buyer, such as training, experience, and leadership in (1) use of EDI and (2) technical requirements of the supplier's product line. Dickson (1983, 36) noted that items such as Universal Product Codes allowed retailers to "evaluate new products and promotions quickly, which is bound to increase the retailer's information power over the manufacturer."

Reputation

Reputation was the level of respect that a firm has for a trading partner. Companies will more likely initiate and keep a relationship with firms with which that they have greater respect than firms with which they have lessor regard. Reputation of firms on the organizational level of analysis was analogous to referent power.

Two sets of authors described asymmetrical approaches to describe the relationship of power between a firm and its trading partner. These authors included Porter (1980) and French and Raven (1959), as shown in table 8. The following proposition is made.

P5: Firms will have greater IOR characteristics of power with customers using EDI than those customers using the traditional paper-based purchasing system.

Reciprocal and Efficiency Approaches

Two other approaches to the IOR between a firm and its customers exist. These are reciprocity and efficiency.

TABLE 8

ASYMMETRICAL APPROACHES

AUTHOR	MAJOR CONCEPT
Porter 1980	Direct power measured by (1) bargaining power of buyer over seller and (2) bargaining power of seller over buyer
Porter 1980	Indirect power measured by (1) threat of new suppliers entering the market (2) intensity of rivalry among existing firms (3) ability of the buyer to substitute products
French and Raven 1959	Power took five forms (1) legitimate (2) expert (3) referent (4) coercive (5) reward

Reciprocity represented the positive effects associated with partnerships and depended upon mutual trust between two parties. The level of reciprocity extended from merely responding to actions, to planning for their occurrence, and to actively working with a given trading partner. Efficiency was the improvement of productivity and was similar to the transaction cost perspective. Reciprocity and efficiency are discussed in the following two sections.

Reciprocity

Reciprocity was similar to French and Raven's (1959) concept of referent power. Reciprocity between a firm and its suppliers included cooperation, collaboration, and coordination (Oliver 1990).

Cooperation

The level of cooperation between companies is a measure of how a firm responds to extraordinary requests from another company (Oliver 1990). Cooperation is a reactive method. Companies often have to react to changing markets, which causes a ripple effect throughout the distribution chain. Firms with good relations with their trading partners can respond positively. Firms with poorer relations are forced to rely upon the specifics of contracts, which may not allow firms to react quickly to new circumstances.

Emery (1967) considered cooperation as a means to adapt to uncertain conditions. Cooperative interactions will occur in balanced power relationships as long as the balance of power is preserved (Stern and Reve 1980). Marketing channels characterized by minimal power will exhibit low levels of cooperation (Stern and Reve 1980, McCammon 1970). This minimal power caused the exchange model to break down.

Frazier and Rody (1991, 53) noted that "interfirm cooperation levels are of only moderate strength between suppliers and distributors in the industrial channel system"

Further, though "interfirm cooperation is desirable, distributors are constrained in the amount of time they can devote to any one supplier," (Frazier and Rody 1991, 53). Distributors have a reasonably high level of independence and autonomy (Evan 1965, Stern and Brown, 1969).

Achrol, Reve, and Stern (1983) suggested that the level of cooperation increases as the amount of a firm's uncertainty grows in the task environment's competitive sector. One method of dealing with uncertainty was to increase planning with other firms.

Collaboration

Collaboration was the extent to which a firm works with another company in the planning stage, such as co-designing a product (Oliver 1990) and involved both partners acting in their own best interests and aligning their operations in areas where they agree. Rogers and Molnar (1975) noted the effect of joint programming and pointed out that information flow increased trust. Miles (1989, 11) observed that "shared information systems [serve] as a basis for trust and coordination." Collaborators optimized at the firm level as they separately determined what is in their respective company's best interest. They may decide that sharing power will provide each partner with an optimal allocation of power.

Interdependence was a complex form of collaborative activity (Molnar 1978) and could have included using

resources more efficiently (Levine and White 1961) or improving effectiveness of service delivery systems (Hage 1975). Daft (1989) described interdependence by how much departments depend upon each other for resources or materials to accomplish their tasks.

Coordination

Coordination is the extent to which the firm acts with another company for mutual benefit, such as co-scheduling production (Oliver 1990). Coordination requires firms to take a proactive part in the partnership.

Achrol, Reve, and Stern (1983, 63) stated, "Increased vertical coordination is initiated by the channel actor that is able to cope more effectively with or absorb the external uncertainty." The amount of coordination required dwarfs formally structured arrangements and is "the embryonic stage in the development" of IOR (Van de Ven and Walker 1984, 598).

High levels of interfirm coordination are best supported by assurances of relationship continuity, durability, and integrity (Macneil 1980, Williamson 1983, 1984). This interfirm coordination is fostered by the climate of goal compatibility, levels of trust among the individuals and companies involved, and environmental uncertainty (Anderson, Lodish and Weitz 1987).

Trust in the partner's subsequent actions will expose a company to a possible loss; however, trust will still be

maintained, "if the firm believes its partner has taken the expected action, but that forces beyond its control have negated the expected outcomes" (Anderson and Narus 1990, 45). Formal communications and interpersonal exchanges greatly affect mutual trust (Boje and Whetten 1981).

> The growth of relatively strong and proactive interfirm relationships is fostered by frequent communications of a non-coercive nature (Anderson and Narus 1990, Van de Ven and Walker 1984). The resultant trust and openness (Kotter 1977, Raven and Kruglanski 1970) should motivate the supplier and distributor to express underlying areas of disagreement at times (Schurr and Ozanne 1985), with the purpose of effectively resolving them and making the exchange relationship stronger . . . The more information that is exchanged between two firms, the greater is the likelihood that some similar norms and values for appropriate business practices will be held by the firms (Kasulis and Spekman 1980, Rogers and Bhowmik 1970). (Frazier and Rody 1991, 55)

The long-term nature of coordinative behavior is noted by heuristic trial and error (Kelley and Schenitski 1972). Clopton (1984, 41) called this "a type of concession behavior in which a bargainer explores all possible settlements at a given level of utility before conceding to a lower level." Moreover, the bargainer concedes very gradually. The actual methods of negotiating may undermine verbal statements and promises. This behavior caused negotiators to view the opponent as manipulative and exploitive (Frey 1971).

Additionally, "most of the research and too many of the marketing strategies treat buyer-seller exchanges as discrete events, not as ongoing relationships" (Dwyer,

Schurr, and Oh 1987, 11). Further, power interacts with trust over third parties (Pfeffer and Salancik 1978). Thus, the reasons for organizations to join together may change over time (Schmidt and Kochan 1977).

Coordinated efforts optimize at the network level, which avoids the problem of sub-optimization. The entire distribution chain benefits from coordinated efforts. For example, the virtual corporation exists because each company is better off in the integrated distribution chain.

Buyers, sellers, and intermediaries, such as shippers, begin to act as a team when they use EDI. Sokol (1989, 12) observed, "It is rather unusual for a project to span company boundaries as this one does. Consequently, the project requires a great deal of coordination." Neo (1994) noted that EDI requires businesses to develop partnerships. For example, Hewlett-Packard viewed EDI as a tool to implement their strategy to develop strong partnerships with its customers and suppliers (Banton 1989).

The flow of the transactional paper trail is just one way the business relationship changes. EDI leaves no physical paper trail for audit, as transactions are done electronically and no judicial review of EDI has determined the validity of the underlying electronic contract between the parties. The absence of a proper paper trail implies a high degree of specificity in the contracts and a measure of trust between the partners (Sokol 1989).

Monczka and Carter (1989) created a model for implementing EDI. In their implementation plan, they noted that EDI influenced the internal systems of the company, and the business relationships between buyers and their suppliers. The relationships are affected by the degree of trust and cooperation exhibited by both parties. These and other concepts of reciprocity are summarized in table 9. Thus, the following proposition is made.

P6: Firms will have greater IOR characteristics of power with customers using EDI than those customers using the traditional paper-based purchasing system.

Efficiency

Oliver (1990) discussed efficiency in a manner similar to the transaction cost model. Efficiency was based on improving internal input to output ratios. These improvements were measured by increasing return of investment or assets, and reducing waste, or down time (Oliver 1990). Efficiency considerations usually prevail over power, at least in profit making enterprises, over the long run (Williamson and Ouchi 1981). The research model involved two measures of efficiency. These measures were ease-of-conducting a transaction and cost-of-conducting a transaction.

TABLE 9

RECIPROCITY CONCEPTS

CONCEPT	AUTHOR
Adapt to uncertainty	Emery 1967
Balanced relationships	Stern and Reve 1980
Channels with low levels of reciprocity	McCammon 1970, Stern and Reve 1980
Increased uncertainty	Achrol, et al. 1983
Time constraints	Frazier and Rody 1991
Interdependence	Molnar 1978, Daft 1989
Efficiency	Levine and White 1961
Effectiveness	Hage 1975
Information flow	Rogers and Molnar 1976
Sequential nature	Rogers 1974, Kloghlan et al. 1976
Vertical integration	Achrol, et al. 1983
Dwarfs formal mechanisms	Van de Ven and Walker 1979
Needs assurance	Macneil 1980, Williams 1983
Climate	Anderson, et al. 1987
Possible losses	Anderson and Narus 1984
Outside interventions	Anderson and Narus 1990
Formal communication	Boje and Whetton 1981
Types of negotiation	Frey 1971

Ease

EDI is an administrative system and administratively coordinated systems are superior to market mechanisms because of the frictions of intermediary markets, such as technology, exchange factors, and behavioral factors (Etgar 1976b). Etgar (1976b) defined technological factors as including the difficulty of assigning costs of common processes to specific members. For example, externalities are not captured readily. The length of channels of communication imposes costs that affect the efficiency of the entire system. Longer channels are more costly than shorter ones (Mattson 1969).

Cost

Schermerhorn (1975) summarized the potential costs of IOR. These included loss of decision making, change in image, expenditure of resources, dynamics of the relationship, and inventory costs.

The first major cost, according to Schermerhorn (1975, 849), is that "Organizational participation in interorganizational cooperation may involve a loss of decision-making autonomy." Thompson and McEwen (1958) stated that IOR requires partners to jointly decide on future activities and thus limits unilateral or arbitrary decisions. Aiken and Hage (1968, 913) noted constraints arising from "obligations, commitments or contracts with other organizations."

The second cost of IOR is that it may "involve unfavorable ramifications for organizational image or identity" (Schermerhorn 1975, 849). This could affect prestige, identity, or strategic position (Gueztkow 1966).

The third cost is "the direct expenditures of scarce organizational resources" (Schermerhorn 1975, 850). These costs were the bases for the resource dependency and exchange models. These included increased internal organizational coordination (Aiken and Hage 1968), expenditures for transportation and communication (Gueztkow 1966), and expenditures of time (Reid 1964). Anderson, Lodish and Weitz (1987) noted an optimal allocation of time.

Dynamics cost included both exchange and behavioral factors. Exchange factors are the give and take of channel relations. Markets create spot imbalances between sellers and buyers that require excess waiting time and increased search time. Buyers and sellers run the risk of choosing the wrong option. Additionally, each company tends to maintain separate intrasystem bargaining positions, which increases total system costs (Etgar 1976b).

Behavioral factors included adherence to norms that deter technological improvements. The different amounts of information available to each firm caused differences in the goals and perceptions of system members (Etgar 1976b).

Stern and Reve (1980, 56) stated that "oligopsonistic situations are likely to lead to information imbalances,

opportunistic behavior, and high transaction costs." Knoke and Rogers (1979) said that low cost networks (in terms of money or loss of authority) will have more reciprocal ties and higher levels of information exchange.

Adding products to the product line increased the cost to channel members (Rao and Mclaughlin 1989). These costs included the entry and maintenance of new data and inventory costs borne by all members of the channel. Noordewier, John, and Nevin (1990) classified purchasing costs into three categories: invoice cost, possession cost, and acquisition cost.

Invoice costs are the price of the items purchased. This is what the layman considers the cost of the product and may be the only costs that are readily visible.

Possession costs are associated with the time discrepancy between when the order is placed and the subsequent use. Unless perfect just-in-time logistics are involved, these include maintenance and storage of items, taxes, insurance, pilferage and the like. The cost of carrying inventory decreases with increases in turnover.

Acquisition costs arise from the need to seek sources of supply and follow up. These include checking the status of goods shipped and acting appropriately. These costs are not likely to be found in accounting records (Noordewier, John, and Nevin 1990).

> As Hannaford (1983) points out, however, for repetitively purchased supplies, "hidden"

> inventory (possession) and administrative (acquisition) costs typically far exceed invoice costs. Because neither possession nor acquisition costs involve the actual invoice price, they are basically "resource losses incurred due to imperfect information" (Dahlman 1979), or "transaction costs." (Noordewier, John, and Nevin 1990, 81)

These transaction costs are indirect costs and do not always show up on the traditional balance sheet. Rational managers may make choices less than the optimal because their decisions reflect only the apparent costs. Managers attribute errors to the vagaries of chance. The concepts of the transaction cost model are summarized in table 10 and lead to the following proposition.

P7: Firms will have greater IOR characteristics of efficiency with customers using EDI than those customers using the traditional paper-based purchasing system.

Three approaches for the IOR between a firm and its customers were discussed in this section. The IOR characteristics were treated as the dependent variables for this research project.

Research Questions

The author designed this study to answer several research questions. The questions were then converted to hypotheses for testing. The first two research questions tested the basic model. They were separated into two questions to take advantage of the greater power of a one-tailed t-test.

TABLE 10

TRANSACTION COSTS

COST	AUTHOR
Overall costs	Schermerhorn 1975, Etgar 1976b
Constraints	Aiken and Hage 1968
Effect on image	Schermerhorn 1975
Effect on strategic placement	Levine, White, and Paul 1963, Gueztkow 1966
Expend scarce resources	Schermerhorn 1975
Internal coordination	Aiken and Hage 1975
Transportation and communications	Gueztkow 1966
Time	Reid 1964
Optimal time allotments	Anderson, Lodish, and Weitz 1987
Reciprocal ties	Knoke and Rogers 1979
New channel members	Rao and Mclaughlin 1989
Purchasing costs	Noordewier, John, and Nevin 1990
Hidden costs	Hannaford 1983, Noordewier, John, and Nevin 1990
Imperfect information	Dahlman 1979

Interorganizational Relationship Ratings

RQ1: Do firms report significantly higher mean dependent ratings on the characteristics of reputation, skill, indirect power, direct power, and reciprocity for the IOR formed between the firm and its trading partners that use EDI than for the IOR formed between the firm and its partners that do not use EDI for the purchases?

Ha: μ EDI > μ non-EDI

The project used the paired t-test to compare the two mean values of each dependent measure. The decision criteria was set at the significance level of $\alpha = .05$.

Efficiency Ratings

RQ2: Do firms report significantly lower mean dependent ratings on the characteristics of efficiency for the IOR formed between the firm and its trading partners that use EDI than for the IOR formed between the firm and its partners that do not use EDI for the purchases?

Ha: μ EDI < μ non-EDI

The investigation used the paired t-test to compare the two mean values of each dependent measure for each respondent. The decision criteria was set at the significance level of $\alpha = .05$.

The next three research questions tested an expanded version of the research model. Each of the three questions involved a separate additional factor treated as a moderating variable.

Initiation Ratings

RQ3: Does the central position of the company that initiates the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?

Ha: four means are not equal

There are four reported positions for the company that initiates the EDI network. The study used analysis of variance to compare the mean values of each dependent measure for each respondent.

Management Ratings

RQ4: Does the central position of the company that currently manages the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?

Ha: four means are not equal

There are four reported positions for the company that manages the EDI network. The project used analysis of variance to compare the mean values of each dependent measure for each respondent.

Number of Customers

RQ5: Does the number of companies with which the firm uses EDI significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?

Ha: five means are not equal

There are five reported groups for the number of companies with which the firm uses EDI. The investigation used analysis of variance to compare the mean values of each dependent measure for each respondent.

The following two research questions were used to investigate any interaction effect of the number of EDI

users and centrality of the network. One question tested the relationship of number of users to the company that managed the EDI network. The other question tested the relationship of the number of EDI users to the company that initiated the EDI network.

Extent versus Management

RQ6: Is the reported extent of EDI use by a firm independent of the company that manages the network?

Ha: extent of EDI use is dependent on the manager

The project used the one-tailed Chi-square statistic to compare the reported extent of EDI use to the company that managed the network.

Extent versus Initiation

RQ7: Is the reported extent of EDI use by a firm independent of the company that suggested using the network?

Ha: extent of EDI use is dependent on the initiator

The study uses the one-tailed Chi-square statistic to compare the reported extent of EDI use to the company that suggested using the network.

Chapter Summary

The purpose of this study was to examine the differences in inter-organizational relationship (IOR) characteristics between a firm and two classes of its customers. The first class of customer used electronic data interchange (EDI) to buy goods from the firm and the second class of customer used the paper-based purchasing system.

EDI is a computer-based logistics system. Firms enter product data in their computers without having the trading partners reenter the data. The definition of EDI follows:

> EDI is the intercompany computer-to-computer communication of standard business transactions in a standard format that permits the receiver to perform the intended transaction. (Sokol 1989, 12)

While the concept dates to the 1950's, EDI technology has flourished only in the last five to ten years. The major concepts of EDI are shown in table 11.

The IOR between the firm and its customers formed the basis for this study. The research model investigated the following relationship characteristics: skill, reputation, indirect power, direct power, reciprocity, and efficiency.

As buying and selling companies interact, they in use transactions, information flows, and establish linkages that support the buyer-seller relationship. The management literature referred to this concept as IOR. IOR researchers suggested several schools of thought to explain these relationships. These included the population ecology, resource dependence, exchange, transaction cost, political economy, and contingency approaches. Greater attention was placed on the latter three models as these refine earlier approaches.

The earliest focus of IOR was the focal organization and its organization set (Evan 1966). Network analysis has since replaced the early focus on dyads in the study of IORs (Benson 1974, Boje and Whetten 1981, Cook 1977, Ghosal and

TABLE 11

ELECTRONIC DATA INTERCHANGE CONCEPTS

CONCEPT	AUTHOR
EDI linked to IOR	Benjamin, de Long, and Morton 1990, Banerjee, and Golhar 1994, Larson 1994, Williams 1994, Vlosky, Smith, and Wilson 1994, Teo, Tan, Wei, and Woo 1995
Act as a team	Monczka and Carter 1989, Buys 1990, Neo 1994
Intermediaries	Sokol, 1989
Power of users	Banton 1989, Senn 1989, Williams 1994
Government power	Stevens 1988
Quasi-integrated system	Arndt 1983
Information systems	Achol, Reve, and Stern 1983
Planned/current use	La Londe Emmelhainz 1985
User characteristics	Banerjee and Golhar 1994, Carter et al., 1987
Implementation	Emmelhainz 1987, Monczka and Carter 1989, Vlosky, Smith, and Wilson 1994
EDI linked to transaction cost analysis (TCA)	Larson 1994

Bartlett 1990, Provan 1983, Pearce and David 1983, Thorelli 1986, Van de Ven and Walker 1979). Provan (1983) said that a linkage network generally refers to a group of organizations that share common organizational ties and can be recognized as a bounded interorganizational system.

A network was formed by individuals with a high degree of interaction among themselves. Studying networks required defining the set of members and determining the degree of interaction. An easily-defined network existed among the interorganizational relationships of buyers and sellers connected by EDI. Electronic data interchange was explicitly linked to IOR by Benjamin, de Long, and Morton (1990). The buyer and seller connected by EDI begin to act as a team (Monczka and Carter 1989, and Buys 1990).

The research model also involved the intervening factors of the centrality of the network. Bavelas (1948, 1950) noted that actors in the center of a network were powerful. The investigation defined centrality as the company that initiated the EDI network, and as the company that managed the EDI network. The research model, as shown in table 12, also included the number of companies with which the firm uses EDI.

This chapter contained a discussion of each component of the research model and concluded with the research questions to investigate. These are shown in table 13.

TABLE 12

FACTORS OF THE RESEARCH MODEL

CONSTRUCTS	VARIABLE
Classes of customers: (1) Firm linked to customer through EDI (2) Firm linked to customer through traditional paper-based system	Independent
Characteristics of the buyer-seller interorganizational relationship: (1) Skill (2) Reputation (3) Direct Power (4) Indirect Power (5) Reciprocity (6) Efficiency	Dependent
Initiator of network (1) Firm (2) Supplier (3) Customer (4) Shipper (5) Third Party	Moderating
Manager of network (1) Firm (2) Supplier (3) Customer (4) Shipper (5) Third Party	Moderating
Number of firm's customers using EDI (1) 0- 5 (2) 6-10 (3) 11-15 (4) 16-20 (5) 21 or more	Moderating

TABLE 13

SUMMARY OF HYPOTHESES

RESEARCH QUESTION		TEST
RQ1:	Do firms report significantly higher mean dependent ratings on the characteristics of reputation, skill, indirect power, direct power, and reciprocity for the IOR formed between the firm and its trading partners that use EDI than for the IOR formed between the firm and its partners that do not use EDI for the purchases?	Paired t-test
Ha:	μ EDI > μ non-EDI	
RQ2:	Do firms report significantly lower mean dependent ratings on the characteristics of efficiency for the IOR formed between the firm and its trading partners that use EDI than for the IOR formed between the firm and its partners that do not use EDI for the purchases?	Paired t-test
Ha:	μ EDI < μ non-EDI	
RQ3:	Does the central position of the company that initiates the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?	ANOVA F-test
Ha:	four means are not all equal	
RQ4:	Does the central position of the company that currently manages the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?	ANOVA F-test
Ha:	four means are not all equal	
RQ5:	Does the number of companies with which the firm uses EDI significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?	ANOVA F-test
Ha:	five means are not all equal	
RQ6:	Is the reported extent of EDI use by a firm independent of the company that manages the network?	Chi-square
Ha:	extent of EDI use is related to (dependent on) the manager	
RQ7:	Is the reported extent of EDI use by a firm independent of the company that suggested using the network?	Chi-square
Ha:	extent of EDI use is related to (dependent on) the initiator	

CHAPTER THREE

METHODOLOGY

This chapter contains a discussion of the methodology used to answer the research questions described in chapter two. It opens with the research design employed in this study. Additional terms used to operationalize the concepts described earlier are defined. The chapter further includes a description of the population, sample, and the specific variables of the model. Data for the study was collected by a rating instrument.

Research Design

The design of this study involved several points. These points included non-experimental design, matched pairs, self reporting of data, same source bias, and the use of hypotheses.

Non-Experimental Design

This research is non-experimental in design. No attempt was made to manipulate the study variables. Instead, the intent was to examine the variables and their relationships in a natural setting to gain insight into the various causal possibilities. Kerlinger (1986) reported that non-experimental research suffers from the following three limitations:

1. The inability to manipulate independent variables
2. The lack of power to randomize
3. The risk of improper interpretation

Non-experimental research is appropriate, however, because social scientific and educational research problems do not lend themselves to experimentation. Survey research is an appropriate method for data collection in these settings. Surveys can collect a wide scope of information from a large population (Kerlinger 1986).

The lack of power to randomize was minimized by using a sufficiently large sample size. This procedure is discussed in a later section.

The risk of improper interpretation was also present in experimental research. The degree to which control was present in this project determined the ability of the researcher to interpret the results. Generally, the greater the control the greater the ability to interpret. Kerlinger (1986) listed the following four methods to control external variables:

1. Choose independent variables as homogeneous as possible
2. Randomly assign subjects to experimental groups and conditions
3. Build extraneous variables into the research design as an attribute variable
4. Match subjects by splitting a variable into two or more parts

This study used industrial distribution firms as the target population. Leenders and Fearon (1993) described the industrial purchasing environment as remarkably cohesive and quite different from the consumer market. In particular, the following describes the industrial purchasing market:

1. The needs of most organizations are often specialized.
2. Purchase quantities tend to be large.
3. The number of potential suppliers is often small.
4. The number of customers is often small.
5. Large sums of money are involved.
6. Suppliers have a large stake in helping customers.
7. Special expertise is required to ensure customer satisfaction.
8. Appropriate systems and procedures are needed to ensure continued performance.

Matched Pairs

The use of matched pairs increased the control of this research. In this study, each firm was asked to rate its relationships with two classes of customers. As Kerlinger (1986, 289) asked "How much better on all possible variables than by matching a subject with himself?" This matching minimized bias or confusion caused by the respondent misunderstanding or misinterpreting a question. The firms rated each of the two classes by the same method according to their understanding of the question. The project used the paired t-test to differentiate between the two classes of customers.

Self-Reporting of Data

Podsakoff and Organ (1986, 531) discuss problems associated with self reporting of data, where two or more variables come from the same source "any defect in that source contaminates both measures, presumably in the same fashion and in the same direction." This study minimizes this effect by using matched subjects and the paired t-test. Any contaminating correlation linking the independent and dependent variable is presumably present in both sets of the matched pairs at the same rate. The paired t-test is evaluated by the difference between the scores of the matched pairs.

Podsakoff and Organ (1986, 539) provide escalating the unit of analysis as a further check on self-reporting data. This study collected data from individuals who reported on the relationships with 592 customers. The unit of analysis for this study was escalated to the firm. This escalation of the unit of analysis reduces the sample size by half to 296 firms; however this is an acceptable number.

Podsakoff and Organ (1986) further suggests reordering the scale as a means of minimizing the self reporting bias. In this study, the "dependent variables follows, rather than precedes, the independent variable," (Podsakoff and Organ 1986, 540).

Same Source Bias

Avolio, Yammarino, and Bass (1991) discussed creating a new data set to compensate for same source bias.

> [Given] the situation when two consumers who own a particular product are asked to note their satisfaction with the product. If one uses the product extensively and the other does not, then their ratings of satisfaction may vary. Matching raters here would be inappropriate. Thus, differences in the correlations between scales collected in the single-source and the multi-source conditions may simply represent a high degree of within group variability in ratings due to valid experiential differences between raters. (Avolio, Yammarino, and Bass 1991, 573)

This project similarly created new scales by multiplying IOR scores by how much importance the firm places on those characteristics. Thus, the scores were weighted to reflect how heavily the firm uses EDI.

Hypotheses

The use of hypotheses further enhanced the credibility of the results. Kerlinger (1986, 385) stated there is a "trend to using survey research as a tool to test theory and hypotheses in contrast to older use in which the emphasis was on finding what is there." Research limited to planned analysis, based on sound theory, minimized the effect of reporting significant results simply by chance because of a large number of possible statistical tests. This study suffered from the full range of internal validity threats. The following sections include descriptions of additional information used to control the design of the study.

Definition of Terms

The following terms operationalized concepts identified in chapter two. These terms expanded upon the definitions identified in chapter one and provided the basis for measuring concepts operationalized as variables.

1. Amount of purchases in dollars - a direct indicator of the economic influence of a given buyer on a firm measured by the value, in dollars, of the buyer's purchases from the firm and is equal to the amount of sales in dollars
2. Amount of sales in dollars - a direct indicator of the economic influence of a firm on a given buyer measured by the value, in dollars, of the firm's sales to the buyer and is equal to the amount of purchases in dollars
3. Collaboration - a direct indicator of the reciprocity between a firm and a buyer measured by the extent to which the buyer plans with the firm, such as listing mutual goals or co-designing products
4. Cooperation - a direct indicator of the reciprocity between a buyer and a firm measured by the extent to which the partner responds to extraordinary requests by the other
5. Coordination - a direct indicator of the reciprocity between the firm and a buyer measured by the extent to

which the firm and the buyer act together, such as scheduling the production of items

6. Cost of handling - a direct indicator of the efficiency of transactions between a buyer and the firm measured by the expense of completing an item release on a buyer's typical purchase order for the firm
7. Ease of handling - a direct indicator of the efficiency of transactions between a buyer and the firm measured by the simplicity of completing a typical purchase order
8. Ease to enter the market - an indirect indicator of the relative economic influence of a buyer and the firm on each other measured by the competitive rivalry among suppliers due to the ability of potential suppliers to go into business and sell to the buyer
9. Economic influence - the interrelationship of a firm and a buyer noted by the (1) buyer's ability to reward the firm with additional purchases or coerce action by canceling the purchase and (2) firm's ability to reward the buyer by special handling of orders or continuing delivery of products during shortages or coerce action by not delivering products, each measured by the asymmetry of power
10. Efficiency - the cost of transactions between a given buyer and the firm measured by (1) the cost of handling a typical purchase order from the buyer to the firm and

(2) the ease of handling a typical purchase order from the buyer to the firm

11. Extent of electronic data interchange use - the relative percentage of trading partners with which the firm uses electronic data interchange out of all the buyers to which the firm sells products
12. Initiation of the EDI network - the company in the distribution chain that provided the initial driving force that induced the firm to start the EDI network, such as: (1) the firm itself, (2) the firm's suppliers, (3) the firm's customers, (4) the firm's shippers, or (5) third parties
13. Management of the EDI network - the company of the distribution chain that sets and maintains the standards for the computer hardware and software used in the EDI network used by the firm, among: (1) the firm, (2) the firm's suppliers, (3) the firm's customers, (4) the firm's shippers or (5) third parties
14. Marketing - the promotion, advertising, selling, and distribution efforts of a firm (Khandwalla, 1981)
15. Percentage of purchases - a direct indicator of the influence of the firm on a buyer measured by the relative amount that the buyer's purchases represent of the total amount of products bought
16. Percentage of sales - a direct indicator of the influence of a buyer on the firm measured by the

relative amount that the supplier's sales to the buyer represent of the total amount of product sold

17. Product pricing - the dollar amount exchanged for a unit of a particular product between the firm and a buyer
18. Product quality - the extent to which a product of a firm meets the requirements of the buyer
19. Product substitution - an indirect indicator of the relative economic influence of a buyer and the firm on each other due to competitive rivalry of suppliers measured by the ability of the buyer to change products of a firm by using another product in its place
20. Product variety - an indirect indicator of the relative economic influence of a buyer and the firm on each other due to the competitive rivalry of suppliers measured by the breadth and assortment of products offered by a given supplier
21. Professionalism - the level of formal education and training of employees (Daft, 1986)
22. Reputation - the level of respect held by the firm of a buyer
23. Rivalry - an indirect indicator of the relative economic influence of a buyer and the firm on each other due the level of competition among suppliers measured by (1) customer service, (2) product quality, (3) product variety, and (4) product pricing

24. Skill - the expertise of a buyer, such as training, experience, and leadership in the (1) use of EDI and (2) technical requirements of the supplier's product line
25. Strategy - the importance that the firm places on a given relationship. This was a check on single-source bias.

Description of the Population

The universal population for this research involved domestic industrial distribution firms that used EDI with their customers. The sampling frame included domestic industrial distribution firms that used EDI with their customers as listed in EDI, Spread the Word!. Each industrial distribution firm listed was contacted to provide an accurate address for the mailing.

EDI, Spread the Word! is a telephone listing of 21,148 domestic service providers, customers, and suppliers of EDI identified by industrial classification. Payne (1992) estimated that only 3,500 users of EDI were not listed.

The yellow pages format identified one section as industrial distributors and cross-referenced other sections. These cross-referenced sections include, but are not limited to, electrical supply, hydraulics, and wire products. These sections of industrial distributors involved 1310 users of EDI, which are further broken down into two categories. There are 728 firms that use EDI just with their customers

and 582 other firms that use EDI with just their suppliers or both suppliers and customers. This study involved only the 728 firms that used EDI with their customers.

The seventh edition contained information supplied for the September 1992, update. This appeared to be the most complete listing of users of electronic data interchange available.

Payne (1992) gathered customer lists of four major EDI third-party providers and supplier lists from independent EDI users. Additionally, he sought and accepted self-listing at no charge. Trade associations, such as the Power Transmission Distributors Association, often cited Payne and referred current and prospective members to EDI, Spread the Word!.

Sampling Plan

The sample consisted of firms randomly selected from the target population. The sampling plan consisted of determining the sample frame, sample size, and then adjusting for non-response.

Sample Frame

As shown in table 14, most research-based articles involved few firms using EDI until recently. Benjamin, de Long, and Morton (1990), readily conceded that using only three cases limited their conclusions. La Londe and Emmelhainz (1985) assessed current and planned use of EDI in

TABLE 14

NUMBER OF EDI USERS REPORTED

STUDY	NUMBER OF USERS
La Londe and Emmelhainz 1985	25
Carter et al. 1987	25
Emmelhainz 1987	15
Monczka and Carter 1988	25
Benjamin et al. 1990	3
Carter and Fredendall 1990	54
Dion et al. 1990	20
Banerjee and Golhar 1994	26
Lohtia and Krapfel 1994	146
Vlosky, Smith and Wilson 1994	29
Williams 1994	109
Banerjee and Golhar 1995	122

their study of 4,800 purchasing executives; however, only 9 percent of their 278 responses came from companies that reported using EDI. That would be about 25 companies; however, the authors expected the use of EDI to increase.

Emmelhainz (1987) in a follow-on report stated EDI improves vendor relationships; but, she used in-depth case analyses of fifteen organizations in the various stages of EDI implementation. Carter, Monczka, Clauson, and Zelinski

(1987) studied twenty-five firms using EDI and a group of third-party network providers.

Until 1994, researchers used limited numbers of companies using EDI. Some of this may be explained by the growth rate of EDI; however, the sampling frames of these studies involved companies whether they used EDI or not. As only a portion of these companies used EDI, the resulting sizes must be smaller.

Sample Size

McCall (1982) determined the sample size by the following criteria:

1. Estimates of population characteristics - Expected percentages near 50 percent require larger sample sizes.

2. Standard error used for the statistics - The largest sample size from this group becomes the sample size used for the survey.

3. Precision required of the study (sampling error) - Smaller error sizes or tighter levels of precision require larger sample sizes. For the sake of efficiency and economy, the researcher should be careful to use an acceptable error as broad as the goals of the study will permit. The limits set by the acceptable error or desired precision are confidence limits.

4. Confidence level - McCall (1982) said that the confidence level referred to "how certain does the researcher wish to be that the calculated confidence limits, based on the sample statistic, do in fact include the parameter being estimated."

The resulting formula follows:

$$n = \pi(1 - \pi)/[\epsilon^2/Z^2 + \pi(1 - \pi)/N]$$

where

n is the estimated sample size required for the desired precision and confidence.

π is the preliminary estimate of the proportion in the population

Z is the two-tailed value of the standardized normal deviate associated with the desired level of confidence.

ϵ is the acceptable error, or half of the maximum acceptable confidence interval.

N is the number of individuals or entities in the population

Based on the formula stated earlier, this study required a sample size n of 295. This is based on π =.5557, Z = 1.96, ϵ = 0.05, and N = 1310. π, 728/1310, is the proportion of firms that use EDI with their customers in the population. N, 1310, is the total listing of firms using EDI with their customers, 728, and suppliers or both, 582. Z = 1.96 provides a confidence level set at 95 percent. The desired precision ϵ refers to the closeness of sample estimates to the population parameter.

Non-response Adjustment

It is common for only a proportion of addressees to respond in a mail survey. The following formula determines the number of instruments required to compensate for non-response:

$$\text{compensated sample needed} = \frac{\text{preliminary sample size}}{\text{expected rate of response.}}$$

> Increasing the preliminary sample size to anticipate non-response does not in any way take into account possible differences existing between the respondent and nonrespondent groups so far as the characteristics under study are concerned. (McCall 1982, 121)

Comparable studies of industrial distribution firms provide an expected 15-20 percent response rate. A sample size of n = 295 is 23 percent of the firms listed in the target population. Thus, the study actually conducted a census of the target population.

Rating Instrument

The author developed the rating instrument used in this study based on a review of the IOR literature. The instrument (contained in appendix A) was designed to examine the effect of using EDI on IOR.

The value of the information collected by the instrument depends upon validity and reliability. Validity refers to accuracy of measurement and reliability refers to the consistency of measurement. The following sections include discussions of the development of the instrument used in this study from Khandwalla's original instrument (1981), and the improvements and testing conducted.

Khandwalla's Instrument

The instrument used in this study is based on Khandwalla's (1981) research of 103 Canadian firms. Khandwalla's instrument, shown in appendix B, used three scales to measure competitive pressure on price, marketing, and product competition. A further three scales measured the attention paid to these forms of competition by the firm's top management.

The intensity rating for the form of competition was multiplied by the importance rating. Khandwalla discussed the validity of the original instrument.

> In 60 out of 103 Canadian firms from which data were secured, two senior executives independently completed the questionnaire. The competitive pressure scores of these 60 pairs of experts on their firms were correlated to serve as one crude measure of validity. The product-moment correlation was 0.71. The average intercorrelation between the three items in the index of competitive pressure was 0.50, yielding a coefficient of reliability or reproducibility of 0.75. (Khandwalla, 1981, 432)

Validity

Researchers estimate content validity or representativeness by examining the goals of the study and comparing them to content of the instrument. Sproull (1988, 78) noted, "Content validity is rarely represented by a numerical figure because it is a logical process of comparing the components of a variable to items of a measure."

Construct validity is a measure of how well the instrument supports the theory and is estimated assessing the validation sample on the major variable. The researcher assesses the validation sample on several related variables to see if the major variable actually differentiates test subjects by related variables. The accuracy of measurement is estimated by a correlation coefficient.

> A typical validity coefficient would be approximately .45 or higher. Higher would be better. However, validity coefficients rarely

> exceed .60 and many are in the range of .30 to .40. (Sproull, 1988, 75)

Reliability

The researcher normally estimated reliability of an instrument by a correlation coefficient. Sproull (1988, 75) explained, "A typical reliability coefficient for a researcher designed instrument is approximately 0.70 or higher."

Khandwalla's instrument was sufficiently valid and reliable for this study. The next section includes a discussion of the steps taken to improve his instrument for this research project.

Improved Instrument

This investigation improved the validity and reliability of the earlier research. Khandwalla used a scale from 1 to 7; however, this project used a 1 to 9 scale to increase the possible dispersion of responses. This allows for greater differentiation and thus discrimination.

Khandwalla measured (1) promotion, advertising, selling, distribution, and (2) quality and variety of products or services, each in one question. Combining several constructs into one scale is inappropriate. This study broke each item into a separate scale. How the improved instrument was tested prior to being used is discussed in the following section.

Tested Instrument

The instrument used in this research was tested by two focus groups. The first group was the EDI Users Forum of Dallas. Executives meet monthly to discuss issues associated with using EDI in their firms. The second group was a series of purchasing managers similar to the target population. Each group discussed the wording and meaning of each scale and the instrument was revised to reflect their comments.

After administering an instrument to a set of objects and obtaining a set of numbers (scores), one can calculate a variance. The variance is a total obtained variance (sum of squares) including systematic and error variances.

Each person has an obtained score that has two components: a true score and an error score. The error score results from errors of measurement. Thus, any obtained score is made up of two components: a true component and error component.

Equivalently, the total obtained variance is made up of two variance components, a true component and an error component. If there were no errors of measurement in the true score, then the total variance would equal the true variance; but, unfortunately, there are always errors of measurement. It is assumed that if the error scores were known and subtracted from the obtained scores, then we would obtain the true scores.

Reliability is defined through error; the more error, the greater the unreliability; the less error, the greater the reliability. Thus, if the error variance of a measure can be estimated, the measure's reliability can be estimated also. The following definitions of reliability are equivalent:

1. Reliability is the proportion of the true variance to the total obtained variance of the data yielded by a measuring instrument.

2. Reliability is the proportion of error variance to the total variance yielded by a measuring instrument subtracted from 1.00, the index 1.00 indicating perfect reliability.

3. Reliability is the proportion of total variance less the error variance to the total variance.

Further, analysis of variance yields the following variances: between items, between individuals, and residuals or error. The total variance is an index of differences between individuals and is a measure of individual differences. The variance of the individuals may substitute from the total variance. Thus:

4. Reliability is the proportion of the true variance to the variance of the individual.

One may indirectly estimate reliability. If the variance of the error can be estimated, then the variance of the error can be subtracted from the variance of the individual to yield an estimate of the true variance. One could ignore the true variance and subtract the proportion of the variance of the error to the variance of the individual from 1 and get the reliability coefficient.

In random samples of the same population, the between-group variance and the within-group variance should be statistically equal. Yet, if the between-group variance is significantly greater than the within-groups error variance, then there is something in the between-group variance over and above chance. Thus, the between-groups variance includes the within-groups variance and some systematic variance.

Similarly, if the variance of the individual is significantly greater than the variance of the error, then there is something in the variance of the individual over and above the error variance.

Reliability is the accuracy of a measuring instrument. The reliable instrument, more or less, measures the true scores of individuals, the "more or less" depending on the reliability of the instrument. The true scores are inferred only from the true differences between individuals.

Reliability could be estimated if the effect of errors of measurement were removed from the variance of the individuals. By subtracting the variance of the error from the variance of the individual, one may estimate the true variance. Then the proportion of the "pure" variance to all the variance "pure and impure," is the variance of the reliability of the measuring instrument (Kerlinger 1988). The reliability coefficients for these variables are listed in table 15.

TABLE 15

RELIABILITY COEFFICIENTS FOR
INTER-ORGANIZATIONAL RELATIONSHIPS

IOR	RELIABILITY COEFFICIENT
SKILL	0.99
INDIRECT POWER	0.99
RIVALRY	0.96
DIRECT POWER	0.85
RECIPROCITY	0.69
EFFICIENCY	0.93

Reliability scores were calculated from analysis of the variance according to the procedure described in Kerlinger, F. N., Foundations of Behavioral Research, third edition. Orlando, Florida: Holt, Rinehart and Winston, Inc., 1986.

Researchers designed instruments to collect particular data. The data collected was converted into information according to the information's value in the hypothesized model. The model was created from a review of the literature that identified critical variables. The variables for this study were described and linked to specific questions of the rating instrument shown in appendix A.

Variables

Sproull (1988) discussed dependent and independent variables.

> The two terms are usually reserved for experimental research. However, it is common practice to describe statistical tests in terms of dependent and independent variables. One reason for this is that the dependent variable is usually the variable that is analyzed while the independent variables are often used to form groups. (Sproull, 1988, 266)

Dependent Variables

This research examined several variables to be analyzed. These include: (1) skill of the trading partner, (2) reputation of the trading partner, (3) asymmetry of direct economic power between the firm and the trading partner, (4) asymmetry of indirect power between the firm and the trading partner, (5) reciprocity between the trading partners, (6) efficiency, and (7) strategy of the focal firm.

Skill of the Trading Partner

Skill was the technical capability of a trading partner of the firm (French and Raven 1957). This capability included the training, expertise, and leadership in (1) EDI, and (2) product line bought from the supplier. Skill was number 24 on the list of definitions at the beginning of this chapter. The survey asked respondents to rate "The expertise in using EDI" and "The expertise in the product line" for both classes of customer. Each skill was measured independently along a nine-point scale. The scale ranged from one to nine, with one indicating the least expert and nine representing the most expert.

The model involved multiplying the EDI and product ratings by the importance placed upon them by the top management of the firm. The importance was discussed in the section on strategy. The square roots of each product dampened extreme scores. The trading partner's technical

capability in using EDI and selling the product was the composite skill level score (Khandwalla 1981). The reliability coefficient for this scale was .98.

Reputation of the Trading Partner

Reputation was level of respect that the firm holds for a trading partner (French and Raven 1957). Reputation was number 22 on the list of definitions in this chapter. The survey instrument asked respondents to rate "The amount of respect you hold for a customer" for each class of customer. Reputation of the partner was measured along a nine-point scale. The scale ranged from one to nine, with one indicating the least respect and nine representing the most respect.

The model involved multiplying reputation scores by the importance placed on reputation by top management of the firm. The square roots of each product dampened extreme scores (Khandwalla 1981). Reputation was based on French and Raven's concept of referent power.

Asymmetry: Direct Power

Direct economic power referred to the theory of competitive advantage (Porter 1980). Direct Power was number two from the list of definitions listed in chapter one. The relative level of economic power between a firm and its trading partner were measured directly by two subscores. The subscores included the (1) amount, in

dollars, of the buyer's purchases from the seller and (2) percentage of the buyer's purchases from the seller.

Respondents were asked to rate "The relative amount of purchases in dollars" and "The relative percentage of purchases" for each class of customer. The model used a nine-point scale which ranged from one to nine, with one indicating small and nine representing large.

The model involved multiplying dollar-purchase and percentage-purchase ratings by the importance placed upon them by top management. The square roots were taken to reduce the effects of extreme scores (Khandwalla 1981). The reliability coefficient for direct power was .85.

Asymmetry: Indirect Power

Indirect relative economic power of a trading partner over a firm was noted by external industrial conditions (Porter 1980). Indirect power was number 6 on the list of definitions listed in chapter one. A composite score for indirect economic power included (1) ease of entry into the market by potential suppliers, (2) ability to substitute products from the seller by the buyer, and (3) amount of competitive rivalry among current suppliers. The amount of competitive rivalry was measured by levels of (1) customer service, (2) product quality, (3) product variety, and (4) pricing.

Respondents were asked to rate items such as "The ease of entering the market by potential suppliers" and "The ease

of substituting products that you sell by a customer" for each of the two classes of customers. The reliability coefficient for rivalry was .96.

The model involved measuring indirect economic power indices along nine-point scales, with one indicating low and nine representing high levels of intensity. The subscores were multiplied by the importance placed on them by top management of the firm. The model used square roots to reduce extreme values. The summed subscores composed indirect power (Khandwalla 1981). The reliability coefficient for indirect power was .99.

Reciprocity

Reciprocity between a firm and its trading partners included cooperation, collaboration, and coordination (Oliver 1990). This was number 9 on the list of definitions presented in chapter one. The relative likelihood of a given trading partner to respond to extraordinary requests from the firm showed cooperation. The relative likelihood of a given trading partner to jointly plan with the firm, such as in designing a product, demonstrated collaboration. The relative likelihood of a given partner to act in concert with the firm, such as scheduling production, indicated coordination.

Respondents were asked to rate "The likelihood of responding to extraordinary requests by a customer," "The likelihood of joint planning with you, such as co-designing

a product, for a customer," and "The likelihood of joint action with you, such as scheduling production, for a customer" for each class of customers.

The model involved measuring cooperation, collaboration, and coordination ratings independently along a nine-point scale, with one representing not likely and nine indicating highly likely. The ratings were multiplied by the importance placed upon them by top management of the firm. The model took square roots to reduce the effects of extreme scores. Subscores were summed to form a composite score (Khandwalla 1981). The reliability coefficient for reciprocity was .69.

Efficiency

Efficiency referred to ease and cost of handling of purchase orders between the firm and its trading partner (Williamson 1975). This was number 10 on the list of definitions at the beginning of this chapter.

Respondents were asked to rate "The cost for you to process a typical purchase order by a customer," and "The ease for you to process a typical purchase order by a customer" for each of the two classes of customer.

The model involved measuring ease along a nine-point scale with one indicating easy-to-handle and nine showing hard-to-handle. Cost was measured along a nine-point scale with one representing cheap-to-handle and nine indicating expensive-to-handle.

The model involved multiplying both ease and cost ratings by the importance placed upon them by top management of the firm. Square roots were taken to reduce effects of extreme values. The model included summed subscores for a composite score (Khandwalla 1981). The reliability coefficient for efficiency was .93.

Strategy

Strategy referred to the importance placed by top management of the firm upon each of the other types of links between the firm and its trading partners. This was number 25 on the list of definitions at the beginning of this chapter. Respondents were asked to rate the firm's policies concerning each of the other dependent variables on a nine-point scale: "Indicate how much importance the top management of your firm places on each of the following concepts when soliciting the typical customer." Examples include "Skill in using EDI," "Customer service," "Product quality," etc. One indicated no importance and nine showed extreme importance (Khandwalla 1981).

The variable, strategy, was based on a method to adjust for single-source bias (Avolio, Yammarino, and Bass 1991). Single source bias was discussed earlier in this chapter.

Independent Variables

The model involved two independent variables or ways of classifying the firm's customers. These included: (1) EDI

as the link with its customers and (2) traditional paper-based purchasing system as the link with its customers.

Moderating Variables

Additional information was collected. These included (1) extent of EDI use within the firm, (2) company that suggested the firm use EDI, and (3) company that manages the firm's EDI network now. These are discussed in the following sections.

The Extent of EDI Use

The instrument used a five-point ordinal scale to rate the extent of the firm's EDI use. The five points of the scale include the firm used EDI: (1) with 0 to 5 buyers, (2) with 6 to 10 buyers, (3) with 11 to 15 buyers, (4) with 16 to 20 buyers, or (5) with 21 or more buyers.

The model tracked the proportion of purchases from buyers using EDI with the firm. The model also measured the proportion of buyers that use EDI with the firm as checks.

The Initiation of EDI Use

Initiation referred to the force that led to the firm first using EDI for its purchasing requirements. Respondents were asked to tell which company provided the original impetus for their firm to use EDI. The instrument used a five-point scale. The choices included (1) their own firm, (2) their customers, (3) their suppliers (a company

closer to the ultimate producer in the distribution chain), (4) their shippers, or (5) third party.

The Management of EDI Network

Management of the EDI network referred to the company that controls computer standards used in the EDI network. These included hardware and software standards. This managing company was the center node of the network. Respondents were asked to show which company managed the EDI network they use by choosing from a five-point scale. This scale consisted of (1) their own firm, (2) their customers, (3) their suppliers (a company closer to the ultimate producer), (4) their shippers, or (5) a third party.

Demographic Data

Demographic data was collected to classify responses. This instrument used the same scales as La Londe and Emmelhainz (1985) in their seminal study of forty-eight hundred firms using EDI.

Research Questions

Information was collected by a rating instrument. The chapter concludes with the specific research questions to be addressed.

Higher IOR Ratings

RQ1: Do firms report significantly higher mean dependent ratings on the characteristics of reputation, skill, indirect power, direct power, and reciprocity for the IOR formed between the firm and its trading partners

that use EDI than for the IOR formed between the firm and its partners that do not use EDI for the purchases?

Ha: μ EDI > μ non-EDI

The study used the paired t-test to compare the two mean values of each dependent measure for each respondent. The decision criterion was set at the significance level of $\alpha = .05$.

Efficiency Ratings

RQ2: Do firms report significantly lower mean dependent ratings on the characteristics of efficiency for the IOR formed between the firm and its trading partners that use EDI than for the IOR formed between the firm and its partners that do not use EDI for the purchases?

Ha: μ EDI < μ non-EDI

The project used the paired t-test to compare the two mean values of each dependent measure for each respondent. The decision criterion was set at the significance level of $\alpha = .05$.

Initiation Ratings

RQ3: Does the central position of the company that initiates the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?

Ha: four means are not all equal

There were four reported positions for the company that initiates the EDI network. The project used analysis of variance to compare the mean values of each dependent measure for each respondent.

Management Ratings

RQ4: Does the central position of the company that currently manages the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?

Ha: four means are not all equal

There are four reported positions for the company that manages the EDI network. The investigation used analysis of variance to compare the mean values of each dependent measure for each respondent.

Number of Customers

RQ5: Does the number of companies with which the firm uses EDI significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?

Ha: five means are not all equal

There are five reported groups for the number of companies with which the firm uses EDI. The project used analysis of variance to compare the mean values of each dependent measure for each respondent.

Extent versus Management

RQ6: Is the reported extent of EDI use by a firm independent of the company that manages the network?

Ha: extent of EDI use is related to (dependent on) the manager

The study used the one-tailed Chi-square statistic to compare the reported extent of EDI use.

Extent versus Initiation

RQ7: Is the reported extent of EDI use by a firm independent of the company that suggested using the network?

Ha: extent of EDI use is related to (dependent on) the initiator

The project used the one-tailed Chi-square statistic to compare the reported extent of EDI use.

Chapter Summary

The methodologies to conduct this research and definition of the terms used in the research were presented in this chapter. It also included a discussion of the population, sampling technique, and variables used. These topics are briefly described in the following sections and summarized in table 16.

Population and Sampling Technique

The target population and sampling technique were discussed. The population for the study was all domestic industrial distribution companies using electronic data interchange. The research involved a census of firms using EDI with their customers as listed in the EDI Yellow Pages.

Model and Variables

The specific variables of the model were explained and how they were measured was described. The model consisted of independent, dependent, and mediating variables.

TABLE 16

SUMMARY OF METHODOLOGY

METHODOLOGY	DISCUSSION
Homogenous independent variables	Leenders and Fearon (1993) differentiate industrial distribution firms from the consumer market.
Matched subject	Each respondent rated both EDI and non-EDI.
Extraneous variables in research design	Centrality of networks and number of EDI-using customers were treated as moderating variables.
Use hypotheses	Specific research questions based on the literature review and the statistical hypotheses to test them were listed in C2.
Definition of terms	Terms were defined in C1. Variables were operationalized in C3 and linked to specific questions of the rating instrument.
Same source bias	New IOR variables were calculated based on the importance placed on those items by the responding firm.
Description of the population	The universal population included domestic industrial distribution firms that use EDI.
Sample frame	The target population included industrial distribution firms found in EDI Spread the Word!, an industrial yellow pages and arguably the best listing of EDI users.
Sample plan	A census was taken.
Sample size	295 responses were needed based on .05 significance, expected response rate and compensating for non-response rate (McCall 1982).
Rating instrument	Instrument used based on Khandwalla (1981) with reliability coefficients of .75.
Improved instrument	Changed scale from 1-7 to 1-9 to improve dispersion. Separated out several constructs Khandwalla measured in a single question.
Tested instrument	Pilot tested the instrument with EDI Users of Dallas and a group of purchasing managers similar to the population. Reliability coefficients for each variable calculated (Kerlinger, 1986).

Independent variables included two classes of customers. The first class of customers used EDI with firm and the second class of customers used the traditional paper-based purchasing systems. Moderating variables included: (1) extent of EDI use, (2) initiation of EDI use, and (3) management of EDI use.

Dependent variables included: (1) skill of the trading partner, (2) reputation of the trading partner, (3) asymmetry of direct economic power between the firm and the trading partner, (4) asymmetry of indirect power between the firm and the trading partner, (5) reciprocity between the trading partners, (6) efficiency, and (7) firms' strategy.

Research Questions

Information was collected by a rating instrument. The conclusion of the chapter addressed the specific research questions.

CHAPTER FOUR

RESULTS OF THE STUDY

The results and findings of the research are discussed in chapter four. Each of the research questions that provided the basis for this study is addressed.

The rating instrument used for this research was sent to all firms listed on the mailing list described in the methodology section of this report. A total of 307 firms responded. Of these 307 firms, 296 responded with usable results; other responses included 4 incomplete responses, 2 incorrect addressees, and 5 refusals. The total was greater than the 295 required for the minimum sample size, given the confidence level and acceptable error rates.

The data collected from each instrument was used to answer the research questions. Then the results were analyzed with Minitab using procedures listed by Kvanli, Guynes, and Pavur (1989). The chapter closes with a discussion of the demographics of the respondents.

Higher IOR Ratings

RQ1: Do firms report significantly higher mean dependent ratings on the characteristics of reputation, skill, indirect power, direct power and reciprocity for the IOR formed between the firm and its trading partners that use EDI than for the IOR formed between the firm and its partners that do not use EDI for their purchases?

Ha: μ EDI > μ non-EDI

Paired t-tests were used to compare the characteristic relationship ratings of firms with two classes of customers. Each firm rated their relationships with customers that used EDI with them and those that used the paper-based purchasing systems. The results of the t-tests are listed in table 17.

TABLE 17

PAIRED T-TEST FOR DIFFERENCES IN FIRMS WHO USE EDI AND THOSE THAT DO NOT USE EDI ON FIVE INTER-ORGANIZATIONAL RELATIONSHIP CHARACTERISTICS

IOR CATEGORIES	EDI		NON EDI			
	m	s	m	s	t	p
REPUTATION	7.16	1.42	6.77	1.45	7.49	.0000*
SKILL	11.67	2.76	10.68	2.52	9.94	.0000*
EDI	5.26	1.71	4.44	1.61	11.96	.0000*
PRODUCT	6.42	1.53	6.24	1.48	3.16	.0009*
INDIRECT POWER	38.85	6.09	37.90	5.87	5.69	.0000*
ENTRY	5.29	1.50	5.32	1.29	- .44	.6700
SUBSTITUTE	5.37	1.49	5.23	1.38	1.82	.0350*
RIVALRY	28.19	4.85	27.34	4.91	6.57	.0000*
R-SERVICE	7.42	1.30	7.05	1.36	6.81	.0000*
R-QUALITY	7.39	1.33	7.23	1.39	4.56	.0000*
R-VARIETY	6.56	1.55	6.45	1.52	2.97	.0016*
R-PRICE	6.82	1.43	6.61	1.36	5.16	.0000*
DIRECT POWER	12.55	2.95	11.68	2.51	5.23	.0000*
TOTAL	6.45	1.54	5.93	1.33	5.91	.0000*
RELATIVE	6.10	1.64	5.75	1.38	3.81	.0001*
RECIPROCITY	17.90	4.40	17.73	4.10	1.23	.1100
REQUEST	6.12	1.66	6.20	1.55	-1.24	.8900
PLAN	5.78	1.74	5.74	1.62	.66	.2600
ACT	6.00	1.64	5.79	1.52	3.66	.0001*

m = mean, s = standard deviation
Tcv = 1.645, df = 296, ($p < .05$)
at the .05 level of significance
* significant positive differences

Measures of reputation, skill, direct and indirect power were higher for partners using EDI at the .05 level of significance. Thus, they support the hypothesis.

The power of a statistical test of a null hypothesis is the probability that it will lead to the rejection of the null hypothesis. An analysis that finds that the power was low should lead one to reject the negative results as ambiguous. Failure to reject the null hypothesis cannot have much substantive meaning when, though the phenomenon exists (to some given degree), the a priori probability of rejecting the null hypothesis was low.

The power of a statistical test depends upon three parameters: the significance criterion, the reliability of the sample results, and the effect size (the degree to which the phenomenon exists). The effect size can be treated as a parameter that takes the value zero when the null hypothesis is true and a nonzero value when the null hypothesis is false. The ES serves as an index of degree of departure from the null hypothesis.

The larger the ES posited, other things being equal (significance criterion, sample size), the greater the power of the test. The relationship between ES and sample size is similar; the larger the ES posited, other things (significance criterion, desired power) being equal, the smaller the sample size necessary to detect it.

Four parameters of statistical inference can be described: power (1 - ß), significance criterion (α), sample size (n), and effect size (ES). They are so related that any one of them is a function of the other three, which means that when any three of them are fixed, the fourth is completely determined.

Given the paired t-test, the investigator may estimate the population matching r between the X, Y, pairs, by working with their difference Z = (X-Y). Thus, the effect size is indexed as

$$d_z = \frac{m_z}{\sigma_z}$$

with the standard deviation of the difference scores as the unit in which the mean difference is expressed, and enters the n tables with d = d(square root of two). The resulting d reflects the additional power of the paired t-test to account for reducing the variance.

Power may be determined by looking at tables including n, effect sizes, and significance coefficients. The tables, in part, are re-created here as power of t-test of $m_1 = m_2$ at $\alpha_1 = .05$.

		d								
n	d_c	.10	.20	.30	.40	.50	.60	.70	.80	.90
300	.13	34	79	98	995					

and the power of the t-test of $m_1 = m_2$ at $\alpha_1 = .10$

		d								
n	d_c	.10	.20	.30	.40	.50	.60	.70	.80	.90
300	.10	48	88	99	995					

These power tables will find their greatest use in determining the power of a test of the significance of a sample after the data are gathered and the test made (Cohen, 1977). The effect sizes and power for the variables of interest are shown in table 18.

TABLE 18

EFFECT SIZES AND POWER FOR
INTER-ORGANIZATIONAL RELATIONSHIPS

IOR	EFFECT SIZE	POWER α = .05.	POWER α = .10
REPUTATION	.6153	.995	.995
SKILL	.8141	.995	.995
EDI	.6525	.995	.995
PRODUCT	.2600	.90 *	.94 *
INDIRECT POWER	.4675	.995	.995
ENTRY	.0241	.07 *	.09 *
SUBSTITUTE	.1492	.56 *	.68 *
RIVALRY	.5399	.995	.995
SERVICE	.5647	.995	.995
QUALITY	.3753	.98	.99
VARIETY	.2444	.87 *	.92 *
PRICE	.4240	.995	.995
DIRECT POWER	.4302	.995	.995
DOLLAR	.4855	.995	.995
PERCENT	.3130	.98	.99
RECIPROCITY	.1012	.34	.48
REQUEST	.1022	.34	.48
PLAN	.0540	.17 *	.24 *
ACT	.3010	.98	.99
EFFICIENCY	.2020	.79 *	.88 *
COST	.2663	.90 *	.94 *
EASE	.0720	.24 *	.34 *

* interpolated scores for n = 300.

Taken from Cohen, J. Statistical Power Analysis for the Behavioral Sciences. New York: Academic Press, Inc. 1977.

The effect sizes for reciprocity were very small which affects the resulting power of the test. Cohen (1988) recommended a power level (1-ß) of at least .80 with a ß of .20 or approximately four times the α level of .05.

Measures of reciprocity were higher, but not significantly higher, for the trading partners using EDI compared to those that did not use EDI. The difference was not great enough to support the hypothesis of research question one; however, this may be due to the poor power of the test. A larger sample size is required to adequately test for reciprocity.

More Efficiency

RQ2: Do firms report significantly lower mean dependent ratings on the characteristics of efficiency for the IOR formed between the firm and its trading partners that use EDI than for the IOR formed between the firm and its partners that do not use EDI for their purchases?

Ha: μ EDI < μ non-EDI

Paired t-tests were used to compare the characteristic relationship ratings of firms that used EDI with their trading partners and those that did not. The results of the t-tests are listed in table 19.

TABLE 19

PAIRED T-TEST FOR DIFFERENCES IN FIRMS
WHO USE EDI AND THOSE THAT DO NOT USE EDI ON IOR
RELATIONSHIP CHARACTERISTICS OF EFFICIENCY

IOR CATEGORIES	EDI		NON EDI			
	m	s	m	s	t	p
EFFICIENCY	9.96	2.83	10.33	2.56	-2.46	.0072*
COST	4.73	1.67	5.03	1.39	-3.24	.0007*
EASE	5.23	1.60	5.30	1.41	- .88	.1900

m = mean, s = standard deviation
Tcv = 1.645, df = 296, ($p < .05$)
at the .05 level of significance
* significant negative differences

Efficiency ratings were significantly lower for trading partners of firms using EDI compared to trading partners that did not use EDI. As shown in table 20, efficiency had medium effect sizes according to Cohen (1988). The power level provided confidence that rejecting the null hypothesis has substantive meaning.

TABLE 20

EFFECT SIZES AND POWER FOR

INTER-ORGANIZATIONAL EFFICIENCY RELATIONSHIPS

IOR	EFFECT SIZE	POWER $\alpha = .05$.	POWER $\alpha = .10$
EFFICIENCY	.2020	.79 *	.88 *
COST	.2663	.90 *	.94 *
EASE	.0720	.24 *	.34 *

* interpolated scores for n = 300.

Taken from Cohen, J. Statistical Power Analysis for the Behavioral Sciences. New York: Academic Press, Inc. 1977.

Efficiency ratings were composite scores including cost-of-use and ease-of-use. Cost-of-use scores were significantly lower for trading partners of firms using EDI compared to trading partners that did not use EDI. Ease-of-use scores were lower, but not significantly lower.

The purpose of using EDI is to make transactions between trading partners cheaper and easier. Further analysis provided additional information by comparing the firm's cost scores with the number of partners with which a firm used EDI.

The cost scores ranged from 1 to 9 with 1 representing cheap and 9 expensive. The scores of 1 to 9 were consolidated into three subsets to increase the size of subsets for analysis. The three subsets were: (1) 1 to 3 being cheap, (2) 4 to 6 being average, and (3) 7 to 9 being expensive. The number-of-users were combined to obtain expected cells with at least five units. A chi-square analysis of independence was conducted as shown in table 21.

Cohen (1988) described the procedure for determining an effect size for the chi-square test. While the computation is different, the philosophy is the same as the t-test. The effect size and power of the test for the chi-square are described.

TABLE 21

CHI-SQUARE TEST FOR INDEPENDENCE
OF NUMBER OF USERS BY COST

# OF USERS	CHEAP	AVERAGE	EXPENSIVE	TOTAL
0 - 5	21	82	52	155
6 - 10	8	35	16	59
11 - 20	14	23	5	42
21 +	15	18	7	40
TOTAL	58	158	80	296

The computed chi-square value was 23.004, with an effect size of .93, power of .93, p-value of .0008. This value exceeded the critical value of 15.507 with 6 degrees of freedom at the .05 level of significance. Thus, cost-of-use was dependent on the number of users. The information was broken down as shown in table 22.

TABLE 22

REVISED CHI-SQUARE TEST FOR INDEPENDENCE

OF NUMBER OF USERS BY COST

NUMBER OF USERS	CHEAP	AVERAGE	EXPENSIVE	TOTAL
0 - 10	29	117	68	214
11 +	29	41	12	82
TOTAL	58	158	80	296

The computed chi-square value was 21.085, an effect size of 1.225, power of .995 and p-value of .0000. This value exceeded the critical value of 3.841, 2 degrees of freedom at the .05 level of significance. While the information suggested that cost-of-use was dependent on the number of users, the trend was hidden in the overall numbers. The information provided by table 22 indicated that the number of users is related from 0 to 10 users and after 11 users.

Initiation

RQ3: Does the central position of the company that initiates the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI?

Ha: four means are not equal

There were four reported positions for the company that initiated the EDI network. The project used analysis of variance to compare the mean values of each dependent measure for each respondent with results shown in table 23.

TABLE 23

ANALYSIS OF VARIANCE OF INITIATOR FOR THE INTER-ORGANIZATIONAL RELATIONSHIP CHARACTERISTICS

SOURCE	df	SS	MS	F	p
REPUTATION					
INITIATOR	3	3.117	1.039	1.28	.282
ERROR	292	237.572	.814		
TOTAL	295	240.689			

TABLE 23 continued

SOURCE	df	SS	MS	F	p
SKILL					
INITIATOR	3	1.750	.580	.20	.899
ERROR	292	866.020	2.970		
TOTAL	295	867.770			
EDI					
INITIATOR	3	.740	.250	.18	.911
ERROR	292	406.430	1.390		
TOTAL	295	407.170			
PRODUCT					
INITIATOR	3	.365	.122	.13	.940
ERROR	292	264.719	.907		
TOTAL	295	265.084			
POWER					
INITIATOR	3	18.050	6.020	.72	.542
ERROR	292	2448.790	8.390		
TOTAL	295	2466.840			
ENTRY					
INITIATOR	3	6.070	2.020	1.47	.224
ERROR	292	403.030	1.380		
TOTAL	295	409.100			
SUBSTITUTE					
INITIATOR	3	.080	.030	.02	.997
ERROR	292	493.070	1.690		
TOTAL	295	493.150			
RIVALRY					
INITIATOR	3	5.500	1.830	.37	.776
ERROR	292	1454.110	4.980		
TOTAL	295	1459.62			
R-SERVICE					
INITIATOR	3	2.216	.739	.84	.472
ERROR	292	256.145	.877		
TOTAL	295	258.361			
R-QUALITY					
INITIATOR	3	.266	.089	.23	.874
ERROR	292	111.712	.383		
TOTAL	295	111.978			

TABLE 23 continued

SOURCE	df	SS	MS	F	p
R-VARIETY					
INITIATOR	3	.259	.086	.21	.889
ERROR	292	120.089	.411		
TOTAL	295	120.348			
R-PRICE					
INITIATOR	3	.920	.307	.65	.582
ERROR	292	137.392	.471		
TOTAL	295	138.313			
DIRECT POWER					
INITIATOR	3	16.960	5.650	.68	.563
ERROR	292	2417.380	8.280		
TOTAL	295	2434.340			
DOLLAR					
INITIATOR	3	3.280	1.090	.48	.698
ERROR	292	667.600	2.290		
TOTAL	295	670.880			
PERCENTAGE					
INITIATOR	3	10.080	3.360	1.30	.273
ERROR	292	752.590	2.580		
TOTAL	295	762.670			
RECIPROCITY					
INITIATOR	3	21.380	7.130	1.21	.307
ERROR	292	1721.750	5.900		
TOTAL	295	1743.130			
REQUEST					
INITIATOR	3	2.330	.780	.72	.542
ERROR	292	315.050	1.080		
TOTAL	295	317.380			
PLAN					
INITIATOR	3	4.728	1.576	1.69	.168
ERROR	292	271.617	.930		
TOTAL	295	276.345			
ACT					
INITIATOR	3	2.103	.701	.71	.547
ERROR	292	288.730	.989		
TOTAL	295	290.833			

TABLE 23 continued

SOURCE	df	SS	MS	F	p
EFFICIENCY					
INITIATOR	3	30.250	10.080	1.50	.214
ERROR	292	1959.300	6.710		
TOTAL	295	1989.550			
COST					
INITIATOR	3	4.610	1.540	.61	.611
ERROR	292	739.750	2.530		
TOTAL	295	744.370			
EASE					
INITIATOR	3	11.640	3.880	1.93	.125
ERROR	292	586.740	2.010		
TOTAL	295	598.380			

Fcv = 2.37 at the .05 level of significance

There were no significant F scores. There were no significant differences between the sample means and the hypothesis is not supported.

The effect sizes and power for F-tests were calculated using the procedures listed by Cohen (1988). These values are shown in table 24.

TABLE 24

EFFECT SIZES AND POWER OF F-TESTS

TEST	INITIATOR	
	EFFECT SIZE	POWER
REPUTATION	.114	.29
SKILL	.045	.09
EDI	.043	.09
PRODUCT	.037	.07
INDIRECT POWER	.086	.19
ENTRY	.132	.28
SUBST.	.012	.02
RIVALRY	.061	.12
R-SERV	.092	.20
R-QUAL	.064	.13

TABLE 24 cont.

EFFECT SIZES AND POWER OF F-TESTS

TEST	INITIATOR EFFECT SIZE	POWER
R-VAR	.046	.09
R-PRICE	.081	.17
DIRECT POWER	.033	.03
DOLLAR	.070	.14
PERCENT	.115	.30
RECIPROCITY	.111	.29
REQUEST	.085	.19
PLAN	.085	.19
ACT	.087	.19
EFFICIENCY	.117	.31
COST	.081	.17
EASE	.140	.42

The effect sizes for each variable were very small; and the power levels for the tests were very low. Thus, any analysis should lead one to reject the negative results as ambiguous. Failure to reject the null hypothesis cannot have much substantive meaning when, though the phenomenon exists, the a priori probability of rejecting the null hypothesis is low.

Management

RQ4: Does the central position of the company that currently manages the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for their purchases?

Ha: four group means are not equal

There were four reported positions for the company that currently manages the EDI network. The study used analysis

of variance to compare the mean values of each dependent measure for each respondent with results shown in table 25.

TABLE 25

ANALYSIS OF VARIANCE OF MANAGER FOR THE INTER-ORGANIZATIONAL RELATIONSHIP CHARACTERISTICS

SOURCE	df	SS	MS	F	p
REPUTATION					
MANAGER	3	1.604	.535	.65	.582
ERROR	292	239.085	.819		
TOTAL	295	240.689			
SKILL					
MANAGER	3	23.850	7.950	2.75	.043*
ERROR	292	843.930	2.890		
TOTAL	295	867.770			
EDI					
MANAGER	3	9.580	3.190	2.35	.073
ERROR	292	397.590	1.360		
TOTAL	295	407.170			
PRODUCT					
MANAGER	3	4.609	1.536	1.72	.163
ERROR	292	260.475	.892		
TOTAL	295	265.084			
INDIRECT POWER					
MANAGER	3	78.250	26.080	3.19	.024*
ERROR	292	2388.580	8.180		
TOTAL	295	2466.840			
ENTRY					
MANAGER	3	6.070	2.020	1.47	.224
ERROR	292	403.030	1.380		
TOTAL	295	409.100			
SUBSTITUTE					
MANAGER	3	.080	.030	.02	.997
ERROR	292	493.070	1.690		
TOTAL	295	493.150			
RIVALRY					
MANAGER	3	5.500	1.830	.37	.776
ERROR	292	1454.110	4.980		
TOTAL	295	1459.620			

TABLE 25 continued

SOURCE	df	SS	MS	F	p
R-SERVICE					
MANAGER	3	9.279	3.093	3.63	.013*
ERROR	292	249.082	.853		
TOTAL	295	258.361			
R-QUALITY					
MANAGER	3	.266	.089	.23	.874
ERROR	292	111.712	.383		
TOTAL	295	111.978			
R-VARIETY					
MANAGER	3	.259	.086	.21	.889
ERROR	292	120.089	.411		
TOTAL	295	120.348			
R-PRICE					
MANAGER	3	.920	.307	.65	.582
ERROR	292	137.392	.471		
TOTAL	295	138.313			
DIRECT POWER					
MANAGER	3	10.310	3.440	.41	.743
ERROR	292	2424.030	8.300		
TOTAL	295	2434.340			
DOLLAR					
MANAGER	3	1.060	.350	.15	.927
ERROR	292	669.820	2.290		
TOTAL	295	670.880			
PERCENT					
MANAGER	3	4.810	1.600	.62	.604
ERROR	292	757.850	2.600		
MANAGER	295	762.670			
RECIPROCITY					
MANAGER	3	26.160	8.720	1.48	.219
ERROR	292	1716.970	5.880		
TOTAL	295	1743.130			
REQUEST					
MANAGER	3	3.690	1.230	1.15	.331
ERROR	292	313.690	1.070		
TOTAL	295	317.380			

TABLE 25 continued

SOURCE	df	SS	MS	F	p
PLAN					
MANAGER	3	3.300	1.100	1.18	.319
ERROR	292	273.045	.935		
TOTAL	295	276.345			
ACT					
MANAGER	3	3.330	1.110	1.113	.338
ERROR	292	287.503	.985		
TOTAL	295	290.833			
EFFICIENCY					
MANAGER	3	25.530	8.510	1.27	.286
ERROR	292	1964.010	6.730		
TOTAL	295	1989.550			
COST					
MANAGER	3	17.260	5.750	2.31	.076
ERROR	292	727.110	2.49		
TOTAL	295	744.370			
EASE					
MANAGER	3	3.260	1.090	.53	.660
ERROR	292	595.120	2.040		
TOTAL	295	598.380			

Fcv = 2.37, p at the .05 level of significance.

Three areas had significant F-ratios. These were overall skill, indirect power-service, and overall indirect power. A significant F-ratio rejects the null hypotheses of equal population means; however, the significant F-ratio by itself does not tell the researcher which of the group means are significantly different from the others. Tukey's test for multiple comparisons is shown in table 26.

TABLE 26

RESULTS OF MULTIPLE COMPARISON TEST
REPORTED BY THE UNDERLINING METHOD

SKILL	S-2 supplier	S-5 VAN	S-1 firm	S-3 customer
N	25	216	54	1
MEANS	.272	.962	1.429	1.620

Q = .2751 at the .05 level
Q = .3336 at the .01 level

OVERALL INDIRECT POWER	I-3 customer	I-2 supplier	I-5 VAN	I-1 firm
N	1	25	216	54
MEANS	-.370	-.001	.831	1.921

Q = .0327 at the .05 level
Q = .0397 at the .01 level

SERVICE INDIRECT POWER	I-3 customer	I-2 supplier	I-5 VAN	I-1 firm
N	1	25	216	54
MEANS	.0000	.0286	.3293	.6997

Q = .2027 at the .05 level
Q = .2458 at the .01 level

The means of each level were significantly different except the ones underlined. For example, skill levels for suppliers were significantly different from VAN providers, firms, and customers; and VAN providers were significantly different from those of the firm and of customers. The

skill levels of the firm were not significantly different from those of the customers.

The reported overall indirect power of customers were significantly different from those of suppliers, VAN providers, and the firm. The indirect power of suppliers were different from those of VAN providers and the firm. VAN providers reported different scores than those of the firm.

The service levels of customers were significantly different from those of the VAN providers and the firm. The service levels of VAN providers were different from those of suppliers and the firm, but the service levels of the customer were not significantly different from those of suppliers.

The effect sizes and power for F-tests were calculated using the procedures listed by Cohen (1988). These values are shown in table 27.

The effect sizes for each test were very small. The resulting power levels were very low. Thus, any analysis should lead one to reject the negative results as ambiguous. Failure to reject the null hypothesis cannot have much substantive meaning when, though the phenomenon exists, the a priori probability of rejecting the null hypothesis is low.

TABLE 27

EFFECT SIZES AND POWER OF F-TESTS

MANAGER

TEST	ES	POWER
REPUTATION	.081	.17
SKILL	.167	.54
EDI	.154	.48
PRODUCT	.132	.38
INDIRECT POWER	.108	.26
ENTRY	.171	.58
SUBST.	.129	.37
RIVALRY	.161	.54
R-SERV	.192	.70
R-QUAL	.164	.56
R-VAR	.060	.12
R-PRICE	.087	.19
DIRECT POWER	.065	.13
DOLLAR	.039	.07
PERCENT	.079	.17
RECIPROCITY	.123	.34
REQUEST	.111	.26
PLAN	.108	.26
ACT	.107	.26
EFFICIENCY	.113	.29
COST	.153	.47
EASE	.073	.15

Number of Customers

RQ5: Does the number of companies with which a firm uses EDI significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for their purchases?

Ha: four means are not all equal

There were four groups reported of the number of companies with which the firm uses EDI. The investigation used analysis of variance to compare the mean values of each dependent measure for each respondent. These results are shown in table 28.

TABLE 28

ANALYSIS OF VARIANCE OF NUMBER OF USERS FOR THE INTER-ORGANIZATIONAL RELATIONSHIP CHARACTERISTICS

SOURCE	DF	SS	MS	F	P	
REPUTATION						
NO-CUS	4	1.605	.401	.49	.7440	
ERROR	291	239.084	.822			
TOTAL	295	240.689				
INDIRECT POWER						
NO-CUS	4	44.940	11.230	1.35	.2520	
ERROR	291	2421.900	8.320			
TOTAL	295	2466.840				
SUBSTITUTE						
NO-CUS	4	12.510	3.130	1.89	.1120	
ERROR	291	480.640	1.650			
TOTAL	295	493.150				
ENTRY						
NO-CUS	4	.560	.140	.10	.9820	
ERROR	291	408.540	1.400			
TOTAL	295	409.100				
RIVALRY						
NO-CUS	4	42.870	10.720	2.20	.0690	
ERROR	291	1416.740	4.870			
TOTAL	295	1459.620				
R-SERVICE						
NO-CUS	4	13.730	3.433	4.08	.0030	*
ERROR	291	244.630	.841			
TOTAL	295	258.361				
R-QUALITY						
NO-CUS	4	1.155	.289	.76	.5530	
ERROR	291	110.822	.381			
TOTAL	295	111.978				
R-VARIETY						
NO-CUS	4	1.499	.375	.92	.4540	
ERROR	291	118.849	.408			
TOTAL	295	120.348				
R-PRICE						
NO-CUS	4	1.609	.402	.86	.4910	
ERROR	291	136.704	.470			
TOTAL	295	138.313				

TABLE 28 continued

SOURCE	df	SS	MS	F	p	
DIRECT POWER						
NO-CUS	4	183.970	45.990	5.95	.0000	*
ERROR	291	2250.370	7.730			
TOTAL	295	2434.340				
DOLLAR						
NO-CUS	4	55.040	13.760	6.50	.0000	*
ERROR	291	615.840	2.120			
TOTAL	295	670.880				
PERCENT						
NO-CUS	4	39.110	9.780	3.93	.0040	*
ERROR	291	723.560	2.490			
TOTAL	295	762.670				
RECIPROCITY						
NO-CUS	4	91.640	22.910	4.04	.0030	*
ERROR	291	1651.490	5.680			
TOTAL	295	1743.130				
REQUEST						
NO-CUS	4	13.510	3.380	3.23	.0130	*
ERROR	291	303.870	1.040			
TOTAL	295	317.380				
PLAN						
NO-CUS	4	7.570	1.892	2.05	.0880	
ERROR	291	268.775	.924			
TOTAL	295	276.345				
ACT						
NO-CUS	4	11.076	2.769	2.88	.0230	*
ERROR	291	279.757	.961			
TOTAL	295	290.833				
EFFICIENCY						
NO-CUS	4	57.270	14.32	2.16	.0740	
ERROR	291	1932.280	6.64			
TOTAL	295	1989.550				
EASE						
NO-CUS	4	48.930	12.23	6.48	.0000	*
ERROR	291	549.450	1.89			
TOTAL	295	598.380				

TABLE 28 continued

SOURCE	df	SS	MS	F	p
COST					
NO-CUS	4	1.870	.47	.18	.9470
ERROR	291	742.490	2.55		
TOTAL	295	744.370			
SKILL					
NO-CUS	4	12.940	3.230	1.10	.3560
ERROR	291	854.840	2.940		
TOTAL	295	867.770			
EDI					
NO-CUS	4	4.050	1.010	.73	.5710
ERROR	291	403.120	1.390		
TOTAL	295	407.170			
PRODUCT					
NO-CUS	4	3.218	.805	.89	.4680
ERROR	291	261.866	.900		
TOTAL	295	265.084			

Fcv = 2.37, p at the .05 level of significance.

Eight areas had significant F-ratios. These were service, overall direct power, direct power-sales in dollars, direct power-percentage of sales, overall reciprocity, responding to requests, joint action, and ease of completing a purchase order. A significant F-ratio rejects the null hypotheses of equal population means; however, the significant F-ratio by itself does not tell the researcher which of the group means were significantly different from the others. Tukey's test for multiple comparisons is an appropriate follow-on shown in table 29.

TABLE 29

RESULTS OF MULTIPLE COMPARISON TEST
REPORTED BY THE UNDERLINING METHOD

REQUEST	S-1	S-4	S-2	S-3	S-5
	0-5	16-20	6-10	11-15	21 +
N	155	13	57	31	40
MEANS	-.267	.012	.042	.193	.267

Q = .2268 at the .05 level
Q = .2703 at the .01 level

ACT	S-1	S-4	S-2	S-3	S-5
	0-5	16-20	6-10	11-15	21 +
N	155	13	57	31	40
MEANS	.0446	.2007	.3347	.3530	.5746

Q = .2222 at the .05 level
Q = .2647 at the .01 level

RECIPROCITY TOTAL	S-1	S-4	S-2	S-3	S-5
	0-5	16-20	6-10	11-15	21 +
N	155	13	57	31	40
MEANS	-.331	.411	.507	.853	1.050

Q = .3463 at the .05 level
Q = .4127 at the .01 level

DIRECT POWER DOLLAR	S-1	S-2	S-3	S-4	S-5
	0-5	6-10	11-15	16-20	21 +
N	155	57	31	13	40
	.204	.476	.747	1.025	1.450

Q = .2706 at the .05 level
Q = .3225 at the .01 level

TABLE 29 continued

DIRECT POWER PERCENT	S-1	S-2	S-3	S-4	S-5
	0-5	6-10	11-15	16-20	21 +
N	155	57	31	13	40
MEANS	.054	.492	.562	.581	.880

Q = .2817 at the .05 level
Q = .3358 at the .01 level

DIRECT POWER TOTAL	S-1	S-2	S-3	S-4	S-5
	0-5	6-10	11-15	16-20	21 +
N	155	57	31	13	40
MEANS	.259	.968	1.309	1.606	2.547

Q = .3741 at the .05 level
Q = .4459 at the .01 level

EFFICIENCY EASE	S-1	S-2	S-3	S-5	S-4
	0-5	6-10	11-15	21 +	16-20
N	155	57	31	40	13
MEANS	-.223	-.060	.627	.728	.839

Q = .2630 at the .05 level
Q = .3134 at the .01 level

INDIRECT POWER SERVICE	S-3	S-1	S-4	S-2	S-5
	11-15	0-5	16-20	6-10	21 +
N	31	155	40	57	40
MEANS	.2462	.2508	.2627	.4239	.8881

Q = .2254 at the .05 level
Q = .2686 at the .01 level

Extraordinary Requests

Firms using EDI with 0-5 customers responded to extraordinary requests at a significantly different rate than those using EDI with 6-10 customers, 11-15 customers, 16-20 customers, and 21 or more customers.

Companies using EDI with 6-10 customers reported responding to extraordinary requests at a significantly different rate than those using EDI with 0-5 customers, and 21 or more customers, but at a rate not significantly different from firm using EDI with 11-15 customers and 16-20 customers.

Firms using EDI with 11-15 customers responded to extraordinary requests at a significantly different rate than those using EDI with 0-5 customers, and 16-20 customers, but at a rate not significantly different from companies using EDI with 6-10 customers and 21 or more customers.

Firms using EDI with 16-20 customers indicated responding to extraordinary requests at a significantly different rate than those using EDI with 0-5 customers and 21 or more customers, but responded to extraordinary requests at a rate not significantly different from those firms using EDI with 6-10 customers, and 11-15 customers.

Companies using EDI with 21 or more customers responded to extraordinary requests at a significantly different rate than those using EDI with 0-5 customers, 6-10 customers, and

16-20 customers, but not significantly different from those using EDI with 11-15 customers.

Joint Action

Firms using EDI with 0-5 customers acted jointly with their customers at a significantly different rate than firms using EDI with 6-10 customers, 11-15 customers, and 21 or more customers and not significantly different from firms using EDI with 16-20 customers.

Companies using EDI with 6-10 customers reported acting jointly with their customers at a significantly different rate than firm using EDI with 0-5 customers, and 21 or more customers but acted jointly with their customers at a rate not significantly different from firms that use EDI with 11-15 customers, and 16-20 customers.

Firms using EDI with 11-15 customers acted jointly with their customers at a significantly different rate than firms using EDI with 0-5 customers, and 21 or more customers and acted at a rate not significantly different from firms using EDI with 6-10 customers, and 16-20 customers.

Companies using EDI with 16-20 customers acted jointly with their customers at a significantly different rate than firms using EDI with 21 or more customers, but acted jointly at a rate not significantly different from firms using EDI with 0-5 customers, 6-10 customers, and 11-15 customers.

Firms using EDI with 21 or more customers acted jointly with their customers at a significantly different rate than

firms using EDI with 0-5 customers, 6-10 customers, 11-15 customers, and 16-20 customers.

Reciprocity

Firms using EDI with 0-5 customers reported significantly different rates of reciprocity with their customers than firms using EDI with 6-10 customers, 11-15 customers, 16-20 customers, and 21 or more customers.

Companies using EDI with 6-10 customers reported significantly different rates of reciprocity with their customers than firms using EDI with 0-5 customers, and 21 or more customers, but reported rates of reciprocity at a rate not significantly different from firms using EDI with 11-15 customers, and 16-20 customers.

Firms using EDI with 11-15 customers responded with significantly different rates of reciprocity with their customers than firms using EDI with 0-5 customers, and 16-20 customers, and with rates of reciprocity at a rate not significantly different from firms using EDI with 6-10 customers, and 21 or more customers.

Companies using EDI with 16-20 customers reported significantly different rates of reciprocity with their customers than firms using EDI with 0-5 customers, 11-15 customers, and 21 or more customers, yet reported rates of reciprocity at a rate not significantly different from firms using EDI with 6-10 customers.

Companies using EDI with 21 or more customers reported significantly different rates of reciprocity with their customers than firms using EDI with 0-5 customers, 6-10 customers, and 11-15 customers, but reported rates of reciprocity at a rate not significantly different from firms using EDI with 11-15 customers.

Direct Power Measured in Dollars of Sales

Firms using EDI with 0-5 customers responded with significantly different rates of direct power (measured in dollar sales) over their customers compared to firms using EDI with 6-10 customers, 11-16 customers, 16-20 customers, and 21 or more customers. Companies using EDI with 6-10 customers reported significantly different rates of direct power over their customers compared to firms using EDI with 0-5 customers, 11-16 customers, 16-20 customers, and 21 or more customers.

Firms using EDI with 11-15 customers reported significantly different rates of direct power over their customers compared to firms using EDI with 0-5 customers, 6-10 customers, 16-20 customers, and 21 or more customers, but reported significantly different rates of direct power over their customers compared to firms using EDI with 0-5 customers, 11-16 customers, and 21 or more customers. Companies using EDI with 21 or more customers reported significantly different rates of direct power over their

customers compared to firms using EDI with 0-5 customers, 6-10 customers, 11-16 customers, and 16-20 customers.

Direct Power Measured in Percent of Sales

Firms using 0-5 customers reported significantly different rates of direct power (measured in percentage of sales) over their customers compared to firms using using EDI with 6-10 customers, 11-15 customers, 16-20 customers, and 21 or more customers.

Companies using EDI with 6-10 customers reported significantly different rates of direct power over their customers compared to firms using EDI with 0-5 customers and 21 or more customers, but reported rates of power not significantly different from 11-16 customers or 16-20 customers.

Firms using EDI with 11-15 customers responded significantly different rates of direct power over their customers compared to firms using EDI with 0-5 customers and 21 or more customers, but reported rates not significantly different from those with 6-10 customers or 16-20 customers.

Companies using EDI with 16-20 customers reported significantly different rates of direct power over their customers compared to firms using EDI with 0-5 customers, and 21 or more customers, but reported rates not significantly different from those with 6-10 customers or 11-15 customers.

Firms using EDI with 21 or more customers reported significantly different rates of direct power over their customers compared to firms using EDI with 0-5 customers, 6-10 customers, 11-16 customers, and 16-20 customers.

Total Direct Power

Firms using EDI with 0-5 customers reported significantly different rates of total direct power over their customers compared to firms using EDI with other numbers of customers. Similarly, firms using EDI with 6-10 customers reported significantly different rates of total direct power over their customers compared to all other numbers of customers.

Companies using EDI with 11-15 customers reported significantly different rates of total direct power over their customers compared to firms using EDI with 0-5 customers, 6-10 customers, and 21 or more customers, but reported rates of total direct power over their customers not significantly different compared to firms using EDI with 16-20 customers.

Companies using EDI with 16-20 customers reported significantly different rates of total direct power over their customers compared to firms using EDI with 0-5 customers, 6-10 customers, and 21 or more customers, but responded with rates of total direct power over their customers not significantly different compared to firms using EDI with 11-15 customers.

Firms using EDI with 21 or more customers reported significantly different rates of total direct power over their customers compared to firms using EDI with all other numbers of customers.

Ease of Transactions

Firms using EDI with 0-5 customers indicated significantly different rates of ease of conducting transactions compared to firms using EDI with 11-15 customers, 16-20 customers, and 21 or more customers, but reported rates of ease of conducting transactions not significantly different compared to firms using EDI with 6-10 customers.

Companies using EDI with 6-10 customers reported significantly different rates of ease of conducting transactions compared to firms using EDI with 11-15 customers, 16-20 customers, and 21 or more customers, but reported rates of ease of conducting transactions not significantly different compared to firms using EDI with 0-5 customers.

Firms using EDI with 11-15 customers reported significantly different rates of ease of conducting transactions compared to firms using EDI with 0-5 customers, 6-10 customers, and 16-20 customers, yet showed rates of ease of conducting transactions not significantly different compared to firms using EDI with 21 or more customers.

Firms using EDI with 16-20 customers showed significantly different rates of ease of conducting transactions compared to firms using EDI with 0-5 customers and 6-10 customers, but reported rates of ease of conducting transactions not significantly different compared to firms using EDI with 11-15 customers and 21 or more customers.

Companies using EDI with 21 or more customers reported significantly different rates of ease of conducting transactions compared to firms using EDI with 0-5 customers and 6-10 customers, but showed rates of ease of conducting transactions not significantly different compared to firms using EDI with 11-15 customers and 16-20 customers.

Indirect Power Service

Firms using EDI with 21 or more customers reported significantly different rates of service compared to firms using EDI with 0-5 customers, 11-15 customers, and 16-20 customers.

Effect Size and Power

The effect sizes of the F-tests and resulting power for each test were explained in table 30. Eight areas had significant F-ratios. These were service, overall direct power, direct power in sales in dollars, direct power in percentage of sales, overall reciprocity, responding to extraordinary requests, joint action, and ease of completing a purchase order. Those means were not equal. These areas

had reasonably high power levels. An analysis that finds that the power is approximately .80 or higher leads one to have confidence when rejecting negative results (Cohen 1988).

TABLE 30

EFFECT SIZES AND POWER OF F-TESTS

NUMBER OF CUSTOMERS

TEST	ES	POWER
REPUTATION	.082	.17
SKILL	.122	.36
EDI	.099	.13
PRODUCT	.113	.31
INDIRECT POWER	.135	.44
ENTRY	.058	.11
SUBST.	.160	.54
RIVALRY	.237	.91
R-SERV	.235	.91
R-QUAL	.101	.24
R-VAR	.111	.30
R-PRICE	.108	.28
DIRECT POWER	.283	.98
DOLLAR	.297	.99
PERCENT	.231	.89
RECIPROCITY	.233	.90
REQUEST	.255	.97
PLAN	.136	.44
ACT	.197	.79
EFFICIENCY	.212	.84
COST	.050	.09
EASE	.296	.99

Extent vs. Management

RQ6: Is the reported extent of EDI use by a firm independent of the company that manages the network?

Ha: extent of EDI use is related to (dependent on) the manager

A chi-square test for independence was conducted as shown in table 31.

TABLE 31

CHI-SQUARE TEST FOR INDEPENDENCE
OF NUMBER OF USERS BY EDI MANAGER

# OF USERS	FIRM	CUSTOMER	SUPPLIER	THIRD PARTY	TOTAL
0- 5	32	14	0	109	155
6-10	9	4	1	45	59
11-15	1	3	0	25	29
16-20	0	3	0	10	13
21 +	12	1	0	27	40
TOTAL	54	25	1	216	296

The computed chi-square value of 20.153 was inflated with 12 degrees of freedom. The table had too many small expected cells to be used. The one case of the supplier-maintained EDI network was eliminated and the numbers-of-users were combined to ensure that all the expected values are at least five. The revised chi-square is shown in table 32.

TABLE 32

REVISED CHI-SQUARE TEST FOR INDEPENDENCE
FOR NUMBER OF USERS BY EDI MANAGER

NUMBER OF USERS	FIRM	CUSTOMER	THIRD PARTY	TOTAL
0- 5	32	14	109	155
6-10	9	4	45	58
11 +	13	7	62	82
TOTAL	54	25	216	295

The computed chi-square value was 1.600 with a p-value of .8182. This value was less than the critical value of 9.487, 4 degrees of freedom, at the .05 level of significance. Thus, one fails to reject the hypothesis that reported extent of EDI use by a firm is independent of the company that manages the network. Given the effect size of .058 and the resulting power of .014, failure to reject the null hypothesis cannot have much substantive meaning.

Extent vs. Initiation

RQ7: Is the reported extent of EDI use by a firm independent of the company that suggested using the network?

Ha: extent of EDI use is related to (dependent on) the initiator

A chi-square test for independence was conducted as shown in table 33.

TABLE 33

CHI-SQUARE TEST FOR INDEPENDENCE
OF NUMBER OF USERS BY EDI INITIATOR

# OF USERS	FIRM	SUPPLIER	CUSTOMER	THIRD PARTY	TOTAL
0- 5	5	146	3	1	155
6-10	6	53	0	0	59
11-15	2	26	1	0	29
16-20	0	13	0	0	13
21 +	8	30	1	1	40
TOTAL	21	268	5	2	296

The computed chi-square value was 20.414, with 12 degrees of freedom. There were too many small expected values for analysis. The information may be consolidated as shown in table 34.

TABLE 34

REVISED CHI-SQUARE TEST FOR INDEPENDENCE
OF NUMBER OF USERS BY EDI INITIATOR

NUMBER OF USERS	SUPPLIERS	OTHERS*	TOTAL
0 - 5	146	9	155
6 - 10	53	6	59
11 +	69	13	82
TOTAL	268	28	296

* others include the firm, customers, and third parties

The computed chi-square value was 6.364, effect size of .348, power of .995, and p-value of .0415. This value exceeded the critical value of 5.991, 2 degrees of freedom, at the .05 level of significance. Thus, the hypothesis was supported and given the high power of the test one can place substantive meaning that the extent of EDI use is dependent on the company that manages the network.

Demographics

The following section discussed the demographics of the respondents. The instrument asked the respondents to describe the following information about themselves and their firms:

1. respondent's position in the firm
2. respondent's highest level of education
3. approximate amount of their firm's sales in dollars
4. approximate number of employees in their firm
5. length of time the firm has been in existence
6. length of time the firm has used EDI
7. length of time the respondent has been with the firm
8. length of time the respondent has been in the same job
9. length of time the respondent has been in purchasing
10. percentage of the customers that use EDI
11. percentage of the dollar amount of sales with EDI
12. percentage of the purchase orders using EDI
13. percentage of transactions using EDI

The responses to these questions are summarized in the tables 35 to 47. A discussion of the responses follows each table.

TABLE 35

RESPONDENT'S POSITION IN THE FIRM

POSITION	N = 296	N %	N CUM %
CEO	27	9.1	9.1
Purch Mgr	12	4.1	13.2
Sales Mgr	52	17.6	30.8
MIS Mgr	133	44.9	75.7
Secretary	12	4.1	79.8
Other	60	20.2	100

The "other" category included financial managers and accountants. The wide range of responses concerning the position of the respondents suggested that there are many uses of EDI by companies and that companies organize their EDI operations in alternative ways.

TABLE 36

RESPONDENT'S LEVEL OF EDUCATION

EDUCATION LEVEL	N = 295	N %	N CUM %
No college	24	8.1	8.1
Some college	82	27.8	35.9
Completed college	129	43.7	89.6
Some grad school	31	10.5	90.1
Comp grad school	29	9.9	100

The information about the respondent's level of education showed a high degree of schooling. This level of education was not surprising considering the positions the respondents held.

TABLE 37

APPROXIMATE SALES OF THE FIRM IN DOLLARS

SALES IN DOLLARS	N = 273	N %	N CUM %
0 - 49 million	195	71.4	71.4
50 - 149 million	38	13.9	85.3
150 - 249 million	14	5.1	90.4
250 - 499 million	13	4.8	95.2
500 - 999 million	4	1.5	96.7
1 billion or more	9	3.3	100

In terms of sales, smaller firms predominate in numbers. This was consistent with the population of study. Industrial distribution firms tend to be small. It should be noted that this question had the most responses left unanswered as some respondents considered the information proprietary.

TABLE 38

APPROXIMATE NUMBER OF EMPLOYEES IN THE FIRM

EMPLOYEES	N = 294	N %	N CUM %
0 - 100	165	56.1	56.1
101 - 250	45	15.3	71.4
251 - 500	36	12.3	83.7
501 - 999	23	7.8	91.5
1,000 +	25	8.5	100

In terms of the number of employees, smaller firms also predominate. Industrial distribution firms can be as small as one or two employees.

TABLE 39

LENGTH OF TIME THE FIRM HAS BEEN IN EXISTENCE

YEARS	N = 293	N %	N CUM %
0 - 1	1	.3	.3
2 - 3	1	.3	.6
4 - 6	8	2.8	3.4
7 - 9	12	4.1	7.5
10 +	271	92.5	100

As most firms have been in existence for ten or more years, this indicated a relatively successful group of organizations. Unsuccessful firms would not be present in the sampling frame.

TABLE 40

LENGTH OF TIME OF FIRM'S USE OF EDI

YEARS	N = 296	N %	N CUM %
0 - 1	11	3.7	3.7
2 - 3	94	31.8	35.5
4 - 6	137	46.3	81.8
7 - 9	35	11.8	93.6
10 +	19	6.4	100

Respondents indicated that their firms have been using EDI for several years. This meant that they have sufficient knowledge of the their companies' EDI use to make informed statements concerning their firms' experience.

TABLE 41

LENGTH OF TIME THE RESPONDENT
HAS BEEN WITH THE FIRM

YEARS	N = 296	N %	N CUM %
0 - 1	9	3.0	3.0
2 - 3	39	13.2	16.2
4 - 6	72	24.3	40.5
7 - 9	39	13.2	53.7
10 +	137	46.3	100

TABLE 42

LENGTH OF TIME IN CURRENT POSITION

YEARS	N = 296	N %	N CUM %
0 - 1	26	8.8	8.8
2 - 3	80	27.0	35.8
4 - 6	77	26.0	61.8
7 - 9	37	12.5	74.3
10 +	76	25.7	100

The respondents showed they have been with their firm for several years. This suggested they have personal knowledge of their firms' experience with EDI. The respondents further showed a wide range of time spent in their current positions, which suggested a range of experience that exposed them to a broader understanding of their firms' operations.

TABLE 43

LENGTH OF TIME IN THE PURCHASING FIELD

YEARS	N = 296	N %	N CUM %
0 - 1	183	61.8	61.8
2 - 3	24	8.1	69.9
4 - 6	27	9.1	79.0
7 - 9	11	3.7	82.7
10 +	51	17.3	100

Respondents indicated a wide range of time in the purchasing field. Those with fewer years in purchasing may have been influenced by the wide range of positions the respondents held. Even those in positions, such as management information systems or accounting, are exposed to the purchasing field through their work with EDI.

TABLE 44

PERCENTAGE OF THE NUMBER OF CUSTOMERS WHO USES EDI WITH THE FIRM

PERCENTAGE CUSTOMERS	N = 296	N %	N CUM %
0 - 5	190	64.2	64.2
6 - 10	44	14.9	79.1
11 - 20	20	6.8	85.9
21 - 30	11	3.7	89.6
31 - 40	5	1.7	91.3
41 - 50	14	4.7	96.0
50 +	12	4.0	100

Most respondents said that they used EDI with less than 10 percent of their customers. The small percentage suggested that those customers with whom they use EDI have certain traits that differentiate them from their usual customers, which was the basis for this study.

TABLE 45

PERCENTAGE OF THE SALES IN DOLLARS
TO CUSTOMERS WHO USE EDI WITH THE FIRM

PERCENTAGE SALES IN $	N = 296	N %	N CUM %
0 - 5	84	28.4	28.4
6 - 10	59	19.9	48.3
11 - 20	49	16.5	64.8
21 - 30	32	10.8	75.6
31 - 40	20	6.8	82.4
41 - 50	18	6.1	88.5
51 +	34	11.5	100

Respondents suggested that a small percentage of the sales to customers are done through EDI. Almost a majority of firms report the first two categories of sales.

TABLE 46

PERCENTAGE OF PURCHASE ORDERS
TO CUSTOMERS WHO USE EDI WITH THE FIRM

PERCENTAGE PURCH ORDERS	N = 296	N %	N CUM %
0 - 5	138	46.6	46.6
6 - 10	49	16.6	63.2
11 - 20	33	11.1	74.3
21 - 30	19	6.4	80.7
31 - 40	9	3.1	83.8
41 - 50	18	6.1	89.9
51 +	30	10.1	100

TABLE 47

PERCENTAGE OF TRANSACTIONS
TO CUSTOMERS WHO USE EDI WITH THE FIRM

PERCENTAGE TRANSACTIONS	N = 296	N %	N CUM %
0 - 5	112	37.8	37.8
6 - 10	53	17.9	55.7
11 - 20	38	12.8	68.5
21 - 30	24	8.1	76.6
31 - 40	15	5.1	81.7
41 - 50	17	5.8	87.5
51 +	37	12.5	100

Respondents indicated that less than 10 percent of the purchase orders from customers were transacted through EDI. A majority reported the first two categories of the number of purchase orders and transactions.

Chapter Summary

The results of the research were discussed in this chapter. The results included analyzing the research questions of the study and demographics of the respondents. The analysis follows:

Interorganizational Relationship Ratings

RQ1: Do firms report significantly higher mean dependent ratings on the characteristics of reputation, skill, indirect power, direct power, and reciprocity for the IOR formed between the firm and its trading partners that use EDI than for the IOR formed between the firm and its partners that do not use EDI for their purchases?

Ha: μ EDI > μ non-EDI

The project used the paired t-test to compare the two mean values of each dependent measure for each respondent. Measures of reputation, skill, direct and indirect power were higher for partners using EDI at the .05 level of significance. Thus, the data supported the hypothesis. Measures for reciprocity were not significantly higher for users of EDI and do not support the hypothesis.

Efficiency Ratings

RQ2: Do firms report significantly lower mean dependent ratings on the characteristics of efficiency for the IOR formed between the firm and its trading partners

that use EDI than for the IOR formed between the firm and its partners that do not use EDI for their purchases?

Ha: μ EDI < μ non-EDI

Measures of efficiency were significantly lower for users of EDI. Thus, the hypothesis was supported.

Initiation Ratings

RQ3: Does the central position of the company that initiated the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for their purchases?

Ha: four means are not equal

There were four positions reported for the company that initiated the EDI network. The investigation used analysis of variance to compare the mean values of each dependent measure for each respondent. There were no significant F ratios. Thus, the hypothesis was not supported.

Management Ratings

RQ4: Does the central position of the company that currently manages the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for their purchases?

Ha: four means are not equal

There were four positions reported for the company that currently manages the EDI network. The study used analysis of variance to compare the mean values of each dependent measure for each respondent. Significant F ratios were

found for overall indirect power, indirect power service, and overall skill. Those means were not equal.

Number of Customers

RQ5: Does the number of companies with which a firm uses EDI significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for their purchases?

Ha: five means are not equal

There were five groups numbering the customers with which the firm uses EDI. The project used analysis of variance to compare the mean values of each dependent measure for each respondent. Significant F ratios were found for service, overall direct power, dollar sales, percentage of sales, overall reciprocity, response to unusual request, joint action, and ease of use. Those means were not equal.

Extent versus Management

RQ6: Is the reported extent of EDI use by a firm independent of the company that manages the network?

Ha: extent of EDI use is related to (dependent on) the manager

The study used the one-tailed chi-square statistic to compare the reported extent of EDI use to the managing company. There was insufficient evidence to support the hypothesis. One fails to reject the idea that the reported extent of EDI use was independent of the company that manages the network.

Extent versus Initiation

RQ7: Is the reported extent of EDI use by a firm independent of the company that suggested using the network?

Ha: extent of EDI use is related to (dependent on) the initiator

The investigation used the one-tailed chi-square statistic to compare the reported extent of EDI use to the initiating company. The extent of EDI use was dependent on the company that manages the network. The results of this and the other six research questions are summarized in table 48.

Demographics

The demographics of the respondents were reported and summarized in fifteen tables. The respondents were asked to answer the following questions:

1. respondent's position in the firm
2. respondent's highest level of education
3. approximate amount of the firm's sales in dollars
4. approximate number of employees in the firm
5. length of time the firm has been in existence
6. length of time the firm has used EDI
7. length of time the respondent has been with the firm
8. length of time the respondent has been in the same job
9. length of time the respondent has been in purchasing
10. percentage of the customers that use EDI
11. percentage of the dollar amount of sales with EDI
12. percentage of the purchase orders using EDI
13. percentage of transactions using EDI

TABLE 48

RESULTS OF HYPOTHESES

RESEARCH QUESTION	TEST	SIGNIFICANCE* (p <.05)	
IOR Ratings μ EDI > μ non-EDI	paired t-test	Reputation Skill Indirect Power Direct Power Reciprocity	.000* .000* .000* .000* .110
Efficiency Ratings μ EDI < μ non-EDI	paired t-test	Efficiency	.007*
Moderator: Initiation four means are not equal firm customer supplier shipper (none reported) third party	ANOVA F-test	Reputation Skill Indirect Power Direct Power Reciprocity Efficiency	.282 .899 .542 .563 .307 .214
Moderator: Management four means are not equal firm customer supplier shipper (none reported) third party	ANOVA F-test	Skill Indirect Power R-Service	.043* .024* .013*
Moderator: Number of Customers five means are not equal 0- 5 6-10 11-16 16-20 21 or more	ANOVA F-test	R-Service Direct Power DP-Dollar DP-Percent Reciprocity REC-Request REC-Act EFF-Ease	.003* .000* .000* .004* .003* .013* .023* .000*
Extent of EDI use is dependent on the manager	Chi-squ	Fail to be not Independent	.818
Extent of EDI use is dependent on the initiator	Chi-squ	Dependent	.042*

CHAPTER FIVE

IMPLICATIONS OF RESULTS AND FUTURE STUDIES

The following items are discussed in this chapter: the results of the research, limitations and strengths of the study, implications of the report, and areas for future study. The summary includes the significance and organization of the study.

Discussion of Results

The following sections include discussions of the results of each research question. Additional analysis is provided to explain unusual results from chapter four.

RQ1: Do firms report significantly higher mean dependent ratings on the characteristics of reputation, skill, indirect power, direct power, and reciprocity for the IOR formed between the firm and its trading partners that use EDI than for the IOR formed between the firm and its partners that do not use EDI for the purchases?

Ha: μ EDI > μ non-EDI

The following results were not significant at $p < .05$:

IOR	p	EFFECT SIZE	POWER $\alpha = .05$	POWER $\alpha = .10$
Reciprocity	.1100	.1012	.34	.48
Request	.1100	.1022	.34	.48
Plan	.2600	.0540	.17 *	.24 *
Indirect power				
Entry	.3300	.0241	.07 *	.09 *

RQ2: Do firms report significantly higher mean dependent ratings on the characteristics of efficiency for the IOR formed between the firm and its trading partners that use EDI than for the IOR formed between the firm and its partners that do not use EDI for the purchases?

Ha: μ EDI < μ non-EDI

The following results were not significant at $p < .05$:

IOR	p	EFFECT SIZE	POWER $\alpha = .05$	POWER $\alpha = .10$
Efficiency				
Ease	.1900	.0720	.24 *	.34 *

* interpolated scores at n = 300

Given the low effect sizes and resulting power, these t-scores may be significant in reality. This research project was not large enough to capture the effect. Respondents said that they often used EDI as an additional method on top of their normal purchasing patterns. These firms that use EDI with specific trading partners pay for their transactions twice. They pay transaction costs for their manual systems and then they pay additional costs for their electronic systems. Companies reported lower cost-of-use only when using EDI with 11 or more trading partners, implying that after 10 partners there are economies of scale. It is possible that after 10 electronic partners, the firm no longer adds EDI to its normal purchasing systems, but changes its internal systems.

RQ3: Does the central position of the company that initiates the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between

the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?

Ha: four means are not all equal

RQ4: Does the central position of the company that currently manages the EDI network significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?

Ha: four means are not all equal

No significant F ratios were present for RQ3. Three areas had significant F-scores for RQ4. These are overall skill at 2.75, indirect power-service at 3.63, and overall indirect power at 3.19. Tukey's test for multiple comparisons is an appropriate follow-on technique. The company that manages the EDI network affects the relationship between the firm and its customers.

All things being equal, it is in the interest of the firm to control the network. This interest might change in the future as the EDI networks continue to become standardized. As the networks standardize, the operations of the network will become less valuable. This change in value will be discussed further in the section on implications.

RQ5: Does the number of companies with which a firm uses EDI significantly alter the differences in the mean dependent ratings for the IOR formed between the firm and its trading partners that use EDI compared to its partners that do not use EDI for the purchases?

Ha: five means are not all equal

Eight areas had significant F-scores for RQ4. These are as follows:

SOURCE	F	P	ES	POWER
R-SERVICE	4.08	.0030	.235	.91
DIRECT POWER	5.95	.0000	.283	.98
DP-DOLLAR	6.50	.0000	.297	.99
DP-PERCENT	3.93	.0040	.231	.89
RECIPROCITY	4.04	.0030	.233	.90
R-REQUEST	3.23	.0130	.255	.97
R-ACT	2.88	.0230	.197	.79
E-EASE	6.48	.0000	.296	.99

Tukey's test for multiple comparisons is an appropriate follow-on procedure. The number of companies with which a firm uses EDI affects the relationship between a firm and its customers. All things being equal, a firm changes its operations after it interacts with five users of EDI. As discussed with RQ2, firms tend to use EDI as an added feature on top of their current operations if they have few customers using EDI and change their internal operations only when they have a critical mass of customers.

RQ6: Is the reported extent of EDI use by a firm independent of the company that manages the network?

Ha: extent of EDI use is related to (dependent on) the manager

RQ7: Is the reported extent of EDI use by a firm independent of the company that suggested using the network?

Ha: extent of EDI use is related to (dependent on) the initiator

There is insufficient evidence to support the hypothesis of RQ6. One fails to reject the idea that the

reported extent of EDI use is independent of the company that manages the network. The extent of EDI use is dependent on the company that initiates the network.

Companies change their operations based on the number of customers that use EDI; however, those firms deciding to use EDI on their own may be more amenable to change than if their customers force them. Similarly, firms with a larger base of customers using EDI will want to move to control the network.

Study Limitations

The research conclusions drawn from this study must be qualified on several points. Some limitations were noted in previous chapters but deserve additional emphasis at this point.

This project was nonexperimental in nature, and no active manipulation of the variables was involved. This aspect opens the problems of internal and external validity.

Internal Validity

This study was subject to several concerns of internal validity. These included testing, history, maturation, mortality, instrumentation, and selection.

Testing

Rating scales are reactive measures because they may change the event that the researcher may attempt to measure. They may focus the attention on the events being observed.

As this attention is uncontrolled, it may serve as a rival hypothesis or explanation for any significant difference.

History

The historic rate of growth in the use of EDI is worth noting in the changes in purchasing organizations. Unfortunately, this raised the "chicken-and-egg" question. Is the use of EDI growing because of changes in the purchasing organizations or are the organizations changing because of the growth of EDI? This study did not test for causation.

Maturation

Companies queried in this study have used EDI for different periods. This opened the research to the threat of maturation as firms may have different levels of experience.

Mortality

Similarly, this research did not control for mortality. Only firms currently using EDI were surveyed. Companies, that have spent the required time, money, and effort to use EDI and then decided to give it up, may have decidedly different views of the value of EDI. This threat may be minimal; however, because most of the firms used EDI at the instigation of their customers.

Instrumentation

Instrumentation, a normal threat to surveys, can be minimized by pilot testing. Further, the respondent answered identical queries for EDI and Non-EDI use. Any respondent's misunderstanding of a question should be offset by the same degree for both the EDI and Non-EDI sections. Thus, instrumentation should not be a major threat to this report.

Selection

The matched pair design of this research insured that each respondent discussed both EDI and non-EDI use. Though all firms surveyed currently used EDI, it is not known if the target population matched the universal population. This was discussed in chapter three.

The demographics of the population are described in several tables starting with table 36, Respondent's Position in the Firm. Although this table noted a variety of job descriptions, the respondents are remarkably similar. The majority have at least a college degree and/or work for small firms noted by sales of less than $ 50 million a year. This similarity is also true if one defines a small company as having 1 to 100 workers. Further, most of the respondents have been in their current position or have been with the company for at least four years.

While this may control the internal validity by standardizing the environment of the firm, it may have

caused firms to alter their views of the process as they became used to EDI.

External Validity

External validity issues can be described as population and ecological issues. These are discussed in the following sections.

Population

The question always arises whether the experimentally accessible population was the same as the target population. This was specifically addressed in the section in the sampling design. Payne's (1992) listing was the most appropriate source of industrial distribution firms using EDI.

Another source of possible invalidity was the interaction between the treatment and subject characteristics. The study prepared for this factor and investigated the number of firms with which the firm used EDI. This moderating variable actually affected some results.

Ecology

Ecological validity concerned the generalization of the results to other settings. Huck, Cormier, and Bounds (1974) discussed the following aspects of ecological validity:

1. Describing the independent variable
2. Describing and measuring the dependent variable

3. Multiple-treatment interference
4. Interaction of history and treatment effects
5. Interaction of time of measurement and treatment effects
6. Pretest and posttest sensitization
7. Hawthorne effects
8. Novelty and disruption effects
9. Experimenter or Rosenthal effect

Independent Variable

The population chosen included only industrial distribution firms. These firms were significantly different from consumer buying companies (Leenders and Fearon 1993). These differences were outlined earlier in the section on research design.

The standard for controlling for this aspect was adequate sufficient explanation so that other researchers could replicate the study. This study should have no problem meeting this standard.

Dependent Variable

Huck, Cormier, and Bounds (1974) described the following five issues of validity concerning the dependent variable

1. Satisfactorily description of the dependent variable
2. Degree of reliability of the test instrument
3. Appropriate choice of the measuring instrument

4. Degree of reliability of the judges

5. Appropriateness of the analysis

The dependent variables were defined in chapter one and operationalized in chapter three. The constructs were developed from the review of the literature as described in chapter two and the reliabilities of each of the dependent variables were evaluated according to a technique described by Kerlinger (1986). Each variable was linked to specific questions of the instrument.

The instrument used in this research was based on Khandwalla's earlier study. Deficiencies of Khandwalla's instrument were addressed in chapter three and the resulting instrument was pilot tested with two groups similar to the target population.

The sample size was limited in number. This research involved 296 usable responses (approximately double the previous largest study of this kind); however, it was not large enough to fully compensate for the very small effect sizes found for specific variables. These issues should be addressed in future studies.

The research used a matched pair design. Each respondent judged both their customers using EDI and their customers using the traditional paper-based system. Thus, the question of whether change on the dependent variable was caused by the treatment or by systematic fluctuation in the ratings of the judges did not arise.

The last concern involved fallibility of the analysis. The type of analysis was appropriate for the type of data collected.

Multiple Treatment Effects

This study was not experimental in nature. Thus, it is difficult to estimate how multiple treatments affected this research.

Interaction Effects

Historical events and the passage of time may color the generalization of results. EDI requirements are becoming more standardized and less proprietary, which should increase the number of companies using EDI. Additionally, the costs of buying the necessary hardware and software are decreasing. This is expected to lead more firms to use EDI in the future.

Pretest and Posttest

Neither a pretest or a post test were given to the respondents. Thus this was uncontrolled.

Hawthorne Effect

Each respondent was sent a cover letter explaining the purpose of the study. It is possible that they responded just to please me, because they knew the results were being evaluated.

Novelty and Disruption Effects

All surveys were addressed in to managers at their normal place of business. Industrial surveys are not unusual in the industrial distribution field. Thus, there should be no problem with novelty or disruption effects.

Experimenter Effect

Huck, Cormier, and Bounds (1974) noted four possible areas of concern for investigators. These were as follows:

1. paradigm effect
2. loose protocol
3. analysis effect
4. fudging effect

The paradigm included the basic assumptions and ways of conceptualizing the area of inquiry. The reason for the study and the significance were addressed in chapter one. The protocol was the step-by-step details of how the research was conducted was stated in chapter three. The analysis was described in chapter four. Fudging was minimized by the constant interaction of the research committee.

Strengths

Though this report contained some limitations, it also had several strengths which were discussed throughout the report in describing how the study was planned and

conducted. These strengths including theory, methodology and execution are discussed here for emphasis.

Theory

In general, good methodology starts with good theory. In chapter two, the theoretical framework for the study was outlined. Though the academic literature on EDI was sparse, it is well established that EDI is linked to IOR theory (Benjamin, de Long, Morton 1990, Banerjee and Golhar 1994, Vlosky, Smith, and Wilson 1994, Williams 1994, and Teo, Tan, Wei, and Woo 1995). This study tracked each of six different IOR schools of thought to determine specific characteristics of interest. These characteristics became the basis for the chosen dependent variables.

The purpose of the study was clearly identified. The purpose led to specific research questions and the resulting statistical hypotheses and techniques. The use of EDI is growing at a 72 percent rate from 1987 to 1992 as shown in figure 1 (Payne 1992). This rate has continued so that there are over 100,000 EDI users world wide as of 1995 (Bowles 1996). EDI users can be easily identified as separate from non-EDI users; thus forming the basis for the independent variable.

Moderating influences were also identified from the literature review. Factors, such as the centrality of the firm (Bavelas 1948, 1950, Galaskiewicz 1979, Boje and Whetten 1981) and number of users (Hinings, et al. 1974),

were summarized in table 7 and provided a richer theoretical environment. This richness made the study closer to real life than a sterile laboratory exercise, which in turn extended the external validity of the study.

Methodology

The methodology was explained in chapter three and summarized in table 16. All constructs were defined in chapter one and operationalized in chapter three. The resulting variables were linked to specific questions of the instrument.

Kerlinger (1986) discussed ways to increase the control of variables, including choosing independent variables as homogenous as possible and matching subjects. Leenders and Fearon (1993) differentiated industrial distribution firms from the consumer market. Only industrial distribution firms were used in this study increasing the homogeneity of the independent variable. This study matched subjects with themselves. Indeed, as Kerlinger (1986, 289) stated "How much better on all possible variables than by matching a subject with himself?"

The rating instrument used was developed from Khandwalla's (1981). This was improved by changing the scales from 1-7 to 1-9 to increase dispersion. Further, constructs measured by Khandwalla by a single question were separated out into several questions. The resulting instrument was pilot tested with two groups. One group was

the EDI Users of Dallas and the second group included purchasing managers similar to the population. Reliability coefficients for each variable were calculated.

Podsakoff and Organ (1986) discussed methods to minimize the self-reporting of data, including escalating the unit of analysis and reordering the scale. This study asked key individuals to rate their firms interactions with their customers. The unit of analysis was escalated from the individual to the firm, reducing the responses from 592 individual relationships with customers to 296 firm relationships. Further, in this study, "the dependent variables follows, rather than precedes, the independent variable," according to the procedure outlined by Podsakoff and Organ (1986, 540).

This study also corrected for same source bias by creating a new data set. New scales were created by multiplying IOR scores by how much importance the firm placed on those characteristics. Thus, the scores were weighted to reflect how heavily the firm uses EDI.

Execution

The instrument was sent to a census of a well defined target population. The target population, a listing of industrial distribution firms that use EDI, was taken from Payne (1992), arguably the most complete listing of the universal population available.

The 296 usable responses received were greater than the 295 responses calculated according to the procedure outlined by McCall (1982). This procedure specifically compensated for non-response rate. The 42 percent response rate was greater than the 19 percent expected of industrial distribution surveys. Further, the 296 dwarfs other responses of earlier EDI studies as shown in table 14.

The response rate when coupled with the calculated power and effect sizes, as shown in tables 17, 20, 24, 27, and 30, provide assurance that the results of the study are meaningful. This lends credence to the implications discussed in the next section.

Implications

The results of this research provide managers with practical implications. These are summarized below and are explained in the following subsections.

1. EDI is a different channel of distribution.
2. EDI shows the buyer-seller relationship of the future.
3. The future way of conducting business is already occurring.
4. The benefits of using EDI accrue to the network as a whole.

Different Channel of Distribution

The primary implication of this study is that EDI forms a different channel of distribution. Significant differences exist between the IOR of firms with two classes

of customers. The first class of customers used EDI with their trading partners and the second class of customers used the traditional paper-based purchasing systems with their partners.

Companies deciding to use EDI with their partners must adapt the way they do business with their partners to account for these differences. La Londe and Emmelhainz (1985, 9) predicted that most purchasing departments in the future "will look far different from the typical purchasing department of 1985." Sokol (1989) affirmed that firms using EDI have a competitive advantage over those that did not.

Buyer-Seller Relationship of the Future

The second implication is that firms and their partners using EDI represent the buyer-seller relationships of the future. This relationship follows from the first implication, which said that the IOR between a firm and its trading partners is different for partners using EDI than for partners using the traditional paper-based systems.

Companies are using EDI with more trading partners. The rate of change is increasing rapidly and is expected to continue in the future (Sokol 1989). This growth rate was a significant reason for conducting this research. Figure 1, Number of Registered EDI Users, showed the number of users worldwide. Domestic use of EDI grew at an annual compound

rate of 72 percent from 1987 to 1992 and the rate is increasing.

Further, the data collected in this study suggests that over 90% of the firms have used EDI for less than seven years. Additionally, more than a third of the respondents have used EDI for less than four years. This usage rate was shown in table 39. Thus, firms should investigate how they deal with trading partners using EDI as a norm for their dealings with all trading partners.

The competitive advantage of firms which use EDI has declined because using EDI is now expected as a norm. Carter, Monczka, Clauson, and Zelinski (1987, 13) studied twenty-five firms and a group of third-party network providers and stated "EDI is quickly gaining acceptance in the purchasing environment and has evolved into the preferred method of business communication between buying and supplying firms."

EDI Already Changing the Relationship

The second implication was that EDI is the trend of the future. The third implication logically follows, as EDI is already changing the way firms conduct business.

Using EDI provides an incentive for firms to change their operations. Many companies, just starting EDI, consider it a cost burden beyond their normal paper-based systems. When EDI is used with just a few special partners, it is in addition to the traditional accounting/inventory/

logistics systems. The results of this research suggest that only when a firm has 11 or more trading partners does EDI become significantly cheaper. Thus, the benefits of EDI will occur only as firms reach an economy of scale or make the required internal adaptations in their organizations.

Monczka and Carter (1989), who developed a model for implementing EDI, noted that EDI influenced the internal systems of the company. This research concurs with their findings.

The competitive advantage of firms using EDI will disappear as the percentage of these companies approaches 100 percent. Conceptually, as firms use EDI with more of their partners, there will be less difference between the buyer-seller relationships of firms using EDI with their partners and the norms of all buyer-seller relationships. When firms use EDI with 100 percent of their trading partners, EDI becomes the norm. Thus, according to the population ecology perspective, firms that use EDI as a normal method of business will survive and those that do not will wither, all other things being equal.

Benefits Accrue to the Network

The fourth implication is that the benefits of using EDI accrue to the network, instead of the firm or its partners. Firms must cede some independence or risk the problem of suboptimizing the network.

Examples from the consumer market of firms ceding independence are readily available. Producers integrate their operations with distributors to form a virtual enterprise. Procter and Gamble and Wal-Mart jointly plan and implement sales campaigns as one entity. Each benefits from the costs incurred by the other. Similarly, suppliers pay for Kroger's weekly advertisements and many transportation firms coordinate inbound and outbound shipments to firms to minimize movements and maximize vehicle loads. The process of mutually working out the details of this integrated effort between the firm and its partners takes time, money, and effort by both sides. The cessation of their independence should lead to increased reciprocity.

This research did not find a significant difference in the levels of reciprocity between the trading partners of firms that use EDI compared to those that did not. Miles (1989) said that shared information systems served as a replacement for trust in networks. The conclusions of this study are similar.

The value of the network increases as the cost of networking becomes cheaper. Hardware and software costs are dropping, but the real value occurs when the network becomes transparent. The use of EDI provides each partner with the same level of information and allows partners to make decisions as easily as the original firm. Third party

providers (VANS) enhance the value of this process by making it easier for firms to connect with trading partners.

These four points explain the current and future use of EDI. These provide the researcher with several new avenues for future studies.

Future Studies

This study focussed on the use of EDI between firms and their partners. Future research can be expanded in several ways. These are listed below and later explained in depth:

1. By comparing the IOR relationship between the focal firm and its suppliers instead of its buyers
2. By replicating in other distribution sectors or consumer markets
3. By comparing firms that do not yet use EDI to firms in the same sector that use EDI
4. By looking into the breadth of EDI use instead of the extent
5. By investigating changes in the organization of the firm using EDI

The first approach may be to replicate the study with the firm's relationship with its suppliers instead of its customers. It can be hypothesized that the direction of the relationship could affect the results. This possibility is particularly true for the area of reciprocity.

Secondly, future research can be expanded to replicate the study in other distribution sectors. This study purposely avoided the consumer market. The consumer purchasing field is considerably different from the

industrial market. Several firms, such as Wal-Mart and Sears, use EDI with literally thousands of partners. Thus, the buyer-seller interorganizational relationships could be further studied in the consumer purchasing field.

Similarly, a third approach would compare firms who are not yet using EDI to others in the same industry sector that are using EDI. This alternate approach, used by La Londe and Emmelhainz (1985) and most other studies in the past, contrasts with this research, which compared firms who used EDI with two classes of trading partners. Groups, such as the Industrial Distribution Association, consist of members who use EDI and members that do not yet use EDI.

Fourthly, differences were noted in several aspects of the buyer-seller relationship depending upon the extent of EDI use. This relationship can be further studied by the breadth of EDI use. EDI comprises far more activities than just purchasing. Firms use EDI for financial, accounting, shipping, quality control, and scheduling information with both sides of the distribution chain. It can be hypothesized that firms with extensive breadth of EDI use will have closer relationships with their trading partners than firms minimally implementing EDI with their trading partners.

Finally, changes in the firm's organization can be studied. Variables of interest include the following questions:

1. At what level does the senior EDI specialist reside in the firm?

2. In what functional areas does the specialist work?

3. Have these variables changed over time and as the level/breadth of EDI use has increased?

4. How does the firm's use of specific policies, such as JIT or quality programs, affect the level of EDI use?

This section included discussions of the ways in which the current study could be expanded in the future. The entire report is summarized in the following section.

Summary of the Report

This report analyzed differences between the buyer-seller relationship of firms using electronic data interchange (EDI) with two classes of customers. The first class involved trading partners that use EDI with the firm and the second class involved partners that use the traditional paper-based purchasing systems.

EDI is a computer-based logistics system. Firms enter product data in their computers without having the trading partners reenter the data again. Analysts have considered EDI as the upcoming technology ever since it emerged in the 1950's; however, companies have realized its potential only in the last five to ten years.

The EDI literature was written primarily from practitioners and lists few referenced articles. This project provided a research base to this list by focussing on the IOR literature to provide an explanation for the

growth and use of EDI. Benjamin, de Long, and Morton, (1990) explicitly described EDI as a special case of interorganizational relationships (IOR). Banerjee and Golhar 1994, Larson 1994, Vlosky, Smith, and Wilson 1994, Williams, 1994, and Teo, et al. 1995 also treated EDI as an IOR. IOR theory is best studied in networks (Whetton 1991) and a natural network exists among the inter-relationships of buyers and sellers connected by EDI.

Specifically, this study involved the following items:

1. The extent of electronic data interchange use by the firm
2. The company that suggests the firm use electronic data interchange
3. The company that manages the electronic data interchange network used by the firm
4. The reputation of the firm's trading partner
5. The skill level of the firm's trading partner
6. The industry practices of the supplier, including: (1) ease of entry into the market by potential suppliers, (2) ability to substitute goods by the trading partner, and (3) intensity of rivalry among existing suppliers
7. The amount of the purchases between a firm and its trading partner in: (1) dollars and (2) percentage of total purchases
8. The amount of reciprocity between the firm and its trading partners
9. The importance top management of the firm places on items listed in 4-8.

Significance of the Study

This study was significant for both practical and theoretical reasons. The practical reasons involved the

growth rate of EDI use and the theoretical reasons revolved around IOR. These were discussed in the following sections.

Practical Reasons

The use of EDI has increased in the last several years. The number of firms using EDI worldwide has grown from 1,400 registered users in 1987 to over 35,000 in September 1992 (Payne 1992).

The cost of hardware and the lack of standardized software limited the use of EDI until recently. Hardware costs are declining as computer capability increases. Similarly, EDI software is becoming available to smaller users as industry standards emerge. Thus, EDI use is expected to increase exponentially (Payne 1992, La Londe and Emmelhainz 1985, Emmelhainz 1987, Carter, et al. 1987).

Theoretical Reasons

Researchers have not explored the underlying theoretical effects of this growth in the number of EDI users. In fact, academic research concerning EDI is limited. Practitioners currently write the vast majority of the articles about EDI and these articles tend to be anecdotal in nature.

Studying EDI was important for another reason. Researchers preferably study IOR in a network setting (Whetton 1981). Networks are formed by a set of individuals who have a high degree of interaction. Studying networks

requires defining the set of members and determining the degree of interaction among the members. A simplified process of determining the makeup of the network would ease the study of IOR considerably.

A network existed among the interrelationships of buyers and sellers connected by EDI. The EDI network has clearly defined members and interrelationships. The researcher can differentiate the users of EDI from non-users and the determine the extent of EDI use. Firms use EDI with only some of their trading partners. Thus, identifying the differences between their partners using EDI and those that do not may lead to a greater understanding of the buyer-seller interrelationship.

Oliver (1990) noted that few empirical studies contrast asymmetrical with reciprocal approaches. Asymmetrical approaches refer to differences in power, while reciprocal arrangements refer to sharing power. Reciprocity between a firm and its suppliers includes cooperation, collaboration, and coordination (Oliver 1990).

The level of cooperation between companies is a measure of how a firm responds to extraordinary requests from another company. Collaboration is the extent to which a firm works with another company in the planning stage, such as co-designing a product. Coordination is the extent to which a firm acts with another company for mutual benefit, such as co-scheduling production.

Applications that test asymmetrical and reciprocal contingency approaches in IOR are rare (Oliver 1990). This research attempted such a test. Thus, the results of this study expand both academic and practitioner knowledge. The organization of the study is discussed in the next section.

Organization of the Study

The researcher organized this study into five chapters. Each chapter is described below.

Introduction

The first chapter is an introduction of the text. It included a discussion of the: (1) statement of the problem, (2) purpose of the research, and (3) significance of the research.

Literature Review

Chapter two included a review of the literature of interorganizational relationships, channels of distribution, information technology, and electronic data interchange. The review included major schools of thought for IOR and a definition of a conceptual model of EDI use. Theoretical constructs were drawn from the review of literature to model variables of the interrelationships of firms and their trading partners. The research involved the contrast between the firm's inter-relationships with two classes of customers. The first class used EDI with the firm, and the

second class used the traditional paper-based purchasing systems.

Methodology

The research procedure and methodology employed in the study were discussed in chapter three. The chapter included a description of the instrument used to answer the research questions and an estimate of the validity and reliability of the instrument. The sample selection plan and hypotheses to test the research questions were presented. Finally, the statistical methodology used to test the hypotheses were discussed.

Results

The results and findings of the research were discussed in chapter four. Each research question was described separately.

Implications and Future Studies

The summary of the findings and implications of the research results were addressed in chapter five. Unusual findings associated with each research question were addressed individually. The managerial and theoretical implications of the research were discussed. Finally, areas for future research were suggested.

APPENDIX A

RATING INSTRUMENT

QUESTIONS BY TYPE OF VARIABLES

MODERATING

how many customers	1
initiating firm	2
managing firm	3

	INDEPENDENT	
	EDI USERS	NON-EDI USERS
DEPENDENT		
Reputation	4a x 20	4b x 20
Skill	sum of EDI and product	
EDI	5a x 21	5b x 21
Product	6a x 22	6b x 22
Indirect power	sum of entry, substitute, and rivalry	
Entry	15a x 31	15b x 31
Substitute	16a x 32	16b x 32
Rivalry	sum of service, quality, variety, price	
Service	7a x 23	7b x 23
Quality	8a x 24	8b x 24
Variety	9a x 25	9b x 25
Price	10a x 26	10b x 26
Direct power	sum of dollar and percent	
Dollar	11a x 27	11b x 27
Percent	12a x 28	12b x 28
Reciprocity	sum of request, plan, and act	
Request	17a x 33	17b x 33
Plan	18a x 34	18b x 34
Act	19a x 35	19b x 35
Efficiency	sum of cost and ease	
Cost	13a x 29	13b x 29
Ease	14a x 30	14b x 30

ELECTRONIC DATA INTERCHANGE USER QUESTIONNAIRE

This questionnaire is designed to determine the extent of your firm's use of electronic data interchange (EDI). There are no right or wrong answers. Your opinions will be kept anonymous and confidential. Thank you for answering the following questions. So that everyone can rate their suppliers in the same manner, please use the following definition of EDI in completing this survey.

Electronic Data Interchange (EDI) is a computer-based purchasing system in which a firm provides data in a standardized machine readable format. This minimizes the need for the trading partner to re-enter the data on its computer to perform the intended transaction.

EXTENT OF ELECTRONIC DATA INTERCHANGE USE

For the following three questions place a mark (X) in the blank in front of the <u>one</u> response that most indicates your firm's degree of EDI use.

1. With how many customers does your firm use EDI?

____ a. 5 or less
____ b. 6 to 10
____ c. 11 to 15
____ d. 16 to 20
____ e. 21 or more

2. Which company provided the initial driving force that induced your firm to start using of EDI?

____ a. your firm
____ b. one of your customers
____ c. one of your suppliers
____ d. one of your shippers
____ e. a third party, (i.e., a value added network)

3. Which company sets and maintains the computer software and hardware standards for the EDI network that you primarily use?

____ a. your firm
____ b. one of your customers
____ c. one of your suppliers
____ d. one of your shippers
____ e. a third party (i.e., a value added network)

please go to next page

For each statement circle the number from 1 to 9 to rate (a) the typical customer with which you use EDI and (b) the typical customer with which you do not use EDI. Please mark both.

	AVERAGE									
SIGNIFICANTLY BELOW AVERAGE	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**SIGNIFICANTLY ABOVE AVERAGE**

The amount of respect you hold for a customer with which										**BA**	**AA**
4.	a.	you use EDI	1	2	3	4	5	6	7	8	9
	b.	you do not use EDI	1	2	3	4	5	6	7	8	9
The expertise in using EDI by a customer with which											
5.	a.	you use EDI	1	2	3	4	5	6	7	8	9
	b.	you do not use EDI	1	2	3	4	5	6	7	8	9
The expertise in the product line by a customer with which											
6.	a.	you use EDI	1	2	3	4	5	6	7	8	9
	b.	you do not use EDI	1	2	3	4	5	6	7	8	9
The intensity of competing in customer service for a customer with which											
7.	a.	you use EDI	1	2	3	4	5	6	7	8	9
	b.	you do not use EDI	1	2	3	4	5	6	7	8	9
The intensity of competing in product quality for a customer with which											
8.	a.	you use EDI	1	2	3	4	5	6	7	8	9
	b.	you do not use EDI	1	2	3	4	5	6	7	8	9
The intensity of competing in product variety for a customer with which											
9.	a.	you use EDI	1	2	3	4	5	6	7	8	9
	b.	you do not use EDI	1	2	3	4	5	6	7	8	9
The intensity of competing in product pricing for a customer with which										**BA**	**AA**
10.	a.	you use EDI	1	2	3	4	5	6	7	8	9
	b.	you do not use EDI	1	2	3	4	5	6	7	8	9
The relative amount of purchases in dollars from a supplier with which											
11.	a.	you use EDI	1	2	3	4	5	6	7	8	9
	b.	you do not use EDI	1	2	3	4	5	6	7	8	9

The relative percentage of your purchases by a customer with which

12. a. you use EDI 1 2 3 4 5 6 7 8 9
b. you do not use EDI 1 2 3 4 5 6 7 8 9

The cost for you to process a typical purchase order by a customer with which	CHEAP							EXPENSIVE
13. a. you use EDI	1	2	3	4	5	6	7	8 9
b. you do not use EDI	1	2	3	4	5	6	7	8 9

The ease for you to process a typical purchase order by a customer with which	EASY							HARD
14. a. you use EDI	1	2	3	4	5	6	7	8 9
b. you do not use EDI	1	2	3	4	5	6	7	8 9

The ease of entering the market by potential suppliers for a customer

15. a. you use EDI 1 2 3 4 5 6 7 8 9
b. you do not use EDI 1 2 3 4 5 6 7 8 9

The ease of substituting products that you sell by a customer with which

16. a. you use EDI 1 2 3 4 5 6 7 8 9
b. you do not use EDI 1 2 3 4 5 6 7 8 9

For each statement circle the number from 1 to 9 to rate (a) the typical supplier with which you use EDI and (b) the typical supplier with which you do not use EDI. Mark both.

SIGNIFICANTLY UNLIKELY	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**NEUTRAL**	**SIGNIFICANTLY LIKELY**

The likelihood of responding to your extra-ordinary requests by a customer with which	**U**					**N**			**L**
17. a. you use EDI	1	2	3	4	5	6	7	8	9
b. you do not use EDI	1	2	3	4	5	6	7	8	9

The likelihood of joint planning with you, such as co-designing a product, for a customer with which

18. a. you use EDI 1 2 3 4 5 6 7 8 9
b. you do not use EDI 1 2 3 4 5 6 7 8 9

The likelihood of joint action with you, such as scheduling production, for a customer with which

19. a. you use EDI 1 2 3 4 5 6 7 8 9
b. you do not use EDI 1 2 3 4 5 6 7 8 9

For each statement circle the number from 1 to 9 to indicate how much importance the top management of your firm places on EACH of the following concepts when soliciting the typical customer.

NO IMPORTANCE 1 2 3 4	AVERAGE 5 6 7	VERY IMPORTANT 8 9

		NI				A				VI
20.	your respect of a customer	1	2	3	4	5	6	7	8	9
21.	skill in using EDI	1	2	3	4	5	6	7	8	9
22.	skill in the product line	1	2	3	4	5	6	7	8	9
23.	customer service	1	2	3	4	5	6	7	8	9
24.	product quality	1	2	3	4	5	6	7	8	9
25.	product variety	1	2	3	4	5	6	7	8	9
26.	product pricing	1	2	3	4	5	6	7	8	9
27.	average amount of purchases in dollars from a particular customer	1	2	3	4	5	6	7	8	9
28.	relative percentage of your purchases from particular customers	1	2	3	4	5	6	7	8	9
29.	cost of handling purchase orders for a customer	1	2	3	4	5	6	7	8	9
30.	ease of handling purchase orders for a customer	1	2	3	4	5	6	7	8	9
31.	ease of entry into the marketplace by potential suppliers	1	2	3	4	5	6	7	8	9
32.	customer's ability to substitute products of one supplier by others	1	2	3	4	5	6	7	8	9
33.	responding to customer's unusual requests	1	2	3	4	5	6	7	8	9
34.	working with customers in the planning stage of your operations	1	2	3	4	5	6	7	8	9
35.	working with customers in the action stage of your operations	1	2	3	4	5	6	7	8	9

Place a mark (X) in the blank in front of the one response which best describes you or your firm.

36. What is your position in the firm?

_____ a. chief executive officer
_____ b. purchasing manager
_____ c. sales manager
_____ d. management information systems officer
_____ e. secretary
_____ f. other (please state)_____

37. What is your highest level of education?

_____ a. no college
_____ b. some college
_____ c. completed a college degree
_____ d. some graduate college
_____ e. completed a graduate degree

38. What was the approximate amount of your firm's last years sales?

_____ a. under $ 50 million
_____ b. $ 50 to $ 149 million
_____ c. $ 150 to $ 249 million
_____ d. $ 250 to $ 499 million
_____ e. $ 500 to $ 999 million
_____ f. $ 1 billion and over

39. What is the approximate number of employees in your firm?

_____ a. 100 or less
_____ b. 101 to 250
_____ c. 251 to 500
_____ d. 501 to 999
_____ e. 1000 or more

Please circle the appropriate response to indicate how long, in years, you or your company have done the following.
How long has
40. a. your company been in existence?
1. 0-1 years 2. 2-3 years 3. 4-6 years
4. 7-9 years 5. 10 or more years

41. b. your company used EDI?
1. 0-1 years 2. 2-3 years 3. 4-6 years
4. 7-9 years 5. 10 or more years

42. c. you been with your current firm?
1. 0-1 years 2. 2-3 years 3. 4-6 years
4. 7-9 years 5. 10 or more years

43. d. you been in your current position?
1. 0-1 years 2. 2-3 years 3. 4-6 years
4. 7-9 years 5. 10 or more years

44. e. you been in the purchasing field?
1. 0-1 years 2. 2-3 years 3. 4-6 years
4. 7-9 years 5. 10 or more years

Estimate the extent to which your firm uses these policies and circle a number on the following scale. 1 represents zero use in your company, and 9 represents use in all products all the time.

POLICY	NONE ALL
45. just-in-time	1 2 3 4 5 6 7 8 9
46. quality control	1 2 3 4 5 6 7 8 9

For the following questions: Please circle the response which best estimates the proportion of business conducted by customers with which your firm uses EDI out of all your current customers.

EDI USE	**ALLOCATION PERCENTAGE**
47. number of customers	0-5 6-10 11-20 21-30 31-40 41-50 51-100
48. amount of purchases (dollar value)	0-5 6-10 11-20 21-30 31-40 41-50 51-100
49. number of purchase orders	0-5 6-10 11-20 21-30 31-40 41-50 51-100
50. number of transactions	0-5 6-10 11-20 21-30 31-40 41-50 51-100

Transactions include all actions to complete an order such as: ordering, receiving and handling partial orders, backorders, and verifying final receipts.

If you would like a copy of the results of this study please send me your business card or provide the information below.

NAME _____

ADDRESS _____

CITY _____

STATE _____

ZIP CODE _____

THANK YOU FOR YOUR PARTICIPATION. PLEASE PLACE THE COMPLETED SURVEY IN THE SELF ADDRESSED STAMPED ENVELOPE PROVIDED OR FAX YOUR RESPONSES TO ROB POOLE AT (817)-565-4394.

APPENDIX B

INDEX OF COMPETITIVE PRESSURE
KHANDWALLA'S ORIGINAL INSTRUMENT

Definition

In the study of 103 Canadian firms, competitive pressure on the firm from price, marketing, and product competition was defined as follows:

(a) There were three scales that measured the perceived intensity of each form of competition. The wording was How intense is each of the following in your main industry? Please circle the number in each scale that best approximates the actual conditions in it. If an item is not relevant to your industry, write N.A.

Competition in promotion, advertising, selling, distribution, etc. in main industry

virtually none a single seller in the market 1 2 3 4 5 6 7 Extremely intense (ie cigarettes, cars detergents, etc)

Competition in the quality and variety of products or services

virtually none (a homogeneous product or service such as a electric utility) 1 2 3 4 5 6 7 Extremely intense (such as the auto industry)

Price competition in industry

none monopoly 1 2 3 4 5 6 7 Extremely intense (cutthroat as in discount retailing)

(b) Three other scales measured the attention paid to these forms of competition by the firm's top management. The wording was:

How much attention does top management pay to the following characteristics of your main industry? In other words, considering their impact on long-term profitability or growth, how much importance does your top management attach to these aspects? Competition in quality and variety of products of service.

little importance	1	2	3	4	5	6	7	Extreme importance

Price competition in the industry

little importance	1	2	3	4	5	6	7	Extreme importance

Competition in promotion, advertising, selling, distribution, etc.

little importance	1	2	3	4	5	6	7	Extreme importance

(c) The rating of the intensity of a form of competition was multiplied by the rating of its importance. The positive square root of this product was taken to dampen the excessive variability in higher magnitude numbers. The three square roots were aggregated to secure an index of pressure on the firm through competition for patronage.

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