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AN EMPIRICAL ANALYSIS OF THE ASSOCIATION BETWEEN THE INTERCOMPANY EFFECTS OF ELECTRONIC DATA INTERCHANGE AND THE LEVEL OF COMPUTERIZATION AND INTEGRATION OF THE ACCOUNTING INFORMATION SYSTEM IN SMALL BUSINESSES

A Dissertation

Submitted to the Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Accounting

by
Maurice George Durler
B.S., Kansas State University, 1977
M. Acc., Kansas State University, 1978
May 1997

DEDICATION

This work is dedicated to:

My grandfather, the late Englebert Durler, who foresaw my future career when he nicknamed me "Professor" in my youth.

My parents, John and Pauline Durler, who have always been there with their support, no matter what my endeavor.

ACKNOWLEDGMENTS

I am deeply indebted to many friends, family, and colleagues for their assistance, and moral support, in completing this project.

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Finally, my thanks to all my fellow graduate students at LSU, and their spouses, keeping us all sane through some very difficult years was a group task. I am grateful for the friendship and emotional support we shared. Specific thanks to Steven and Koni, Phyllis, Jim and Cathy, Bob, and Gisele: special friends and confidantes.

Any shortcomings of this research are solely attributable to the author.

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ABSTRACT

This study investigates intercompany effects on the accounting information system (AIS) of small businesses when electronic data interchange (EDI) is implemented at the request of influential trading partners. The intercompany effects are examined by analyzing the association of the owner/manager's attitude toward computers, the owner/manager's perception that EDI was forced on the business, and the owner/manager's awareness of EDI benefits, with the level of AIS computerization and integration (AIS computerization).

Two groups of hypotheses are proposed. The hypotheses in the first group assert that an association exists between the level of AIS computerization, the owner/manager's general computer attitude, and the owner/manager's perception that EDI has been forced upon the company. The second group of hypotheses assert that an association exists between owner/manager knowledge, defined as awareness of EDI issues and benefits, and the level of AIS computerization.

General computer attitude is measured using the Computer Attitude Scale developed by Nickell and Pinto. The perception that EDI is forced and awareness of EDI issues and benefits are measured by scales developed in the

study. A variation of the Nolan computer growth model is used to measure the level of AIS computerization. Data is gathered from a nationwide sample of small businesses in the agriculture equipment dealer industry using a survey questionnaire. Correlation analysis and analysis of variance (ANOVA) are the primary statistical techniques employed in the study.

The results suggest an association exists between general computer attitude and the level of AIS computerization. The results also support the assertion that an association exists between EDI awareness and AIS computerization. While the analysis suggests a relationship exists between the owner/manager's perception that EDI is forced on the small business and the level of AIS computerization, additional study is required to understand the nature of that relationship. Overall, the results suggest a need for further research with respect to trading partner influences on owner/manager attitudes, perceptions, and behavior toward AIS technology.

INTRODUCTION

This study explores the association between the intercompany effect of electronic data interchange (EDI) and the level of accounting information system (AIS) computerization and integration in small businesses. This chapter introduces the major aspects and overviews the study. The chapter is organized as follows: First, the motivation for the research is discussed. Second, an overview of related prior research is presented. Third, an overview of the research hypotheses, testing methods, and results are provided. The chapter concludes with a summary section.

MOTIVATION

In recent years many small business owners have taken advantage of decreasing computer hardware prices and the availability of standardized software to automate many functions of their business. Previously, only large companies possessed the resources necessary to achieve high levels of computerization. In some situations these computers have transformed the AIS from primarily a manual structure into an integrated[1] computerized system providing the owners with timely information for decision making

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[1] Integrated applications share data between programs.

purposes. However, in other cases the computer has either not been utilized to improve the AIS, or efforts to do so have been relatively unsuccessful.

Why would such situations occur? One reason might be that the computer was originally purchased for a non-accounting purpose and the decision makers were unaware of its accounting related benefits, or had no desire to use it for that purpose. This reasoning is understandable when the original purpose for acquisition was not, or only remotely, related to the accounting process. For example, the computer was purchased for word processing or graphical design and the decision makers were satisfied with their existing manual AIS. However, this reasoning is not as apparent when the computer was purchased for a function, such as EDI, that is closely related to the accounting process. As suggested below, circumstances surrounding the computer acquisition may provide some insight in this regard.

Normally, decisions to acquire or expand company resources, including computer resources, are made by the internal management of that business. However, EDI can alter the circumstances regarding acquisition, or expansion, of computer systems in that it may be the decision of a trading partner rather than the owner, or managers, (owner/managers) that determine what is purchased

and when the purchase transaction occurs (Udo and Pickett 1994; Wang and Seidmann 1995). This EDI related phenomena is hereafter referred to as the intercompany effect.

In recent years many small businesses have acquired computer systems to support EDI (Walton 1994; Premkumar et al. 1994). The American Institute of Certified Public Accountants (AICPA 1996, p. 8) states that:

> There are essentially two types of EDI implementation:
>
> - Stand-alone EDI - ... Transactions are often printed, manually reviewed, and rekeyed for entry into the application system. In this situation, there is little change in the work flow...
>
> - Integrated - application-to-application EDI with integration of the receiver's and sender's computer systems (for example, order processing, fulfillment, and payment).

The greatest advantages of EDI are achieved when integration not only occurs within EDI applications but also between EDI applications and the AIS. Further benefits can be attained when applications within the AIS are also integrated. While some small businesses have chosen to computerize their accounting systems to gain these benefits, others have not. Accordingly, this study seeks to gain an understanding of whether an association exists between the intercompany effect and the level of AIS computerization and integration (computer growth) in a small business.

OVERVIEW OF PRIOR RESEARCH

Previous EDI studies have dealt primarily with implementations in large companies. Initially, costs to implement EDI were high enough that only large companies had the transaction volume to justify such systems. This study extends prior research, by investigating small business EDI implementations.

Also, previous research has focused on implementations where a large number of relatively small suppliers (manufacturers) were persuaded to use such systems by a small number of large customers (Premkumar et al. 1994; Udo and Pickett 1994; Walton 1994). In contrast, this study examines situations where a small number of large suppliers (manufacturers) influence the use of computer systems by a large number of relatively smaller customers (retailers). Since the large trading partner in this study is on the opposite side of the supplier/customer relationship than in prior studies, AIS functions directly affected by EDI are different (i.e. purchasing versus sales). This difference may affect how EDI influences the extent of computer integration in the AIS.

Research in the area of computer growth originated with observations of large companies. Recent studies have expanded this research to small businesses. However, this research has concentrated on situations where decisions

regarding the acquisition and expansion of computer resources have been made internally by the management of the company. This study extends research in this area by investigating computer growth when acquisition and expansion decisions were influenced, to varying degrees, by the decisions of external trading partners.

OVERVIEW OF RESEARCH HYPOTHESES AND METHODS

To gain an understanding of whether an association exists between the intercompany effect of EDI and the level of AIS computerization and integration in a small business, two groups of hypotheses are tested. The first group examines the association between the small business owner/manager's attitude toward computers and EDI with the computerization of the AIS. These hypotheses postulate that a negative attitude, whether developed before implementation of EDI, or after, will hinder computerization. The second group explores the association between awareness of EDI issues and AIS computerization. The hypotheses in this group theorize that the more aware the owner/manager becomes about EDI benefits, the more EDI serves as a catalyst for the computerization of the AIS.

A survey questionnaire is used to gather data regarding attitude, awareness and usage from owner/managers in an industry using EDI. This data is then used to determine the current level of AIS computerization, and the

owner/manager's attitude toward computers, perception that EDI was forced on the business, and awareness of EDI benefits. A three stage computer growth model (Telem 1989) is used to measure the extent of computer growth and integration. The study hypotheses are then tested using various statistical tools including Analysis of Variance (ANOVA), and regression analysis.

The results of these tests generally support the overall assertions of the two groups of hypotheses. However, not all specific hypotheses are supported. While the overall results of the study suggest that an association exists between the intercompany effect of EDI and the level of AIS computerization and integration in a small business, future research is needed to further clarify the nature of this association.

SUMMARY

While prior research has studied computerization of the AIS in small businesses, little research has investigated the intercompany effect occurring when trading partners must coordinate computer applications in order to implement technologies such as EDI. This study uses two groups of hypotheses to explore this intercompany effect. The first group looks at the intercompany effect on owner/manager attitudes and computer growth. The second scrutinizes the intercompany effect on owner/manager

awareness of EDI benefits and computer growth. Computer growth is measured using a three stage model developed by prior researchers. The results from tests of the hypotheses provide general support for the overall study assertions.

LITERATURE REVIEW

INTRODUCTION

This chapter provides a review of the literature relevant to this study. For organizational purposes this chapter is presented in three sections: Electronic Data Interchange, Computer Growth Models, and Computer Usage in Small Businesses. The first section reviews how EDI affects the AIS of a company, the intercompany nature of EDI, and how adoption of EDI by small businesses differentiate from large businesses. Computer growth concepts and models are discussed in the second section. In the third section, relevant literature related to computer usage in small businesses is reviewed. The relationship between growth models and small business computer use is also discussed in this section. A summary concludes the chapter.

ELECTRONIC DATA INTERCHANGE

EDI is defined as, "an exchange of electronic business documents between economic trading partners, computer to computer, in a standard format" (Chan et al. 1995). EDI systems have been in existence for more than twenty years. Pioneer efforts in the transportation, drug, food and grocery, and railroad industries were instrumental in the development of the technology and standard setting process

(Chan et al. 1995; Walton 1994). However, in recent years EDI usage has expanded into retail and international trade as hardware costs have decreased and software has become more available. Wal-Mart, Ford Motor Co., American Airlines, and Dillard's Department Stores are a few well known companies using EDI (Clolery 1994; Udo and Pickett 1994; Wang and Seidmann 1995).

Typical EDI systems have a computerized data entry function, a translating function which transforms the input data into a format for transmission, and a communication function that transmits the formatted data over a telecommunications network to the trading partner's computer. The data entry is often integrated with inventory, sales, and production applications. Once received, the trading partner processes the data, without the need for new data entry procedures. The processed results may then include data transmitted back to the originating partner.[2]

---

[2] Electronic ordering systems (EOS) have essentially the same characteristics as EDI. The hardware technology is essentially the same, computers, modems, and a telecommunications network, and the software is also similar in its application. To an end user the applications would appear identical. In general the major difference between an EOS and EDI is the lack of industry and cross-industry standardized data formats.

The two types of systems are similar enough that much of the literature for each is relevant for both and many research studies have referred to EDI systems which may in fact not strictly fit the Chan et al. (1995) definition. This study intends to investigate the general

Documents frequently exchanged electronically include purchase orders, invoices, payment orders, and other documents, all of which are usually generated by the AIS. The AIS is a collection of resources designed to transform financial, and other data, into information (Bodnar and Hopwood 1995). This collection of resources consists of the people, manual procedures, computer applications, and data storage methods (paper or electronic) used to record and communicate the economic events of the organization. It also includes internal controls designed into the system to safeguard resources, ensure reliability and accuracy, and assure company objectives are met (Wilkinson 1989).

Economic events, also called transactions, may be grouped according to four common cycles of business activity, revenue, expenditure, production, and finance (Bodnar and Hopwood 1995). These cycles can be individually described as follows: The revenue cycle consists of events related to the distribution of goods and services to other entities and the collection of related payments. Events related to the acquisition of goods and services from other entities and the settlement of related obligations make up the expenditure cycle. The production

---

characteristics of implementing EDI and not the technical details, therefore the term "EDI" will be used to refer to any system for exchanging information between trading partners that exhibit the general characteristics of EDI.

cycle describes events related to the transformation of resources into goods and services for sale. The finance cycle consists of those events related to the acquisition and management of capital funds and providing financial reports to interested external users (Bodnar and Hopwood 1995; Wilkinson 1989). All of these cycles are potentially affected by EDI as transactions are generated and entered into the AIS by trading partners instead of internally. The integrity of the data now relies upon both the internal controls within the organization and the internal controls of the trading partner.

EDI will also typically have a substantial impact on the accounting functions in the AIS related to inventory, sales, and accounts payable. These functions become more integrated to take advantage of the electronic format of EDI. The procedures for input and review must also be changed to accommodate the new environment (Clolery 1994).

The magnitude of the impact EDI has on the AIS is demonstrated by the importance attributed to EDI by the Information Technology Research Subcommittee of the American Institute of Certified Public Accountants (AICPA). This group is charged with monitoring information technologies and identifying their impact on the accounting profession and business practices in general. In 1994, and again in 1995, EDI was identified by this subcommittee as

that technology with the most significant impact on the profession in the foreseeable future AICPA 1994; AICPA 1995).

EDI differs from most other information technologies in that it involves intercompany implementation rather than intracompany implementation. Accordingly, relationship dynamics between companies play a greater role with respect to such implementations, and maintenance of the systems, versus other information technologies (Wang and Seidmann 1995). Since EDI involves the computer-to-computer exchange of information, a basic requirement of the technology is that all parties use computers.

Initially only large companies purchased computers due to their high cost, large size, and special environmental requirements. However, during the past decade smaller, cheaper computers have allowed small businesses to introduce computerization into their operations as well. A recent impetus for some small businesses to acquire their first computer has been EDI requirements imposed by a larger business partner (Clolery 1994; Premkumar et al. 1994; Wang and Seidmann 1995; Udo and Pickett 1994). In some cases a large dominant business partner (e.g. a customer or vendor) can influence or demand how and when a smaller partner implements EDI related technology.

Companies normally adopt a new technology when its benefits are greater than its costs. Companies can expect some of the following benefits from using EDI (Chan et al. 1995; Premkumar et al. 1994; Udo and Pickett 1994; AICPA 1996):

- Improved customer service, usually through quicker response time
- lower inventory costs
- lower administrative costs, typically from reduced paperwork
- greater accuracy, due to less clerical error
- decreased manufacturing and operations costs
- improved control of data
- competitive advantages leading to increased sales

When surveyed, most large companies respond with variations of the benefits listed above, which are primarily economic in nature, as the reason for adopting EDI (Walton 1994; Premkumar et al. 1994).

However, while some small businesses adopt EDI for the economic reasons above, some studies have found that a primary reason for adopting EDI by small business is influence, sometimes as a mandate, from larger trading partners (Walton 1994; Udo and Pickett 1994; Clolery 1994; Wang and Seidmann 1995). Maintaining intercompany relationships therefore appears to be a primary reason for small businesses to adopt EDI. Instead of adopting EDI for

a variety of economic benefits derived from greater efficiency and improved information resources, it appears many small business concerns tend to adopt EDI for one basic economic purpose, to continue doing business with a significant trading partner.

There may be a number of reasons why small businesses do not perceive EDI providing the same benefits larger companies achieve. EDI is especially beneficial when a large volume of transactions are processed, but many small businesses may not achieve the transaction volume necessary to realize these benefits (Wang and Seidmann 1995; Premkumar et al. 1994). Also, even with rapidly decreasing costs, the investment in computer hardware and software may still be substantial for a small business. In addition, small business owners often lack sufficient knowledge of the technical issues of EDI and may fear the operational, administrative, and physical changes involved. They may also be concerned about data security given that EDI requires electronic communication systems between partners.

If the primary reason for adopting EDI is due to external influence, small business owners may be reluctant to adopt EDI and therefore do so grudgingly. Many small business owners may even resent an "iron-fist" approach by a large trading partner demanding EDI adoption (Udo and Pickett 1994; Premkumar et al. 1994; Wang and Seidmann

1995). This resentment may affect the attitude the small business owner/manager has regarding all the technology related to EDI, which may then affect the growth of computer usage within the small business.

Much of the early literature regarding EDI dealt with relatively technical issues dealing with implementation problems, merits of use, and industry specific case studies (Premkumar et al. 1994). More recent studies have started to explore the aspects of intercompany relationships. For example, through personal interviews, phone interviews and survey questionnaires, Walton (1994) examined the marketing and logistics channels of EDI in the transportation industry and found that reduction of product demand uncertainty, due to the strategic relationships EDI creates between trading partners, was an important reason for adoption. However, her findings also indicate that while shippers adopt EDI pro-actively, their unilateral power mandates EDI adoption by carriers (i.e. the relatively smaller carriers adopt EDI as a reaction to demands from shippers). A few other studies have investigated the intercompany relationships of EDI. These include examination of innovation diffusion between companies (Premkumar et al. 1994), and an analytical modeling of strategies for encouraging trading partners to adopt EDI (Wang and Seidmann 1995).

COMPUTER GROWTH MODELS

The concept of a stage model to describe the growth of computer resources within companies was postulated by Churchill, Kempster, and Uretsky in 1969. Four stages, labeled as Types 1-4, were identified. A major distinction was made between the first two, clerical applications, and the last two, managerial oriented applications. Applications in the first stage were essentially just faster and cheaper versions of existing manual systems. In the second stage, applications extended or improved earlier applications in terms of efficiency or more comprehensive reporting. Applications that integrated previously separate systems or incorporated decision processing into the programs were introduced in the third stage. Finally, in the fourth stage, applications extend into the strategic decision making of senior management and allow for ad hoc queries (Churchill, Kempster, and Uretsky 1969).

A more significant effort toward development of a model of computer growth has been the Nolan stage model (Benbasat et al. 1984). Stage theory is based on the premise that elements in systems move through a pattern of distinct stages over a period of time and that these stages can be described (Nolan 1973). Initially Nolan (1973) described four stages for describing computer growth within a company: initiation, contagion, control, and

integration. Table 2.1 has detailed descriptions of these stages. This model was later refined and expanded by Nolan based on additional observations that indicated computing growth continued beyond what had originally been considered the maturity stage. Instead of leveling out, as predicted by the four stage model, continued growth in computing costs were observed. The original fourth stage was renamed as "integration" and two additional stages, data administration and a new "maturity" were added (Nolan 1979). Descriptions of the stages for the six stage model are also included in Table 2.1. One important concept underlying the Nolan model is that as computer growth progresses, management begins to view the computer as a resource for information, rather than as just a source of improved efficiency. This is similar to Churchill's (1969) assessment of progression of the computer from a tool for efficiency to a managerial decision resource.

Nolan (1979) identifies six benchmark variables that can be used to assess the stage of a company's data processing. These are: budgeted costs, technology, application portfolio, IS organization, IS planning and control, and user awareness. Table 2.2 provides Nolan's descriptions of the characteristics of these variables at each stage. Various studies have sought to empirically test the validity of the Nolan six stage model. Several

Table 2.1
Nolan Stage Model

1973 Model	1979 Model	Description
Initiation	Initiation	Introduction of computing into the organization to meet basic needs; slow growth in use; beginning of problems caused by computing's role as a "change agent"; little management response to these problems; decentralized control; minimal planning. Few applications are installed, control is lax, and planning is almost non-existent.
Contagion	Contagion	Rapid growth in computing use due to top management commitment to exploiting computing potential plus high expectations among users; rapid rise in costs; top management search for controls to contain cost growth; beginning of centralization; little increase in planning. Development is encouraged through greater slack, but lack of planning results in systems of poor design quality.
Control	Control	Problems from poor design cause difficulties for management so control becomes tighter; the advent of data communications and distributed systems increase expectations but users almost give up on getting what they want because of excessive controls and the cost of chargeback systems. Top management begins to think in terms of data resources rather than computer resources.
Maturity	Integration	Controls refined to allow exploitation of computing without runaway costs; planning well established; users more knowledgeable and capable in their uses of computing; operations more rational; economic analyses (e.g. cost benefit analysis) used to set priorities for new systems; chargeout systems modified to ease restriction on use; system analysts sometimes decentralized to user departments to encourage improved systems development; centralization/decentralization decisions made in light of organizational and business strategy; growth slowing markedly, but new investments bringing greater marginal benefits. In this stage database systems are brought in to help the move toward data resource management.
	Data Administration	Focus of computing management turns to data administration. Control of computing resources is tight but slack is maintained in development of systems that bring high added value in terms of data resources.
	Maturity	The applications portfolio is "complete" and the structure of the company's computerized information structure mirrors the organization and information flows of the company.

Source: Data from King, John L., and Kenneth L. Kraemer. 1984. Evolution and Organizational Information Systems: An Assessment of Nolan's Stage Model. *Communications of the ACM* 27 (5, May):466-75.

TABLE 2.2
Characteristics of Benchmark Variables for Each Nolan Stage

Stages / Benchmarks	Initiation	Contagion	Control
DP expenditures	same as rate of sales growth	exceeds rate of sales growth	is less than rate of sales growth
Technology	100% batch processing	80% batch 20% remote job entry processing	70% batch, 15% database, 10% inquiry, 5% timesharing processing
Applications Portfolio	Functional cost reduction applications	Proliferation	Upgrade documentation and restructuring of existing applications
DP Organization	Specialization for technological learning	User-oriented programmers	Middle management
DP Planning & Control	Lax	More lax	Formalized planning and control
User Awareness	"Hands off"	Superficially enthusiastic	Arbitrarily held accountable

Stages / Benchmarks	Integration	Data Administration	Maturity
DP expenditures	Exceeds rate of sales growth	is less than rate of sales growth	same as rate of sales growth
Technology	50% batch and remote job entry, 40% database, 5% personal, 5% mini/micro computer	20% batch and remote job entry, 60% database / communication, 5% personal, 15% mini/micro computer	10% batch and remote job entry, 60% database / communication, 5% personal, 25% mini/micro computer
Applications Portfolio	Retrofitting existing applications using database technology	Organization integration of applications	Application integration "mirroring" information flows
DP Organization	Establish computer utility and user account teams	Data administration	Data resource management
DP Planning & Control	Tailored planning and control systems	Shared data and common systems	Data resource strategic planning
User Awareness	Accountability learning	Effectively accountable	Acceptance of joint user and data processing accountability

Source: Reprinted from Benbasat, Izak, Albert S. Dexter, Donald H. Drury, and Robert C. Goldstein. 1984. A Critique of the Stage Hypothesis: Theory and Empirical Evidence. *Communications of the ACM* 27 (5, May): 476-85.

are summarized by Benbasat et al. (1984) and King and Kraemer (1984). Overall, the results of these studies dispute the validity of using budgeted cost as a single surrogate measure of the element determining the growth stage, but not the stage model itself. Drury (1983) evaluated whether the collective use of these variables would reliably classify firms into the six Nolan stages. His results indicate that the direction of the scale for each variable is consistent with progression from lower to higher stages of DP development (Drury 1983).

In general, despite some questions regarding measuring the stages, many researchers believe the stage model concept remains valid and continue to use it as a basis for information system research. For example, a study of user involvement and organizational context as factors for perceived information system usefulness used a framework based on the stage model (Franz and Robey 1986). More recently, Premkumar et al. (1994) examined innovation diffusion of EDI using the stage model to determine whether large companies should provide incentives for EDI use.

COMPUTER USAGE BY SMALL BUSINESS

The literature related to small business covers a wide range of topics. That portion related to information systems topics generally fall into one of three classifications: prescriptive studies offering advice or

methods for selecting computer hardware and software, survey studies of the status of computer usage, and studies of computer applications in managerial decisions (Cooley, Walz, and Walz 1987). Some of the literature in the second category is useful for determining whether computer usage patterns exist and are therefore relevant to this study.

Cheney (1983) collected data from a representative sample of small firms, by questionnaire and interviews, regarding four computer related issues: 1) hardware and software considerations, 2) support considerations, 3) success considerations, and 4) implementation problems. Among other things, the survey results indicate that small firms tend to use computer systems initially for accounting related functions such as general ledger, payroll, accounts receivable, invoicing, and accounts payable (Cheney 1983). Several other surveys corroborate that accounting functions are typically among the first to be computerized by small businesses (Farhoomand and Hrycyk 1985; Nickell and Seado 1986; Holzinger and Hotch 1993; Hotch 1995). One common characteristic of these studies is that computer acquisition and expansion are determined by internal decision makers.

A research agenda for studying computer implementation in small businesses is described by Cooley, Walz, and Walz (1987). A call is made for research to determine if the

stages identified by Nolan (1973, 1979) are valid for small business entities. Small firms may benefit from the experience of large firms if the model of the computing environment is equivalent. However, it is noted that small firms have unique characteristics which should be taken into account in adapting the Nolan model when researching small business computer usage.

Key differences regarding resources, structure, maturity, and decision time frames exist between large and small businesses regarding computers and information technology (IT).[3] Specifically, small businesses differ in that they often (Magal and Lewis 1995):

- Lack needed resources
- Spend a smaller portion of their sales on computer operations
- Have less in-house computer expertise
- Have fewer persons dedicated to computer systems
- Spend a greater portion of their IT budget on hardware instead of software or personnel
- Have a more centralized IT function, that is higher in the organization
- Have little IT planning

---

[3] The terms information technology and computer technology are often used synonymously in the literature. The term information technology has become more popular recently as issues beyond the computer hardware are studied.

- Have less experience since they have been using computers for a shorter time
- Have not matured with the data processing industry
- Tend to implement few sophisticated applications

In spite of these limitations, successful IT implementation is important for a small business because of its potential to play a significant role in improving the efficiency of operations, effectiveness of decision making, and the firm's overall competitiveness.

Magal and Lewis (1995) examine the effect of four determinants on IT growth in small businesses: race, attitude, awareness, and use. Race is measured in terms of black/non-black ownership. The Computer Attitude Scale (CAS) (Nickell and Pinto 1986) is used to measure attitudes. Lists of common software were provided to measure awareness and use. Using a five point Likert scale (Likert 1932; Menezes and Elbert 1979), respondents indicated the extent they were familiar with or used the applications. Use therefore, was determined by the number of applications with a use measurement above one on the scale. Awareness was measured in a similar fashion. Race proved to be consistently insignificant, awareness and attitude significant. Results indicate that small businesses use IT primarily for efficiency improvement since simpler applications such as accounting and word

processing were the predominant uses (Magal and Lewis 1995).

Using the Cooley, Walz, and Walz agenda, and the Nolan stage model, motivators and inhibitors relating to computing growth in small manufacturing businesses in the engineering industry were investigated by Cragg and King (1993). Interviews with the "person responsible for computing" (Cragg and King 1993, p. 49) were conducted for a sample of six privately held firms with fewer than fifty employees. The results indicate variations of the Nolan stage model can be applied to small business concerns.

In an attempt to apply the Nolan stage model to Israeli schools in the 1980s, Telem (1989) notes that models based on observations of large companies may need to be modified to consider those characteristics unique to smaller organizations. He listed five characteristics related to computer usage which differentiated small organizations from the large corporations used to construct the Nolan model (Telem 1989, p. 446):

- hardware usually consists of one or a few networked or unnetworked microcomputers.
- there is an absence, or only one or perhaps two, of ... DP professionals.
- there is a paucity of expertise in the MIS field among personnel.
- managers themselves ... play the role of computer operator and/or prepare or enter the data and/or use the information.

- the software is developed by an external developer.

While Telem was referring to schools in Israel, several researchers have noted similar characteristics in many small for-profit businesses (Udo and Pickett 1994; Magal and Lewis 1995; Montazemi 1988). Telem also notes that developments in information technology, particularly the microcomputer, have changed the environment from what existed when Nolan presented his six stages. These environmental changes, including the microcomputer's increase in performance, dramatic reduction in cost, and availability of interactive and user-friendly software, provide tools to the small organization that were unavailable for even large organizations earlier. He therefore, postulates that "For this reason, small organizations that begin to automate in the 1980s do not have to move through the same MIS growth stages as did large organizations that started to automate in the early or late 1970s" (Telem 1989, p. 446). Consequently, the six stages of Nolan's model are collapsed into three stages by Telem. Table 2.3 describes Telem's modified Nolan stage model. This modified version of Nolan's stage model provides a basis for evaluating whether small business firms experience computer growth similar to large organizations.

Table 2.3
Telem Adaptation of Nolan Stage Model

Label	Description
Initiation	The computer is introduced into one or more systems in the small organizations. Information integration is nonexistent at first but develops gradually. A communications network usually does not exist. Focus is on time and labor consuming clerical activities. There are the beginnings of an integration of basic automated office tools.
Contagion	Initial problems of establishing and operating the logistic infrastructure of the information system are overcome and it begins to become an integral part of the organization's activity. Increase information integration is achieved. Attention is shifted to information functions such as organizing, planning, directing, controlling, and staffing. Additional automated office tools such as electronic mail are introduced. Use of the system is geared toward achievement of the organization's goals.
Maturity	The system become fully assimilated as an integral part of the small organization's structure and activities. The user pool expands to include all functionaries. A totally integrated database assists in synchronization of the organization's systems, improvement of decision making, and reinforcement of managerial control and supervision. Office tools are integrated with data management tools.

Source: Data from Telem, Moshe. 1989. Managing Information Growth and Integration in Small Organizations. *Information Processing and Management* 25 (4):443-52.

SUMMARY

Literature related to three major areas of interest, electronic data interchange, computer growth models, and computer usage by small businesses, were discussed in this chapter. Relevant studies in each area were presented and reviewed. EDI impacts a company's AIS by altering how data enters and/or leaves the system. Data related to economic transactions, traditionally recorded by internal procedures, enter the system via external trading partner data transmitted directly into the AIS. This alters the company's ability to impose internal controls and increases the reliance on the other party's control procedures for reliable and accurate data. The decision to implement EDI may also differ from other technology implementations due to its intercompany nature. Though EDI provides numerous economic benefits, a small business may implement EDI solely to maintain trading partner relationships rather than for other economic benefits. The decision makers of the small business may therefore perceive EDI as forced on them and this in turn may affect their attitude toward related technology used in the AIS. Early EDI studies concentrated on technical issues, recently however, intercompany behavioral issues have also been addressed.

Computer growth models embody the concept that the expansion of computer usage in an organization occurs in

distinct stages. A significant example of such a model is the Nolan stage model developed from observations of computer usage in large organizations. This model, or variations thereof, can be used as a basis to measure the extent of computerization and integration of the AIS.

Small businesses are unique and differ from large organization in several respects. One difference is that the initial purchase of a computer by a small business is typically accounting related and involved with the automation of the AIS when the decision is internal. However, the purchase of a computer for EDI purposes involve external influence which may significantly alter usage and growth patterns. Another difference is that owner/manager awareness and attitude toward technology are more significant factors for computer growth. Though studies have shown that the Nolan stage model for computer growth can be applied to small business research, the unique characteristics of small businesses, including owner/manager awareness and attitude, should be considered. A modified version of the Nolan model, by Telem, incorporates these differences and may be a more useful model for small business research.

HYPOTHESES AND RESEARCH DESIGN

INTRODUCTION

Hypotheses useful for investigating the intercompany effect of EDI and the level of AIS computerization and integration, and a research design for testing those hypotheses are developed in this chapter. To facilitate these two purposes, the chapter is organized into two major sections, hypotheses and research design, with appropriate subsections in each. The chapter concludes with a summary.

HYPOTHESES

Introduction-Hypotheses

A six stage model describing the growth of computer usage in companies was developed by Nolan (1979). Telem (1989) modified this model to a three stage model to fit the characteristics of small business. The basic premise of these models is that computer growth in an organization will progress from an initial stage of initiation, where the primary objective is to increase efficiency of operations through the use of computers, to a maturity stage, where the objective is effective use of information for decision making. To achieve this latter objective, computer applications become increasingly integrated.

Cragg and King (1993), and Magal and Lewis (1995), found that the owner's knowledge and enthusiasm toward

computing were significant motivating factors for computer growth in a small business. The two studies also found lack of owner support and knowledge to be significant inhibiting factors. However, internal decision makers decided on computer acquisition and expansion in the companies investigated by both Cragg and King (1993) and Magal and Lewis (1995). Are the same factors significant when external parties influence computer acquisition, use, and expansion decisions? To answer this question, this study will test two groups of hypotheses, an attitude group and an awareness (knowledge) group to determine if these factors also affect computer growth in circumstances where external parties have significant influence by requiring the use of EDI.

Attitude Hypotheses

Though not explicitly stated, the stage growth models assume that internal management are making the decisions regarding computer related purchases. In other words, decisions regarding computer growth are intracompany decisions. Implementations of EDI alter this basic assumption in that the technology involves intercompany decisions between trading partners. In some cases a dominant trading partner, typically a large company, has the economic power to significantly influence adoption of EDI by the other company. This influence may even be to

the extent of determining the hardware, software, and training choices of the weaker partner. If the smaller trading partner adopts EDI only to placate a larger trading partner, some researchers have speculated that management may resent the situation (Udo and Pickett 1994; Premkumar et al. 1994; Wang and Seidmann 1995). This may inhibit them from gaining an awareness of EDI benefits to exploit the technology to its full extent. However, little empirical evidence is available to support this assertion.

It is also possible that the owner/manager had a negative attitude toward computers before the trading partner requested the use of EDI. Such an attitude may induce the owner/manager to believe EDI was forced upon the business. A negative attitude may also inhibit gaining an awareness of EDI benefits to take advantage of the technology through the use of an integrated system.

Accordingly, if would be interesting to know if an association exists between a negative attitude toward computers and a perception that EDI was forced upon the business. The following hypothesis, stated in the alternative, will therefore be tested:

H1a: Owner/managers who have a negative attitude toward computers will also believe EDI systems were forced on them.

Either a negative attitude toward computer technology, or a perception that EDI was forced upon the business, may

inhibit expansion of systems beyond the minimum required to deal with the trading partner. Since a company achieves the greatest benefit from EDI when applications are fully integrated, little or no integration with other applications would be expected in such situations. Such firms would be expected to remain at the initiation stage in Telem's model for an extended time period. The following hypotheses, stated in the alternative, will therefore be tested.

H1b: The computer systems at companies with owner/managers with a negative attitude toward computers will be at the initiation stage of the Telem model.

H1c: The computer systems at companies with owner/managers who perceive EDI as forced upon the business will be at the initiation stage of the Telem model.

H1d: The computer systems at companies with owner/managers with a positive attitude toward computers will be at the contagion or maturity stage of the Telem model.

H1e: The computer systems at companies with owner/managers who do not perceive EDI as forced upon the business will be at the contagion or maturity stage of the Telem Model.

Awareness Hypotheses

Alternatively, a small business owner/manager may view a request by a trading partner to adopt EDI as an opportunity to improve the overall operations of the company. Instead of reacting negatively, the owner/manager may seek to become aware of the benefits of EDI and related technology. This awareness may, in turn, create a positive attitude toward computers in general which may increase the

likelihood that the AIS will be further computerized. The following hypothesis may thus be tested:

H2a: Owner/managers with a positive attitude toward computer technology will have an awareness of EDI benefits.

Since EDI is most beneficial when it is fully integrated with a company's operations, management of a small company that is cognizant of EDI advantages may choose to integrate computer applications earlier than the Nolan or Telem models would predict to take advantage of EDI benefits. The accounting applications would be fully integrated with EDI and operations applications. Such firms therefore would be at the contagion or maturity stage of the Telem model, either bypassing or quickly moving through the initiation stage. Since EDI benefits are realized through integrated applications, and integrated applications are characteristics of the contagion and maturity stages of Telem's model, the following hypotheses will also be tested.

H2b: The computer systems at companies with owner/managers with an awareness of EDI benefits will be at the contagion or maturity stages of the Telem model.

A stronger hypothesis regarding the effect of an owner/manager's awareness of EDI benefits may also be postulated. If awareness is a key factor in determining the extent of AIS computerization, then it may moderate any negative effect related to a perception that EDI was forced

upon the business by a larger trading partner. Faced with implementing EDI, the owner/manager may choose to learn more about the technology. While still resentful about the circumstances related to the introduction of EDI technology, the recognition of EDI advantages may induce the owner/manager to take steps to achieve these benefits. To evaluate this supposition the following hypothesis will be tested.

H2c: The computer systems at companies with owner/managers who perceive EDI as forced upon the business and have an awareness of EDI benefits will be at the contagion or maturity stages of the Telem model.

Figure 3.1 illustrates hypothesis H2c as a 2 X 2 matrix with each panel representing one of the four possible outcomes. The lower right panel represents the hypothesized outcome when only a weak perception exists that EDI has been forced upon the dealer and a high awareness of EDI benefits exists. The predicted Telem stage for this situation is maturity, although contagion would support the hypothesis. The upper left panel represents a situation where a strong perception EDI is forced and a low awareness of EDI benefits exist. The hypothesized Telem stage in this case is the initiation stage. The upper right panel illustrates the hypothesis that awareness of EDI benefits will outweigh the negative influence of a perception EDI was forced, resulting in a Telem contagion, or possibly maturity, stage. The lower

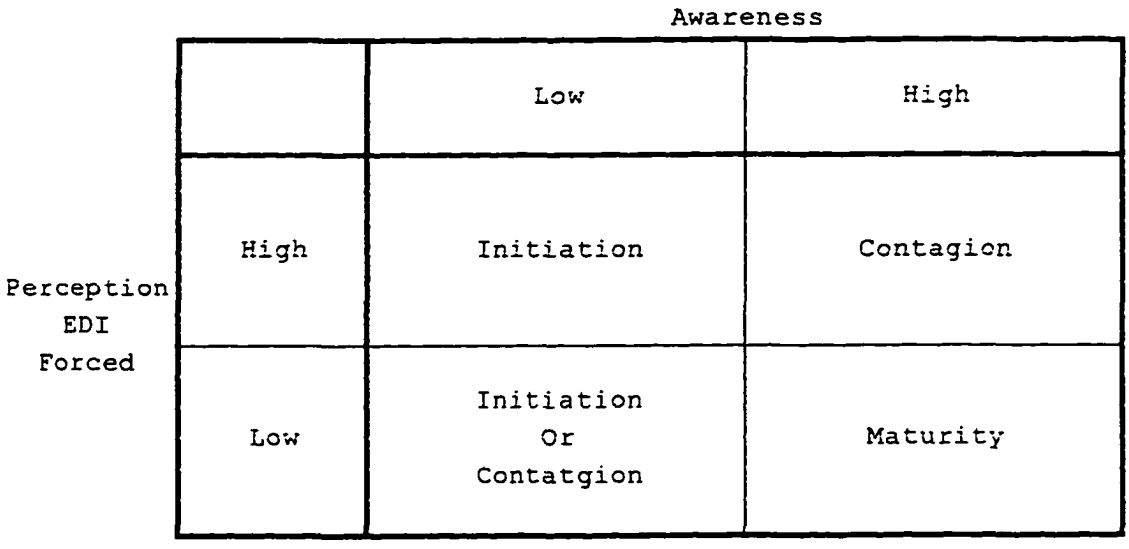

Figure 3.1
H2c: Forced EDI and Awareness

left panel, on the other hand, indicates that the outcome is unknown when a low awareness of EDI benefits exist along with a low perception that EDI is forced. The most likely outcome would be the initiation Telem stage, but could be contagion.

Hypotheses Interaction

Figure 3.2 illustrates the interaction of the two groups of hypotheses as a two by two matrix. The two possible factors, attitude and awareness, each have two possible values. Four possible outcomes are therefore expected as indicated by the intersections of the factor possibilities, the Telem stages of initiation or contagion and maturity.

The lower right panel of the figure represents the situation where the respondent has both a positive attitude and an awareness of EDI benefits. Hypothesis H2b, and H1d, suggests that the outcome should be the maturity stage for this situation. However, the contagion stage is a transitional stage on the way to maturity, therefore, the hypotheses would still be supported if a respondent is at that stage. The upper left panel represents the situation where the respondent has both a negative attitude and a lack of awareness of EDI benefits. Hypotheses H1b, and H2b, suggests that the company would remain at the initiation stage under these circumstances.

Attitude Toward Computers	Awareness: Low	Awareness: High
Negative	Initiation	Unknown
Positive	Unknown	Maturity

Figure 3.2
Attitude and Awareness Hypotheses Interaction

The remaining two panels represent outcomes when the combination of attitude and awareness results in one being positive/high and the other negative/low. Evaluating the stage of computer growth for respondents who fit into these panels of the matrix will help determine which factor may be more significant in determining the extent of computerization, awareness or attitude. If the results indicate the initiation stage is the outcome for either panel, then the negative/low factor is more important in predicting the extent of computerization. If the results indicate contagion or maturity are the likely outcomes, then the positive/high factor is more important.

Summary-Hypotheses

Two sets of hypotheses for testing the intercompany effect of EDI on the level of AIS computerization and integration were developed above. The first set considers the relationship between the attitude of owner/managers toward EDI and computers, and computer growth. The second set deal with the relationship between owner/manager awareness, or knowledge, of EDI benefits and computer growth. The interaction of the two sets of hypotheses is then discussed.

RESEARCH DESIGN

Introduction-Research Design

This section is divided into four subsections. The sample criteria subsection describes the characteristics of the sample firms. Data collection method describes the various data collection methods that could have been used and the reason for choosing the mail survey method. The type of data collected is described next and tied to specific questions in the survey. The criteria used for a pre-test survey and the results of that survey are then discussed. The section is concluded with a summary.

Sample Criteria

To test the above hypotheses, relevant data was collected from a sample of small business firms that have implemented EDI and have a dominant trading partner. While EDI usage has increased significantly in recent years, it is likely firms using it are still a relative minority of the general population of small business firms. This study identified a single industry with a group of small businesses using EDI and obtained data from those firms. Selecting a sample from a single industry provided a relatively homogeneous sample group which aided in the control of confounding factors. The selected industry also has the characteristic of a small group of large dominant suppliers that have advocated the use of EDI. The sample

group exhibits relatively homogeneous general characteristics, but sufficient independence exists regarding factors relevant to the study questions.[4]

The industry selected for the study is the agricultural equipment dealer (ag dealer) industry. The agriculture equipment sector of the economy consists of a small number of large, full-line, manufacturers (e.g. John Deere, AGCO, Caterpillar, and Case), a larger number of smaller specialty manufacturers, and a large number of relatively small dealers. Manufactured products (whole goods) are distributed through networks of independently owned small businesses (dealers) that purchase the equipment for resale to the eventual end users, farmers. The ag dealer industry is similar to the automobile dealer industry in that most dealers are affiliated with one of the large manufacturers. While many dealers also carry goods from one or more specialty manufacturers, a large

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[4] Several industries have a large number of small businesses and either one or a small group of economically powerful trading partners. Examples include: Defense contractors, where the federal government is a single dominant customer; aircraft parts suppliers where Boeing, and a few others, have sufficient economic power to influence manufacturing quality control procedures; the U.S. automobile manufacturing and distributing industries where General Motors, Ford, and Chrysler yield considerable economic influence on both parts suppliers as major customers and on dealer networks as major product suppliers; and the travel industry where the major airlines have considerable influence with travel agents due to their reservation systems. Some of these industries also use EDI for intercompany communication.

portion of the whole goods sold and the majority of repair parts for those whole goods come from their affiliation with a single large manufacturer.

However, while auto manufacturers have exerted considerable influence on the accounting information systems of their dealers, this is less common in the agriculture industry. Therefore, unlike the automobile industry, dealers (with the possible exception of John Deere dealers) have considerably more independence regarding the internal operation of their computer and accounting information systems. In the past five to ten years most of the major manufacturers have implemented systems with EDI features that the dealers use to place parts orders (Kramer 1995). These industry characteristics made the industry a good candidate for the sample selection for this study. See Appendix 1 for more information about the ag dealer industry.

Data Collection Method

Two primary means of collecting data for the study were possible, the interview (either face-to-face or telephone) and the survey questionnaire (Berdie, Anderson, and Niebuhr 1986; Dillman 1978). While face-to-face interviews typically provide high quality data per respondent, difficulty in locating respondents and the cost of traveling to locations to conduct interviews were

primary disadvantages of using this method for this study. Another problem was the time required to conduct a large number of interviews, whether face-to-face or by telephone. This time could have been decreased by expanding the number of interviewers but this would have increased costs and introduced interviewer differences and biases (Berdie, Anderson, and Niebuhr 1986).

Mail survey questionnaires, on the other hand, are a cost effective and timely method of contacting a large, geographically dispersed sample (Berdie, Anderson, and Niebuhr 1986; Dillman 1978). The primary disadvantage of mail surveys is the potential for low response rates, which may decrease the quality of the data collected (Berdie, Anderson, and Niebuhr 1986; Dillman 1978). However, with sufficient response rates the data collected in this manner is of the same essential quality as can be obtained with interview (Berdie, Anderson, and Niebuhr 1986; Dillman 1978). Appendix 2 discusses ways to improve response rates.

For purposes of efficiency, timeliness, and a desire to obtain data from a nationwide sample, a survey questionnaire was the primary means employed in this study for data collection. The questionnaire was mailed to a representative sample of ag dealers. Background information was obtained from agriculture equipment

manufacturers to insure terminology used on the questionnaire encouraged response. Questionnaire design was also discussed with a dealer representative in order to develop a questionnaire that would gather a large amount of data yet be, and appear, easy for dealers to complete. Follow up mailings were conducted to ensure an adequate number of responses were received. See Appendix 3 for a copy of the survey questionnaire.

Data Collected

To test the hypotheses, four types of data were collected: 1) data regarding the owner/manger's attitude towards computers and EDI, 2) data regarding the owner/manager's awareness of EDI and computer related issues, 3) data for classifying the computer growth stage of the respondent company, and 4) demographic data regarding the company and parts purchases. All questions related to the respondent's attitude are contained in section three of the questionnaire. Some questions are worded in a negative framework to reduce wording bias. The scores for those questions must then be reversed for data analysis. The attitude and awareness data are used to compute four composite variables: Computer Attitude - attitude toward computers in general, Perception EDI Forced - perception that EDI was forced on the respondent, Awareness of EDI Benefits - a measure of an awareness of

certain AIS related EDI benefits, and EDI Attitude - attitude toward using EDI for parts purchases. Data for two additional composite variables, Self-reported Telem Stage and Telem Stage, are also collected. The composite variable Telem Stage is a measure of each respondent's computer growth stage computed from the data. The Self-reported Telem Stage is also a measure of each respondent's computer growth stage but based on self-reported classifications using six growth characteristics. The demographic data describes other sample characteristics.

Computer Attitude

To determine the owner/manager attitude toward computers, the questionnaire includes, as questions thirty, and forty-eight through fifty-six, the Nickell and Pinto short form CAS as used by Magal and Lewis (1995). This scale is also reproduced in Table 3.1 and consists of ten questions answered on a scale of one to five, where one means the respondent strongly disagrees and five is strongly agree. Additional questions specifically related to EDI and the circumstances regarding its use and introduction in the company are included on the questionnaire as questions thirty-one through forty-seven.

To determine a score for the respondent's attitude toward computers, answers for the negative questions (49, 50, 52, 53, 55, and 56) are first reversed, then the scores

Table 3.1
Short Form of the Computer Attitude Scale

1.	Computers will never replace human life
2.	Computers make me uncomfortable because I do not understand them.
3.	People are becoming slaves to computers.
4.	Computers are responsible for many of the good things we enjoy.
5.	Soon our lives will be controlled by computers.
6.	I feel intimidated by computers.
7.	There are unlimited possibilities of computer applications that have not even been thought of yet.
8.	The overuse of computers may be harmful and damaging to humans.
9.	Computers are dehumanizing to society.
10.	Computers can eliminate a lot of tedious work for people.

Each question is answered on a Likert scale of 1 (disagree) to 5 (agree). To score the answers for the negative questions (2,3,5,6,8, & 9) are reversed and the scores averaged. A score of 1 indicates an extremely negative attitude toward computers, a score of 5 is an extremely positive attitude, and a score of 3 is neutral.

Source: Reprinted from Magal, Simha R., and Cedric D. Lewis. 1995. Determinants of Information Technology Success in Small Businesses. *Journal of Computer Information Systems* 35 (3, Spring):75-83.

for the ten questions are averaged. A score of one indicates an extremely negative attitude toward computers, a score of five an extremely positive attitude, and a score of three is considered neutral.

Perception EDI Forced

Questions thirty-one, thirty-five, and thirty-nine are used to determine if the respondent perceives EDI as forced upon the business. The answer for thirty-five is reversed, then the three are averaged to obtain a score. A score of five indicates the respondent believes EDI is forced on trading partners, a score of one indicates the respondent does not believe EDI is forced.

Awareness of EDI Benefits

A similar procedure is used to determine the respondent's EDI awareness using questions thirty-two through thirty-four, thirty-six through thirty-eight, forty, and forty-one. The answers for questions thirty-two, forty, and forty-one are reversed, then an average score is determined. A score of five indicates an extremely high awareness of EDI advantages, while a score of one indicates a low awareness, three is neutral.

EDI Attitude

Questions forty-one through forty-seven are used to determine the respondent's attitude toward EDI. Question forty-one is used for both the EDI awareness score the EDI

attitude score. To determine an EDI attitude score, answers to questions forty-one, forty-three, forty-five, and forty-seven are reversed, then an average score is computed from the seven questions. A score of five indicates an extremely favorable attitude toward EDI, one indicates an extremely negative attitude, three indicates a neutral attitude.

Telem Stage Variables

The level of computerization and integration is measured by the Telem stage. The Telem stage is measured two ways, a self reported method, Self-reported Telem Stage, and a computed method, Telem Stage. Both variables use criteria based on the Nolan and Telem growth models.

While Nolan used budgets and computer cost expenditures as a surrogate variable to measure transition from one stage to another, the changing cost structure of computer equipment during the past decade makes it difficult to use cost to measure growth stages in this study. Since significant growth in computer capability can now be achieved at a cost substantially lower than the original cost of the replaced equipment, a comparison based solely on cost would likely indicate a decline in computer capacity when growth actually occurred. Therefore, cost data was not gathered.

Telem (1989) uses six features to describe the difference between computer growth stages and includes a table to illustrate these features. That table is recreated here as Table 3.2. The general nature of these growth features, with some modification and clarification, are used in this study to determine the growth stage of each sample respondent. Table 3.3 lists the Telem growth features and the criteria which are used in this study to classify respondents into the three stages, initiation, contagion, or maturity.

The self reported score is determined from questions fifty-seven through sixty-two in section three of the questionnaire. Each respondent is asked to match their current situation with descriptions of the three stages for each growth feature. A composite score is then determined by finding the average of the six questions. This composite score is the Self-reported Telem Stage value.

The composite variable, Telem Stage, is a computed score that classifies each respondent's Telem stage based on several survey data items primarily included in section one of the questionnaire. The following formula is used for the classification process:

$$TS = \frac{CF + T + N + I + D_1 + D_2}{F}$$

Table 3.2
Growth Features Using Telem Stages

Growth Features	Growth Stages		
	Initiation	Contagion	Maturity
No. of computerized systems	Few	Many	"All"
No. of microcomputers or computer terminals	One to few	Few to many	All relevant locations
Communication network	None	Partial	Full
Intersystem Integration	None	Large	Full
Clerically oriented usage	Most	Less	Low
Information usage for Decision Support Systems (DSS) and Group DSS	Local. if at all	Little	Most
Automated office tools use	Few	Many	Full
MIS and automated office tools integration	None	Low to medium	Full
Information integration	From none to medium	From medium to very high	Full

Source: Reprinted from Telem, Moshe. 1989. Managing Information Growth and Integration in Small Organizations. *Information Processing and Management* 25 (4):443-52.

Table 3.3
Criteria for Stage Classification

Growth Features	Growth Stages		
	Initiation	Contagion	Maturity
No. of computerized systems	EDI, some accounting	EDI, accounting, some other functions	EDI, Accounting, other operations functions
No. of microcomputers or computer terminals	1-3	Multiple computer/terminal with sharing	All regular users have own computer/terminal
Communication network	No LAN, Stand-alone computer(s)	Simple LAN such as Lantastic or a multiuser computer	Sophisticated LAN such as Novell or a multiuser computer
Intersystem Integration, Information Integration	1-3 applications, accounting & EDI applications only no database use	up to 2/3 applications checked, all accounting plus other	over 2/3 applications checked
Clerically oriented usage, Information usage for Decision Support Systems (DSS) and Group DSS, Automated office tools use	users are: parts personnel, clerical staff. Manager rarely uses computer Applications are: Primarily Accounting applications	users are: parts personnel, clerical staff, regular but non-daily computer use by manager Applications are: Accounting and limited other applications	users: all personnel use, manager uses daily. Applications are: Wide variety of applications including accounting
MIS and automated office tools integration	no database use	Spreadsheet and some database use	Database usage

where:

TS = Telem stage (initiation, contagion, maturity based on total score)
CF = Number of computerized functions (standardized and scaled from 1 to 3)
T = Number of terminals or microcomputers (standardized for company size and scaled from 1 to 3)
N = Network (0-no network, 1-simple PC network, 2-sophisticated PC network, 3-multiuser computer with multiple terminals)
I = Extent of integration (1-accounting only, 2-accounting and other, 3-accounting, other, and database)
D_1 = Who uses the system (1-clerical and staff, 2-staff and department managers, 3-staff, managers, and owner/manager)
D_2 = Types of applications (1-basic accounting functions only, 2-all accounting functions, 3-accounting and other)
F = number of features used to determine Telem stage.

These variables are related to specific questions on the questionnaire as follows:

CF - Number of computerized functions:

Several studies indicate that accounting applications are the first functions computerized by small companies followed by integration into other operations areas as computer usage matures (Cheney 1983; Farhoomand and Hrycyk 1985; Nickell and Seado 1986; Holzinger and Hotch 1993; Hotch 1995). Therefore, questions eight and nine are used to determine the number of computerized systems used at the company.

T - Number of microcomputers or computer terminals:

Questions four and five gather this data directly. Further clarification is determined by using questions

seven and eight. The number of terminals is standardized by dividing by the number of employees to control for company size. Companies at the initiation stage are expected to have fewer, and less sophisticated, computers. Companies at the contagion and maturity stages are expected to have multi-user computers with multiple terminals or a network of microcomputers.

N - Communication network:

Communication networks connect two or more computers, or terminals, and provide the ability to share applications and data. Such sharing is necessary to realize the benefits of EDI through integration of applications. The extent that communication networks are utilized is determined by inquiring whether the company uses a local area network (LAN) or a mid-range computer with multiple terminals. Presence of a communications network place a company at the contagion or maturity stage. Lack of a network indicates the company is at the initiation stage. Question four gathers information to determine if a communication network exists. Local area networks are classified into simple or sophisticated based on the underlying operating system used. The answer to question four is further clarified using answers to questions five, six, seven, and eight. In addition, question eleven is used to verify the existence of a multi-user system since

single-user systems are less likely to have access limitation capabilities. Aspects of this clarification process were performed when entering the data.

I - Intersystem Integration and Information Integration:

In addition to determining the number of computerized systems, questions nine and ten are used to determine the extent functions are computerized and integrated. At the initiation stage only accounting applications and applications directly related to the EDI requirements of the trading partner would be expected to be computerized. Companies at the contagion or maturity stages would have most or all accounting and many non-accounting functions computerized. Another indication of system and information integration is the use of client/server[5] or database oriented applications instead of stand-alone or flat-file

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[5] In a client/server environment processing for an application is performed on two or more computers. The functions of the application are separated into four components: the database management system (DBMS), the user task, the database, and the database policies. The DBMS is a "master program" that controls the storage and retrieval of data. The user task is the program which processes the data for the specific user application desired, the data obtained via the DBMS. The database contains the actual data. Finally, the database policies are the security and integrity protocols that protect the data from corruption and unauthorized access (Bodnar & Hopwood 1995). In a client/server environment these components are performed on at least two separate computers. Typically the user task is performed on one computer, the client, and the remaining tasks are done by the server.

applications.[6] Question ten includes database systems in the list of applications.

D_1 - Clerical Orientation, Decision support (DSS), and Automated office Tools:

Number of users and types of applications are used to classify respondents for these purposes. Question seven specifically inquires who uses the system and is used as the primary source for determining whether users are performing clerical or managerial tasks. In general, the more users who use the computer on a regular basis, the more likely the company is at the contagion or maturity stage. An indication that owners and managers do not use computers on a regular basis indicates a clerically oriented usage. Since decision making is a principle activity of management, daily use of computers by owners and managers indicates DSS systems exist. Data gathered from question eight is used to confirm and/or validate the type of use.

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[6] Stand-alone and flat-file are used as terms to describe applications where software programs create and maintain all data files within the programs for that application alone. Each application has its own data files even if the data is the same as that used by another application. Databases on the other hand have data independence. All applications share data held in common data files which are maintained independent of which applications use the data.

D - Automated office tool use, MIS, and automated office tools integration:

Basic accounting applications, such as accounts payable, inventory, and accounts receivable are more clerically oriented. Word processing is also typically more clerically oriented. The more accounting and non-accounting functions are performed on the computer the more likely integration exists between the applications. Questions nine and ten are used to gather data regarding the types of applications. If word processing and only a small number of accounting applications are checked, the company is more likely at the initiation stage. If most accounting applications and a few other applications are checked, the company is likely to be at the contagion stage. Substantially all accounting and a large number of applications indicate the company is at the maturity stage.

Data regarding parts purchases is gathered to determine the extent EDI is used for this purpose and to obtain some demographic data about the respondent company's size and operations. However, the primary determinant used for company size is the number of full employees. Questions regarding the frequency of parts orders, methods used to place the orders, and internal control procedures are also included to gather additional data regarding EDI awareness and use. Some of these data items are employed

in the statistical analysis as control variables. Since manufacturer affiliation may influence computer usage, this information was also requested. Various other information useful for classifying respondents was also requested.

Sample Selection

A list of ag dealer names and addresses was obtained from a commercial list broker. Information supplied by the broker indicated a population of approximately 9,000 possible dealers. Two groups of dealer names and addresses were purchased. A small group, used for a pre-test survey, consisted of only dealers in the state of Louisiana. The second group was a randomly selected (by the list broker) of dealers nationwide and was used to collect study data.

The pre-test sample constituted the entire population of Louisiana dealers available through the broker. Inspection of this list revealed that some dealers had multiple locations. A determination of which site most logically represented the primary business location was made and duplicate locations were eliminated. Fifteen sites were removed from the mailing list in this manner. The remaining one hundred sites were mailed a survey.

Forty-four completed surveys were returned from the pre-test mailing for a 44% response rate. This was a higher than expected response rate, believed to be due to the influence of Louisiana State University letterhead and

a loyalty of in-state dealers to the state's flagship, and agriculture related, university. No significant differences were shown between different cover letter formats or question organization. Therefore, only minor changes were made to the survey questionnaire based on an analysis of the responses. The pre-test survey did show a slight response bias toward dealers affiliated with one full-line manufacturer (i.e. John Deere). A preliminary evaluation of the nationwide distribution of dealers suggested that this bias would not likely occur with regard to the main survey. Subsequent results did not indicate the existence of a similar bias.

The nationwide sample list initially consisted of 1,000 dealer names and addresses.[7] A random sample of businesses with the SIC code of 5083-10 (Farm Equipment) excluding any that also had the SIC code of 5511 (Automobile Dealers) was requested. An analysis of this list revealed that the criteria provided to the list broker should have specified that only businesses with a primary SIC code of 5083-10 be selected. The address list received included several companies in which farm equipment sales

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[7] One hundred-fifty usable responses are required for statistical significance. An initial target response rate of 30% was desired, therefore at least 500 surveys had to be mailed. Since a safety margin was desired, the study design called for at least 750 surveys. However, the addresses for the nationwide group could only be purchased in increments of 500, therefore 1,000 names were purchased.

constitute a secondary source of sales and is not the primary line of business. Thus some manufacturers and other non-relevant businesses were initially included in the sample. An initial analysis of the list eliminated 118 such businesses, leaving 882 names and addresses determined to be valid for the mailing.

Summary-Research Design

The discussion of the research design of the study was presented in four subsections. The subsection on sample criteria describes characteristics required for the sample firms. The ag dealer industry met these requirements: an industry using EDI with a large number of small business with independence in selection of AIS components and a small number of dominant suppliers. The data collection method describes relative merits of various data collection methods that can be used and reasons for choosing the mail survey method. The type of data used by the study was described in the next subsection and tied to specific questions in the survey. This includes data regarding the owner/manager's attitude toward computers and EDI, awareness of EDI issues, data for determining the growth stage of each sample company, and other demographic data. In the final subsection, the acquisition of survey mailing lists and the results of a pre-test survey were discussed.

SUMMARY

The study hypotheses and research design were described in this chapter. Two sets of research hypotheses were developed. The first set postulate the association between owner/manager attitude and computerization and integration in the AIS. The second set of hypotheses deal with the association between owner/manager awareness, or knowledge, of EDI and the level of computerization and integration in the AIS. The interaction of the two sets of hypotheses is also discussed.

Several issues of the research design are then presented and discussed. A sample industry is determined, data collection methods discussed, and data requirements ascertained. Specific data required to test the hypotheses are then tied to the data collection instrument to be used and sample selection is discussed.

ANALYSIS AND RESULTS

INTRODUCTION

This chapter is presented in two main sections. The first section provides an analysis of the effectiveness of the survey procedures and resulting response characteristics. The second section describes the analysis of the data collected with the survey. A summary section concludes the chapter.

SURVEY ANALYSIS

Introduction-Survey Analysis

A discussion of an analysis of the survey is presented in two parts: Survey response rates, and survey response bias tests. The first part discusses the response rates for returned surveys using various base (denominator) amounts. The second reviews various tests performed to determine if significant bias exists between surveys returned and those not returned. A summary concludes the discussion.

Survey Response Rates

Table 4.1 illustrates various response rate information regarding the mailing. Response rates are reported based on three different base terms, total number mailed, number of "good" addresses, and dealers only. The good address base is determined by subtracting the net

TABLE 4.1
Response Rates

	Total Mailed		Good Addresses		Dealers Only	
	Count	Percent	Count	Percent	Count	Percent
Mailed	882	100.0%	852	100.0%	837	100.0%
Undeliverable	30	3.4%	n/a	n/a	n/a	n/a
Returned:						
Manufacturer	4	0.5%	4	0.5%	n/a	n/a
Non-dealer	11	1.2%	11	1.3%	n/a	n/a
Incomplete	20	2.3%	20	2.3%	20	2.4%
Usable	189	21.4%	189	22.2%	189	22.6%
Total returned	224	25.4%	224	26.3%	209	25.0%

count[6] of surveys returned by the postal service as undeliverable from the total mailed. As shown in Table 4.1, 224 responses were received for a general response rate of 25.4%. However, only 189 of the responses returned are determined to be usable for a response rate of 21.4% using the total mailing as a base. Surveys were determined to be unusable for two reasons, the survey is missing key data, or the respondent is not actually an ag dealer. Using the good address base number a general response rate of 26.3% and a usable response rate of 22.2% were obtained. The corresponding response rates using only ag dealers as the base amount are 25.0% for the general rate and 22.6 for the usable rate. Overall, the response rate is less than the pre-test rate of 44%,[9] but still adequate for statistical analysis of the data.

Survey Response Bias Tests

Response bias can be a problem when using surveys to gather research data (Fowler 1984; Ferber 1948; Armstrong and Overton 1977; Goudy 1978; Jones and Lang 1980). Response bias refers to differences between people that

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[6] New addresses were found for some of the undeliverable surveys from the initial mailing. These were re-sent and are not included in the net count of undeliverable.

[9]As previously discussed, the high pre-test response rate of 44% is attributable to certain special circumstances, i.e. geographical and institutional loyalty.

complete and return the survey and those that do not. If respondents differ from non-respondents in some systematic way then the data may be biased and inferences to the population as a whole may not be possible. This would cause validity problems for the research. Several tests for possible respondent bias can be used. The most common are: the non-parametric runs test, and comparison of the means of early responders with late responders for statistically significant differences (Fowler 1984; Ferber 1948; Armstrong and Overton 1977).

The non-parametric runs test can indicate if a biased pattern possibly exists for selected factors. A runs test uses the order in which surveys are received and observes whether surveys fall above or below a selected cut-off point for a selected variable. A significant number of surveys on one side of the cut-off point received in a row would indicate a pattern of response may exist. To test for response bias the number of runs is determined. A run is counted each time a survey is on the opposite side of the cut-off point than the previous survey. The larger the number of runs observed in a sample, the less likely a pattern of response exists. The runs test is particularly useful when the sample size is small, but may be used for a larger sample as a quick method for evaluating possible problems needing more analysis. Table 4.2 reports the

TABLE 4.2
Runs Tests for Response Bias

	Cut-off=median		Cut-off=mean	
Variable of Interest	Number of Runs	Significance	Number of Runs	Significance
Attitude score	97	0.7754	98	0.6658
Forced perception	88	0.7967	90	0.4277
EDI awareness	89	0.6623	89	0.6623
EDI attitude	99	0.5306	99	0.5306
Number of computers	95	0.5913	74	0.4586
Years using computer	87	0.3061	87	0.3061
Number of PCs/Terminals	87	0.3329	81	0.8009
Percent of employees using computer	88	0.4183	88	0.4183
Submit parts electronically	69	0.9084	69	0.9084
Self reported Telem Stage	77	0.6449	91	0.9935
Number of full-time employees	86	0.4047	70	0.2921
Number of computer professionals	n/a	n/a	76	0.9658
AGCO dealer	n/a	n/a	55	0.0594
Case/IH dealer	n/a	n/a	61	0.8846
Caterpiller dealer	n/a	n/a	9	0.7503
Ford dealer	n/a	n/a	45	0.8359
Gehl dealer	n/a	n/a	25	0.3028
John Deere dealer	n/a	n/a	87	0.9689
Kubota dealer	n/a	n/a	46	0.3012
Massey dealer	n/a	n/a	41	0.0987
New Holland dealer	n/a	n/a	59	0.097
Other dealer	n/a	n/a	69	0.7286
Computed Telem Stage	95	0.979	87	0.3978

number of runs for several questionnaire variables. The runs test does not indicate any response bias for the variables examined.

When the respondent sample is large enough, statistical comparisons of the group means of early versus late responders for selected variables can also be used to test for response bias (Fowler 1984). To perform such tests the 189 usable survey questionnaires are divided into four groups based on order received. The group means for several variables are then compared between groups for significant differences. Significant difference in the means may indicate that early responders differ in some systematic way from later, and more significantly, non-responders. That would imply that those responding have some bias that motivates them to respond that the general population under study does not have. Table 4.3 reports the results of ANOVA tests of the groups means of several survey questionnaire variables. These results indicate that two variables tested, forced EDI and EDI awareness, may exhibit some response bias. A closer analysis of EDI awareness indicates that the awareness variable has outlier data in groups three and four. Re-analysis of the data without these outlier values (Neter, Waserman, and Kutner 1985, p. 115) indicates no meaningful problem of response

TABLE 4.3
Response Bias Test-Groups by Order Received

Variable of Interest	Probability that no pair of means differ	
Computer Attitude score	0.4278	
Forced perception	0.0365	*
EDI awareness	0.0577	
EDI attitude	0.7706	
Number of computers	0.0923	
Years using computer	0.7780	
Number of PCs/Terminals	0.2286	
Percent of employees using computer	0.6323	
Submit parts electronically	0.7822	
Purchased Computer for EDI use	0.3003	
Years ago started using EDI	0.6699	
Percentage of Parts Ordered with EDI	0.8585	
Self reported Telem Stage	0.6588	
Number of full-time employees	0.2097	
Number of computer professionals	0.6928	
AGCO dealer	0.1899	
Case/IH dealer	0.7435	
Caterpiller dealer	0.5820	
Ford dealer	0.7305	
Gehl dealer	0.0874	
John Deere dealer	0.2505	
Kubota dealer	0.6076	
Massey dealer	0.2255	
New Holland dealer	0.8526	
Other dealer	0.6335	
Computed Telem Stage	0.3011	

*- Significance difference at .05 level between groups for variable, using Bonferroni method

bias exists for this variable in that no significant differences were then found between the groups.

The forced EDI variable measures the extent the respondent perceives EDI as forced upon the dealer by manufacturers. A closer look at this variable does indicate the sample may contain a slight bias in favor of early responders having a stronger belief that EDI has been forced on their business. However, a regression line plotted on the data indicates that the slope of the line, while significant, is small enough (-.0027, with a y intercept of 3.7556) that it does not influence an interpretation of the results and is unlikely to present validity problems applying the results to the population. Also, since no other variable indicates a bias between groups it appears that while those that perceive EDI as being forced upon them appreciate an opportunity to vent their frustration by answering the survey, they do not constitute a unique group that are non-representative of the population as a whole.

Ag dealers are distributed unevenly among the 50 states since agriculture is more predominate in some states than others. Some manufacturers' sales may also be concentrated in specific regions of the country. In addition, agriculturally related busy seasons may differ between various areas of the country and the survey may

have been administered during one region's such season. These geographical differences could create response bias in the data. To test if any geographical response bias exists, the percentage of the total respondents from each state are compared to same state's percentage of the total mailing. Table 4.4 illustrates this comparison. Statistical comparison of the relative percentage of surveys mailed to each state versus the relative percentage returned from each state indicate no significant differences are shown to exist on a geographical basis.

Summary-Survey Analysis

In summary, a response rate between 20% and 25% was obtained with the survey questionnaire, depending on the base amount used. This provides an adequate number of responses to achieve a representative sample of the ag dealer population. Various tests indicate non-respondents do not differ significantly from respondents based upon the data analysis, with the exception of a small bias toward those perceiving EDI as being forced upon their business having responded earlier. Thus, these results indicate that the data collected appear to be a representative sample of the population under study and conclusions may be extended to the entire population.

TABLE 4.4
Response by State

	Mailing		Responses		Usable Responses	
State	Count	Percent of Total	Count	Percent of Total	Count	Percent of Total
AK	4	0.5	1	0.4	1	0.5
AL	13	1.5	6	2.7	5	2.6
AR	20	2.3	6	2.7	5	2.6
AZ	4	0.5	0	0.0	0	0.0
CA	34	3.9	5	2.2	2	1.1
CO	17	1.9	7	3.1	6	3.2
CT	2	0.2	0	0.0	0	0.0
FL	11	1.2	2	0.9	2	1.1
GA	16	1.8	2	0.9	2	1.1
HI	1	0.1	0	0.0	0	0.0
IA	47	5.3	19	8.5	18	9.5
ID	11	1.2	2	0.9	2	1.1
IL	51	5.8	10	4.5	8	4.2
IN	29	3.3	10	4.5	8	4.2
KS	40	4.5	8	3.6	7	3.7
KY	29	3.3	6	2.7	5	2.6
MA	3	0.3	2	0.9	1	0.5
MD	5	0.6	1	0.4	1	0.5
ME	3	0.3	2	0.9	2	1.1
MI	17	1.9	2	0.9	1	0.5
MN	49	5.6	14	6.3	11	5.8
MO	43	4.9	13	5.8	10	5.3
MS	24	2.7	7	3.1	7	3.7
MT	13	1.5	3	1.3	2	1.1
NC	15	1.7	1	0.4	1	0.5
ND	26	2.9	4	1.8	3	1.6
NE	32	3.6	7	3.1	6	3.2
NH	1	0.1	1	0.4	1	0.5
NJ	4	0.5	0	0.0	0	0.0
NM	2	0.2	0	0.0	0	0.0
NV	1	0.1	1	0.4	1	0.5
NY	16	1.8	5	2.2	4	2.1
OH	41	4.6	11	4.9	10	5.3
OK	20	2.3	7	3.1	7	3.7
OR	8	0.9	0	0.0	0	0.0
PA	28	3.2	11	4.9	8	4.2
SC	9	1.0	1	0.4	1	0.5
SD	14	1.6	5	2.2	5	2.6
TN	16	1.8	1	0.4	0	0.0
TX	46	5.2	8	3.6	7	3.7
UT	7	0.8	2	0.9	2	1.1
VA	24	2.7	7	3.1	7	3.7
VT	6	0.7	2	0.9	1	0.5
WA	11	1.2	3	1.3	3	1.6
WI	58	6.6	18	8.0	15	7.9
WV	8	0.9	1	0.4	1	0.5
WY	3	0.3	0	0.0	0	0.0
Total	882	100.0	224	100.0	189	100.0

DATA ANALYSIS

Introduction-Data Analysis

The data obtained from the survey questionnaire is the primary source of information for the study. The following sections describe statistical tests performed to evaluate the nature of this data and to test the study hypotheses. Supplemental tests that provide insight about the study phenomena are also described. A summary is then provided.

Descriptive Analysis of Data

Small Business Classification

The scope of the study is limited to the growth of AIS computerization in small businesses. Size of a company can be measured by volume of sales or number of employees. The United States Small Business Administration classifies an ag dealer as small if it has fewer than one hundred employees (Small Business Administration 1996). Number of employees is also used by this study to determine if a respondent is a small business. Table 4.5 provides summary information regarding the number of employees of ag dealers in the study sample. Only one of the usable respondent companies has greater than one hundred employees (115). This count is not significantly greater and the company exhibits no other characteristics which serve to differentiate it from other respondents. Therefore all of the usable responses are determined to represent small

TABLE 4.5
Information About Employees

Number full time employees			
Description		Frequency	Percent
Less than Ten		79	41.7
Ten to Nineteen		54	28.6
Twenty to Twentynine		28	14.8
Thirty to Thirtynine		11	5.8
Forty to Fortynine		6	3.2
Fifty to Fiftynine		3	1.6
Sixty to Sixtynine		2	1.1
Seventy to Seventynine		0	0.0
Eighty to Eightynine		1	0.5
Ninety to Ninetynine		0	0.0
Over one hundred		1	0.5
Data not supplied		4	2.1
Total		189	100.0
Mean	16.514	Median	15
Std dev	15.607	Mode	5

Number part-time employees			
Description		Frequency	Percent
None		51	27.0
Less than Five		127	67.2
Five to Nine		9	4.8
Ten or greater		1	0.5
Data not supplied		1	0.5
Total		189	100.0
Mean	2.394	Median	3
Std dev	1.775	Mode	3

Number of computer professionals			
Description		Frequency	Percent
None		136	72.0
Only one		28	14.8
Two to Four		20	10.6
Five to Nine		3	1.6
Ten to Fifteen		1	0.5
Data not supplied		1	0.5
Total		189	100.0
Mean	0.644	Median	0
Std dev	1.501	Mode	0

businesses and are included in the analysis. Greater than 94% of the responses are from ag dealers with fewer than fifty employees.

Since a large number of part-time employees could indicate a size effect not identified by measuring full-time employees, Table 4.5 also includes information regarding number of part-time employees. The data does not indicate a large use of part-time employees by the industry. Table 4.5 also included information about the number of employees that can be classified as computer professionals as that may also influence the level of computerization of the AIS. The data indicates a majority of ag dealers do not employ full-time computer professionals.

Number of Computers

Number of computers is an important factor in determining the current Telem stage of computer growth. The number of computers reported by the respondents is provided in Table 4.6. A majority, approximately 60%, of the respondents have at least one computer, but less than four. Almost eleven percent (10.6) of the respondents have no computer. Less than ten percent have ten or more computers. However, number of computers may not be a clear indication of the level of computerization of the respondent since some computers are more sophisticated than

TABLE 4.6
Number of Computers

Description	Frequency	Percent
0	20	10.6
1	55	29.1
2	36	19.0
3	24	12.7
4	9	4.8
5	11	5.8
6	10	5.3
7	6	3.2
8	1	0.5
10	5	2.6
11	2	1.1
12	1	0.5
13	1	0.5
14	2	1.1
15	2	1.1
18	1	0.5
20	1	0.5
40	1	0.5
60	1	0.5
Total	189	100.0

Mean	3.667	Median	2
Std dev	6.028	Mode	1

others and can be used simultaneously by more than one user. Therefore, Table 4.7 provides information regarding the type of computer and number of terminals for those companies reporting owning a computer. Examination of this table shows that a large percentage (48.5%) of respondents do, in fact, have computers that support multiple terminals. However, the number of terminals at each company is still relatively small.

While an analysis of the number of computers and terminals provides some insight into the growth stage, it may be influenced by the size of the company. Another measure of the extent of computer utilization which may be useful is the percentage of employees that use the computer as a regular part of their job responsibilities. Table 4.8 shows the reported percentage of employees who use the computer on a regular basis. It indicates an approximately normal distribution exists for the data item.

Length of Computer Ownership

Another factor that should influence the Telem stage of computerization is the length of time since the dealer first acquired a computer. Question two on the survey gathered this information. When the decision to purchase the first computer is an internal decision it is expected that computer usage will grow over time (Telem 1989; Nolan 1973; Nolan 1979). This may not hold true in situations

TABLE 4.7
Information About Current Computer

Type of Computer System		
Description	Frequency	Percent
Data not supplied	4	2.4
Off-site Computer	8	4.7
Multiple Unconnected Computers	14	8.3
Multiple LAN Connected Computers	16	9.5
Multiple Connected Computers	22	13.0
Single Computer	23	13.6
Computer with Multiple Terminals	82	48.5
Total	169	100.0

Number of PCs or Terminals			
Number		Frequency	Percent
1		20	11.8
2		15	8.9
3		20	11.8
4		11	6.5
5		24	14.2
6		11	6.5
7		8	4.7
8		6	3.6
9		5	3.0
10		8	4.7
11		6	3.6
12		4	2.4
13		4	2.4
14		4	2.4
15		2	1.2
16		1	0.6
17		2	1.2
18		2	1.2
19		2	1.2
20		2	1.2
21		1	0.6
22		1	0.6
23		1	0.6
Greater than 25		9	5.4
Total		169	100.0
Mean	8.148	Median	5
Std dev	8.658	Mode	5

TABLE 4.8
Percentage of Employees Using Computer

Description	Frequency	Percent
5	13	7.7
15	3	1.8
25	20	11.8
35	12	7.1
45	20	11.8
55	35	20.7
65	16	9.5
75	20	11.8
85	11	6.5
95	9	5.3
100	9	5.3
Data not supplied	1	0.6
Total	169	100

Mean	54.024	Median	55
Std dev	26.043	Mode	55
Skewness	-0.112	Kurtosis	-0.702

where the initial acquisition of a computer was significantly influenced by external decision makers. Therefore, Table 4.9 provides information regarding the number of years that have expired since the initial acquisition of a computer and the reported purpose of its acquisition. A comparison of the number of years since the initial computer acquisition and the implementation of EDI may indicate whether this decision was due to external influence. Survey question twenty asked how many years ago EDI was implemented. Table 4.10 reports the number of years since implementing EDI and Table 4.11 shows the results of paired t-tests of the two factors for all usable responses, only those from dealers using EDI, and only those dealers who indicated, on survey question forty-three, a computer purchase was required for EDI.

A comparison of years since acquiring the first computer and implementing EDI indicate that while the two are correlated it appears that a dealer's initial computer purchase is not necessarily done at the same time as implementing EDI. However, the reported purpose of the initial computer supports the supposition that computer purchases and EDI are related for some dealers. A large percentage (41.4%) of the initial computer use reported was for parts purchases, inventory maintenance, and telecommunications, all of which are EDI related. A

TABLE 4.9
Information Regarding First Computer

Years Since Acquiring First Computer		
Years	Frequency	Percent
Less than one year	4	2.4
1	2	1.2
2	4	2.4
3	9	5.3
4	7	4.1
5	5	3.0
6	15	8.9
7	10	5.9
8	17	10.1
9	12	7.1
10	25	14.8
11	10	5.9
12	7	4.1
13	4	2.4
14	1	0.6
15	11	6.5
16	3	1.8
17	4	2.4
18	4	2.4
20	7	4.1
21	3	1.8
22	2	1.2
23	1	0.6
32	1	0.6
Data not supplied	1	0.6
Total	169	100.0
Mean 9.875	Median	9
Std dev 5.457	Mode	10

Primary Purpose of First Computer		
Description	Frequency	Percent
Other purpose	1	0.6
Word processing	3	1.8
Sales purchases	6	3.6
Not answered	7	4.1
Tele-communications	8	4.7
Parts purchases	27	16.0
Inventory functions	35	20.7
Multiple items check	39	23.1
Accounting functions	43	25.4
Total	169	100.0

TABLE 4.10
EDI Implementation Information

Use EDI to Order Parts

Description	Frequency	Percent
No	28	16.6
Yes	141	83.4
Total	169	100

Mean 0.834
Std dev 0.373

Years ago started using EDI

Years	Frequency	Percent
less than one	28	16.6
1	0	0.0
2	5	3.0
3	9	5.3
4	7	4.1
5	15	8.9
6	14	8.3
7	10	5.9
8	18	10.7
9	6	3.6
10	28	16.6
11	6	3.6
12	5	3.0
14	1	0.6
15	5	3.0
16	2	1.2
18	2	1.2
20	1	0.6
21	3	1.8
22	1	0.6
23	1	0.6
Data not supplied	2	1.2
Total	169	100.0

Mean 7.084 Median 7
Std dev 5.091
Mode-tie between less than one and 10 years

Purchased computer for EDI

Description	Frequency	Percent
No	61	36.1
Yes	106	62.7
Data not supplied	2	1.2
Total	169	100

Mean 0.635
Std dev 0.483

TABLE 4.11
Comparison of Computer Purchase and Start of EDI

	All Usable Responses	Respondents Using EDI	Purchased Computer for EDI
Mean Years Since First Computer	8.9185	10.1056	9.7642
Mean Years Since Started EDI	6.3750	8.2324	8.1792
Mean Paired Difference	2.5435	1.8732	1.5849
95% Confidence Interval			
Low	1.762	1.003	0.699
High	3.325	2.743	2.471
t-value	6.42	4.26	3.55
Significance	0.000	0.000	0.001
Correlation	0.5482	0.4831	0.5354

portion of those that checked multiple items are also likely to be EDI related. Also, of the 141 dealers using EDI, 106 (75%) indicate a computer purchase was required for that purpose.

Composite Variables

This focus of this study is the intercompany effect of EDI as reflected in the influence it has on owner/manager attitudes toward computers and EDI in determining the extent the AIS is computerized. Four attitude scores are determined from the data supplied on the questionnaire: 1) Computer Attitude - attitude toward computers in general, 2) Perception EDI Forced - perception that EDI was forced on the respondent, 3) Awareness of EDI Issues - a measure of an awareness of certain AIS related EDI issues, and 4) EDI Attitude - attitude toward using EDI for parts purchases. Each score has a range from one to five. The distributions of these scores in the sample are shown in Table 4.12. The scores shown are rounded to the nearest integer however, the actual scores are computed to hundredths. No normality problems are indicated with the scores, although very few extreme low values exist. Descriptive statistics and stem-leaf plots for these variables are included in Table 4.13.

The dependent variable in most of the hypotheses tests is a measurement of the stage of computer growth as

TABLE 4.12
Attitude Scores

Computer Attitude Score			
Description		Frequency	Percent
Strong negative computer attitude		0	0
Negative Computer Attitude		3	1.5
neutral computer attitude		85	45.1
positive computer attitude		92	48.5
strong positive computer attitude		9	4.8
Total		189	100.0
Mean	3.615	Median	3.6
Std dev	0.53	Mode	3.3

Perception EDI Forced Score			
Description		Frequency	Percent
Strongly Perceives EDI Not Forced		1	0.5
Perceives EDI as Not Forced		17	9.0
Neutral Peception whether EDI Forced		79	41.8
Perceives EDI is Forced		69	36.5
Strongly Perceives EDI is Forced		23	12.1
Total		189	100.0
Mean	3.48	Median	3.333
Std dev	0.777	Mode	3

Awareness of EDI Issues Score			
Description		Frequency	Percent
Very Unaware of EDI Issues		0	0.0
Unaware of EDI Issues		11	5.7
Neutral Awareness of EDI Issues		98	51.7
Aware of EDI Issues		73	38.5
Very Aware of EDI Issues		7	3.7
Total		189	100.0
Mean	3.462	Median	3.5
Std dev	0.599	Mode	3.5

EDI Attitude Score			
Description		Frequency	Percent
Strong Negative EDI Attitude		0	0.0
Negative EDI Attitude		10	5.2
Neutral EDI Attitude		76	40.2
Positive EDI Attitude		93	49.1
Strong Positive EDI Attitude		10	5.3
Total		189	100.0
Mean	3.665	Median	3.714
Std dev	0.609	Mode	3.714

TABLE 4.13
Descriptive Statistics for Attitude Scores

Computer Attitude Score

Mean	3.6153	Std Err	0.0385	Min	2.2
Median	3.6	Variance	0.2808	Max	5
5% Trim	3.615	Std Dev	0.5299	Range	2.8
95% CI for Mean	(3.5393, 3.6914)			IQR	0.8
Skewness	0.0899				
S E Skew	0.1768				
Kurtosis	-0.3613				
S E Kurt	0.3518				

Frequency	Stem &	Leaf
0	2 *	
1	2 t	2
2	2 f	45
6	2 s	667777
8	2 .	88888899
17	3 *	00000011111111111
34	3 t	22222222222222233333333333333333
20	3 f	44444444445555555555
26	3 s	66666666666667777777777777
24	3 .	88888888888999999999999
21	4 *	000000000000000001111
10	4 t	2222222333
12	4 f	444445555555
8	4 s	66666677
0	4 .	
1	5 *	0

Perception EDI Forced Score

Mean	3.4797	Std Err	0.0568	Min	1
Median	3.333	Variance	0.6032	Max	5
5% Trim	3.4814	Std Dev	0.7767	Range	4
95% CI for Mean	(3.3683, 3.5912)			IQR	1
Skewness	-0.0151				
S E Skew	0.1768				
Kurtosis	-0.3574				
S E Kurt	0.3518				

Frequency	Stem &	Leaf
1	Extremes	(1.0)
6	2 *	000000
11	2 t	33333333333
0	2 f	
22	2 s	6666666666666666666666
0	2 .	
31	3 *	0000000000000000000000000000000
26	3 t	33333333333333333333333333
0	3 f	
29	3 s	66666666666666666666666666666
0	3 .	
27	4 *	000000000000000000000000000
13	4 t	3333333333333
0	4 f	
15	4 s	666666666666666
0	4 .	
8	5 *	00000000

(table con'd)

Awareness of EDI Issues Score

Mean	3.4625	Std Err	0.0436	Min	1.625
Median	3.5	Variance	0.3586	Max	4.875
5% Trim	3.4704	Std Dev	0.5989	Range	3.25
95% CI for Mean	(3.3766, 3.2790)			IQR	0.8125
Skewness	-0.1944				
S E Skew	0.1763				
Kurtosis	0.4319				
S E Kurt	0.3513				

Frequency	Stem &	Leaf
3	Extremes	(1.6), (1,8)
1	2 *	1
6	2 t	233333
1	2 f	5
12	2 s	666677777777
6	2 .	888888
32	3 *	00000000000000000011111111111111
27	3 t	22222222222333333333333333
22	3 f	55555555555555555555
30	3 s	66666666666666667777777777777
10	3 .	9888888888
16	4 *	0000000001111111
13	4 t	2222222233333
3	4 f	555
6	4 s	667777
1	4 .	8

EDI Attitude Score

Mean	3.6651	Std Err	0.0443	Min	1.857
Median	3.714	Variance	0.3705	Max	5
5% Trim	3.6668	Std Dev	0.6087	Range	3.143
95% CI for Mean	(3.5778, 3.7525)			IQR	0.857
Skewness	-0.0693				
S E Skew	0.1763				
Kurtosis	-0.2375				
S E Kurt	0.3513				

Frequency	Stem &	Leaf
1	Extremes	(1.9)
1	2 t	2
8	2 f	44455555
3	2 s	777
9	2 .	888888888
23	3 *	00000000000011111111111
14	3 t	22222222222222
27	3 f	44444444444445555555555555
25	3 s	7777777777777777777777777
17	3 .	88888888888888888
25	4 *	00000000000001111111111111
9	4 t	222222222
17	4 f	44444444444455555
3	4 s	777
3	4 .	888
4	5 *	0000

described by the Telem growth model. For each respondent company two variations of this stage is determined from the data supplied on the survey questionnaire. One is a self reported score, the other is a computed score based on the questionnaire data. Table 4.14 provides the results of statistical tests and stem-leaf plots for these two scores.

The results shown indicate that the survey respondents tend to overstate their current Telem growth stage compared to the computed Telem stage. It also appears that there may be normality problems associated with the self reported stage variable. Therefore, the tests of the hypotheses will be conducted using the computed Telem stage variable and the self-reported composite score will only be used in alternative tests.

Factor Analysis

To gain additional insight into the nature of owner/manager attitudes the questions comprising the various composite variables are examined using factor analysis with varimax rotation. Factor analysis is a means of investigating the underlying latent factors in the data (Vogt 1993). Many times these factors can not be measured directly. Instead, researchers must rely on multiple data variables using questions that can be directly asked. Factor analysis is used in this study to try to determine

TABLE 4.14
Descriptive Statistics for Telem Stage Variables

Self Reported Telem Stage

Mean	2.0194	Std Err	0.0695	Min	0	Skewness	-0.8807
Median	2.3333	Variance	0.9127	Max	3	S E Skew	0.1768
5% Trim	2.0771	Std Dev	0.9554	Range	3	Kurtosis	-0.3355
95% CI for Mean	(1.8823, 2.1565)			IQR	1.5	S E Kurt	0.3518

Frequency	Stem &	Leaf
20	0 *	00000000000000000000
0	0 t	
2	0 f	55
2	0 s	66
1	0 .	8
12	1 *	000000011111
13	1 t	3333333333333
7	1 f	5555555
8	1 s	66666666
7	1 .	8888888
17	2 *	00000011111111111
12	2 t	333333333333
14	2 f	55555555555555
15	2 s	666666666666666
25	2 .	8888888888888888888888888
34	3 *	00000000000000000000000000000000000

Computed Telem Stage

Mean	1.6041	Std Err	0.0527	Min	0	Skewness	-0.8955
Median	1.833	Variance	0.5255	Max	3	S E Skew	0.1768
5% Trim	1.6326	Std Dev	0.7249	Range	3	Kurtosis	0.1956
95% CI for Mean	(1.5001, 1.7081)			IQR	1	S E Kurt	0.3518

Frequency	Stem &	Leaf
20	0 *	0000000000
0	0 t	
1	0 f	&
2	0 s	6
6	0 .	888
21	1 *	0011111111
10	1 t	33333
18	1 f	555555555
11	1 s	66666
20	1 .	8888888888
54	2 *	000000000000001111111111111
12	2 t	333333
6	2 f	555
6	2 s	666
1	2 .	&
1	3 *	&

if there is a set of underlying factors comprising the various composite attitude scores. The results of this analysis are shown in Tables 4.15, 4.16, and 4.17. The analysis indicates that three underlying factors appear to be related to the computer attitude questions, two underlie awareness of EDI issues, and two relate to EDI attitude. Factor analysis was also performed with the questions comprising the perception EDI forced and Telem Stage variables, but only one factor was found for each.

Looking at the results of factor analysis for those questions comprising the computer attitude score indicates three groups exist consisting of six, two, and one questions. A closer examination of those questions reveals that the group of six questions appear to be related to the respondent's personal comfort with computers and their impact on society. The second group appears to be related to the potential computers have to change how work is performed. The final underlying factor deals with the role of computers and humans in the work environment.

To maintain comparability with previous research the hypotheses are tested using the composite computer attitude score determined from the ten questions used by Magal and Lewis (1995) and Nickel and Pinto (1986) CAS scale. However, since factor analysis indicates a primary

TABLE 4.15
Factor Analysis - Computer Attitude

Survey Question	Factor 1	Factor 2	Factor 3
Factor 1:			
Question 53	0.76133	-0.34674	0.23949
Question 55	0.75162	0.05373	0.00436
Question 50	0.74172	0.06303	-0.22943
Question 56	0.73389	0.02358	-0.25783
Question 49	0.71222	-0.22141	0.27822
Question 52	0.62244	-0.22764	-0.19287
Factor 2:			
Question 51	0.21485	0.80600	0.12515
Question 54	0.20941	0.63837	0.47633
Question 30	0.42009	0.44566	-0.35936
Factor 3:			
Question 48	0.18460	-0.19035	0.65014

Final Statistics:

Variable	Communality	Factor	Eigenvalue	Pct of Var	Cum Pct
Question 30	0.50423	1	3.42853	34.3	34.3
Question 48	0.49299	2	1.52049	15.2	49.5
Question 49	0.63368	3	1.08546	10.9	60.3
Question 50	0.60677				
Question 51	0.71146				
Question 52	0.47645				
Question 53	0.7572				
Question 54	0.67826				
Question 55	0.56783				
Question 56	0.60562				

TABLE 4.16
Factor Analysis - Awareness of EDI Issues

Survey Question	Factor 1	Factor 2
Factor 1:		
Question 37	0.74950	0.14193
Question 36	0.73542	-0.38210
Question 33	0.73027	-0.28505
Question 38	0.64258	-0.12109
Question 34	0.60706	-0.22580
Question 32	0.56043	0.03160
Factor 2:		
Question 41	0.45613	0.66922
Question 40	0.44024	0.62401

Final Statistics:

Variable	Communality	Factor	Eigenvalue	Pct of Var	Cum Pct
Question 32	0.31509	1	3.13327	39.2	39.2
Question 33	0.61455	2	1.1513	14.4	53.6
Question 34	0.41950				
Question 36	0.68685				
Question 38	0.42757				
Question 37	0.58189				
Question 40	0.58321				
Question 41	0.65591				

TABLE 4.17
Factor Analysis - EDI Attitude

Survey Question	Factor 1	Factor 2
Factor 1:		
Question 47	0.80776	0.07549
Question 44	0.75068	-0.34976
Question 45	0.73703	0.16098
Question 46	0.73407	-0.01984
Question 42	0.71246	-0.42748
Question 41	0.57890	0.18374
Factor 2:		
Question 43	0.36662	0.80653

Final Statistics:

Variable	Communality	Factor	Eigenvalue	Pct of Var	Cum Pct
Question 41	0.36888	1	3.27519	46.8	46.8
Question 42	0.69034	2	1.02132	14.6	61.4
Question 43	0.78490				
Question 44	0.68585				
Question 45	0.56912				
Question 46	0.53925				
Question 47	0.65817				

underlying factor is present in this scale, the hypotheses are also tested using a more succinct, one dimensional, computer attitude score derived from the reduced set of six questions comprising the first factor. The test results of the two scales are then compared.

Examining the questions comprising each factor group for the awareness variable also provides some insight into the underlying factors involved. The first group's questions seem to be related to the respondent's belief that EDI improves the efficiency of operations. The second group are related to internal control issues regarding increased risk of using EDI. One interesting note, the reliability analysis of the two questions in the second group indicate they were not interpreted by respondents as expected. This may indicate respondents are not familiar with risk issues related to EDI and may also explain why factor analysis place these two questions in a separate group.

An owner/manager's complete knowledge of both benefits and problems may be important in determining the Telem stage, therefore the hypotheses are tested using an awareness score derived from the complete set of questions. However, since the respondents may have misinterpreted the questions related to internal control, the hypotheses are also tested using a more succinct, one dimensional, scale

developed from those questions identified with the efficiency factor.

Examination of the question groups contained in the factor analysis results of the EDI attitude variable also indicate what the underlying factors may be. The first group appears to be related to efficiency, as was the first group of the awareness variable. The questions in this group appear to be related to the use of computers to eliminate the tedious nature of ordering parts or other work related concerns. The single question comprising the second group appears to be related to personal comfort with using automated systems, also a factor in the computer attitude variable. Since the single question comprising the second factor has little separate effect on the composite variable, separate tests are not performed using a more succinct EDI attitude variable.

Composite Reliability Analysis

Since the attitude scores and the Telem stage variables are composites of several survey questions, it is important that these questions consistently and reliability measure the underlying factors involved. Cronbach's alpha scores are computed for each group of survey questions comprising a composite variable to test for this reliability(Vogt 1993, p.53). The alpha scores for each attitude score and the two Telem stage variables are shown

in Table 4.18. A minimum alpha of .6000 is desired for each score. The tests indicate that the questions used to derive the various scores meet the minimum criteria for consistently measuring the underlying factors. Reliability tests are also performed for the variables derived from a reduced set of questions as determined by factor analysis. Since only one dimension is involved with these variables, higher Cronbach's alpha scores are expected. These results are also reported in Table 4.18.

Summary of Descriptive Analysis

In summary, items of interest to this study were examined to determine if characteristics important to the study exist in the sample data. Analysis of the data indicates the following: Respondents' company size meets the study requirements for small businesses. Computer usage is well distributed among the respondents whether measured by number of computers, type of computer, number of terminals, or percentage of employees using the system. Respondents have acquired computers from less than one year prior to the survey up to thirty-two years before, but most acquired their first computer around ten years ago. A common purpose for acquiring the first computer was for accounting functions, but EDI related purposes (telecommunications, parts purchases, and inventory) are, as a group, the most common purpose. Finally, it appears that

TABLE 4.18
Reliability Statistics of Composite Variables

Description	Number of Questions	Alpha	Standardized Alpha
Computer Attitude Score	10	.7650	.7493
Reduced Computer Attitude Score	6	.8254	.8271
Perception EDI Forced Score	3	.6460	.6476
Awareness of EDI Issues Score	8	.7682	.7694
Reduced Awareness Score	6	.7723	.7772
EDI Attitude Score	7	.7728	.7990
Self-reported Telem Stage	6	.9315	.9329
Computed Telem Stage	7	.7682	.7694

implementation of EDI lag the initial purchase of a computer from one to two years.

An analysis of the sample also indicates no major problems with key variables related to computer attitude, awareness, and the Telem stage. Factor analysis does indicate that computer attitude, awareness, and EDI attitude have multiple underlying factors and it may be possible to test the hypotheses using more succinct variables. However, tests are first performed using the originally proposed variables for comparability to prior research, or to test the effect of the entire set of factors. Reliability tests indicate the questions used to determine these composite variables appear to consistently measure the element of interest. While some of the composite variables do not cover the entire range of possible values, reasonable distributions do exist. Table 4.19 provides a summary list of the study variables.

Tests of Hypotheses

Group One: Attitude Hypotheses

The first group of hypotheses postulate that an intercompany EDI effect can be measured in the manner owner/manager attitudes will effect the level of AIS computerization in a company. Five specific hypotheses were developed that could be used to test this overall supposition.

TABLE 4.19
Variable List

Variable Name	Description	Variable Type	Scale
Computer Attitude	Attitude of the owner/manager toward computers in general. Measured using the Nickell and Pinto CAS scale	Study Variable	1 to 5
Reduced Computer Attitude	Attitude of the owner/manager toward computers in general using only questions factor analysis includes in the first factor	Alternate Variable	1 to 5
Perception EDI Forced	Perception of the owner/manager that EDI has been forced on the business	Study Variable	1 to 5
Awareness	Measurement of the knowledge of EDI benefits and issues	Study Variable	1 to 5
Reduced Awareness	Measurement of the knowledge of EDI benefits and issues using only questions factor analysis includes in the first factor	Alternate Variable	1 to 5
EDI Attitude	Attitude of the owner/manager toward EDI and electronic ordering systems	Study Variable	1 to 5
Telem Stage	Computed level of computerization using the Telem three stage model	Study Variable	1 to 3
Self Reported Telem Stage	Telem stage level determined directly from respondents answers regarding six characteristics	Alternate Variable	1 to 3
Size	Size of respondent business as measured by number of full-time employees	Control Variable	1 to 115
Affiliated Manufacturer	Manufacturer affiliated with respondent	Control Variable	0 or 1
Years Using EDI	Number of years dealer has used EDI	Control Variable	0 to 32

The first hypothesis in this group states:

H1a: Owner/managers who have a negative attitude toward computers will also believe EDI systems were forced on them.

One method of testing this hypothesis is to determine if computer attitude and perception of forced EDI are negatively correlated. Correlation analysis provides a means of testing the strength of the linear relationship between two variables (Norusis and SPSS Inc. 1993). However, it does not presuppose an explanatory-response relationship (Moore and McCabe 1989). A correlation matrix for the attitude variables and the computed Telem stage variable is presented in Table 4.20. Examination of this table reveals that while the correlation is negative (-0.0313), as expected from hypothesis H1a, it is not a large correlation and the correlation is not statistically significant (p value = .669). This indicates the null hypothesis of no correlation between computer attitude and perception of EDI being forced on small businesses can not be rejected. Therefore, hypothesis H1a is not supported by the results of this test.

Another test of this hypothesis can be performed by comparing the mean perception EDI is forced score for those with low computer attitude scores with the mean score of those with high computer attitude scores to determine if it

TABLE 4.20
Correlation Matrix - Telem Stage to Attitudes

	Telem Stage	Computer Attitude	Perception EDI Forced	EDI Attitude	Awareness EDI
Telem Stage	1.0000				
Computer Attitude	0.3309	1.0000			
	(.000)				
Peception EDI Forced	0.2584	-0.0313	1.0000		
	(.000)	(.669)			
EDI Attitude	0.4436	0.5572	0.1165	1.0000	
	(.000)	(.000)	(.110)		
Awareness EDI Issues	0.3349	0.4559	-0.1771	0.7180	1.0000
	(.000)	(.000)	(.015)	(.000)	

() - indicates p value.

is significantly different and lower. A one-way ANOVA procedure can be used to test the significance of differences of the means. The ANOVA procedure is a statistical method for comparing several population means (Moore and McCabe 1989). To perform this procedure the data is first stratified into three groups, a low attitude score group, a high attitude score group, and a middle group. Though ideally these three groups will have an equal number of members, ties of computer attitude scores create slightly unequal numbers. The mean perception of forced EDI scores of the two extreme groups are then compared using ANOVA procedures. Table 4.21 illustrates the results of this ANOVA procedure. The results indicate that no statistically significant difference exist between the two group means, i.e. the null hypothesis that the two means do not differ can not be rejected. This is further illustrated by the overlap of the confidence intervals for the perception variable means of the two groups. Therefore, this test also fails to support hypothesis H1a.

Hypothesis H1a is important to the overall assertion that owner/manager attitudes toward the computerization of the AIS are affected by whether it is perceived that EDI has been forced on the business. However, a failure to find evidence to support it does not directly indicate the remaining hypotheses of the first group are also

TABLE 4.21
ANOVA Table - Perception EDI Forced by Computer Attitude

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	0.0071	0.0071	0.0109	0.917
Within Groups	99	64.087	0.6473		
Total	100	64.0941			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean
bottom third	49	3.4014	0.8194	0.1171	3.166 TO 3.6367
top third	52	3.3847	0.7904	0.1096	3.1646 TO 3.6047
Total	101	3.3928	0.8006	0.0797	3.2347 TO 3.5508

Group	Minimum	Maximum
bottom third	2.0000	5.0000
top third	1.0000	5.0000
Total	1.0000	5.0000

Group 1 - Approximately bottom one third of cases by computer attitude score
Group 2 - Approximately top one third of cases by computer atttitude score

unsupported. Therefore, each of these hypotheses are also tested to determine the extent computer attitude and a perception that EDI is forced on small business partners have an association with the level of AIS computerization.

The second, H1b, and fourth, H1d, hypotheses of the first group can be tested at the same time since they both postulate about the relationship between computer attitude and the current Telem stage of the responding company. These two hypotheses state:

> H1b: The computer systems at companies with owner/managers with a negative attitude toward computers will be at the initiation stage of the Telem model.
>
> H1d: The computer systems at companies with owner/managers with a positive attitude toward computers will be at the contagion or maturity stage of the Telem model.

The correlation matrix shown in Table 4.20 provides weak support for these hypotheses since there is a positive correlation between computer attitude and the Telem stage score. However, this correlation is not large. A stronger test of the hypotheses can be performed by stratifying the respondents by computer attitude scores into three groups, then comparing the mean Telem stage scores of the two extreme groups using ANOVA. This test indicates if the means significantly differ and the accompanying descriptive statistics report if the group with lower computer attitude scores also have lower Telem stage scores. The results of

the ANOVA test, group means and confidence intervals for the means are shown in Table 4.22. These results support both hypotheses. The probability that the means of the Telem stage scores are equal between the two groups is so low as to be unmeasurable (.0000), so the null hypothesis of no difference can be rejected. This supports the hypothesis that the means differ. The table also shows that the Telem Stage mean for the group with low computer attitude scores (1.2688) is at the Telem initiation stage. This supports H1b. The mean score of 1.8943 for the high computer attitude group places that group at the Telem contagion stage, which supports hypothesis H1d.

The remaining two hypotheses from the first group can also be tested using a single ANOVA procedure along with accompanying descriptive statistics. These two hypotheses theorize that the owner/manager's perception of whether EDI has been forced on the dealer by a larger business partner will have an effect on the level of AIS computerization. The score for perception EDI is forced is high when the owner/manager believes EDI was forced on the company. Thus, an inverse relationship is expected, the stronger the perception of force the lower the Telem stage score. Specifically the two hypotheses state:

> H1c: The computer systems at companies with owner/managers who perceive EDI as forced upon the business will be at the initiation stage of the Telem model.

TABLE 4.22
ANOVA Table - Telem Stage by Computer Attitude

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	9.8702	9.8702	18.5352	.0000
Within Groups	99	52.7186	0.5325		
Total	100	62.5888			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
bottom third	49	1.2688	0.8633	0.1233	1.0208	TO	1.5167
top third	52	1.8943	0.5765	0.0799	1.7338	TO	2.0547
Total	101	1.5908	0.7911	0.0787	1.4346	TO	1.747

Group	Minimum	Maximum
bottom third	0.0000	2.6670
top third	0.0000	2.8330
Total	0.0000	2.8330

Group 1 - Approximately bottom one third of cases by computer attitude score
Group 2 - Approximately top one third of cases by computer atttitude score

H1e: The computer systems at companies with owner/managers who do not perceive EDI as forced upon the business will be at the contagion or maturity stage of the Telem Model.

Results of the ANOVA test are shown in Table 4.23. The ANOVA results indicate there is a difference in the Telem scores between those that have high perception EDI forced scores and those that have low scores. There is only a probability of .0005 that the means are equal, therefore the null hypothesis can be rejected and a conclusion that the means significantly differ can be reached. However, the table also shows that the mean Telem score for those with high perception EDI forced scores is 1.7884 which would place it at the Telem contagion stage. This result fails to support hypothesis H1c. The mean Telem score for those with low perception EDI forced scores is 1.3522, which places it at the Telem initiation stage. This also fails to support hypothesis H1e.

These results are the opposite of those hypothesized for the effect of the perception EDI forced variable. This indicates further examination of the relationship between that variable and the Telem stage is warranted. Supplemental tests of the data, including regression analysis, were performed after the hypotheses tests to explore the association between the study variables and the

TABLE 4.23
ANOVA Table - Telem Stage by Perception EDI Forced

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	6.3522	6.3522	12.6531	.0005
Within Groups	99	66.2669	.5020		
Total	100	72.6191			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean
bottom third	71	1.3522	0.8365	0.0993	1.1542 TO 1.5502
top third	63	1.7884	0.5281	0.0665	1.6554 TO 1.9214
Total	134	1.5573	0.7389	0.0638	1.431 TO 1.6835

Group	Minimum	Maximum
bottom third	0.0000	2.8330
top third	0.0000	3.0000
Total	0.0000	3.0000

Group 1 - Approximately bottom third of cases by perception EDI forced score
Group 2 - Approximately top third of cases by perception EDI forced score

Telem stage. The results of these supplemental tests are discussed later, after the discussion of hypotheses tests.

Group Two: Awareness Hypotheses

The second group of hypotheses deal with the owner/manager's awareness, or knowledge, of EDI and the level of AIS computerization, as measured by the Telem stage model. In general this group postulates that the more aware the owner/manager is of EDI benefits and risks, the more favorable the computer attitude and the more likely the AIS will be computerized to take advantage of those benefits. The first two hypotheses of this group are:

H2a: Owner/managers with a positive attitude toward computer technology will more likely have an awareness of EDI benefits.

H2b: The computer systems at companies with owner/managers with an awareness of EDI benefits will be at the contagion or maturity stages of the Telem model.

The correlation matrix shown in Table 4.20 shows some support for hypothesis H2a. The correlation between computer attitude and EDI awareness is .4459 with a p-value of .000. This indicates that there is an association between the two scores, though not strong, with a statistically significant indication that the null hypothesis of no association can be rejected. This provides weak support for the hypothesis. To further test H2a the sample is stratified into three groups based on

their computer attitude score, low, middle, and high scores and the means of the two extreme groups' awareness scores are compared using ANOVA procedures. These results are shown in Table 4.24 and indicate that the groups do significantly differ since there is a zero probability that the means are equal. To support H2a the mean of the low group must be not only significantly different than the high group but also lower on the awareness scale. Table 4.24 indicates the mean of the low group is 3.1352, while the high group has a mean of 3.8317. Since the low group's mean is less than the high group, H2a is supported by an analysis of the data.

A comparison of means from a stratified subsample of the data can also be used to test hypothesis H2b. The data are stratified based on awareness scores into three groups, low, high, and middle. The mean Telem stage score is then compared between the low and high groups. This comparison is shown as an ANOVA table and accompanying descriptive statistics in Table 4.25. Examining this table it can be seen that there is a statistically significant difference between the Telem stage means of the two groups. The probability that the null hypothesis of no difference is close to zero, therefore it can be rejected. Hypothesis H2b is supported in that the mean of the Telem stage for

TABLE 4.24
ANOVA Table - Awareness Score by Computer Attitude

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	12.2392	12.2392	43.7766	.0000
Within Groups	99	27.6788	0.2796		
Total	100	39.918			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean
bottom third	49	3.1352	0.5554	0.0793	2.9757 TO 3.2947
top third	52	3.8317	0.5024	0.0697	3.6919 TO 3.9716
Total	101	3.4938	0.6318	0.0629	3.3691 TO 3.6185

Group	Minimum	Maximum
bottom third	1.6250	4.7500
top third	2.8750	4.8750
Total	1.6250	4.8750

Group 1 - Approximately bottom one third of cases by computer attitude score
Group 2 - Approximately top one third of cases by computer atttitude score

TABLE 4.25
ANOVA Table - Telem Stage by Awareness of EDI

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	11.4535	11.4535	26.2518	.0000
Within Groups	121	52.7916	0.4363		
Total	122	64.2451			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean
bottom third	61	1.3279	0.821	0.1051	1.1176 TO 1.5382
top third	62	1.9382	0.4499	0.0571	1.824 TO 2.0525
Total	101	1.6355	0.7257	0.0654	1.506 TO 1.7651

Group	Minimum	Maximum
bottom third	0.0000	3.0000
top third	0.8330	2.8330
Total	0.0000	3.0000

Group 1 - Approximately bottom one third of cases by awareness score
Group 2 - Approximately top one third of cases by awareness score

the low awareness group is lower than that of the high group.

Hypothesis H2c is included in the study as a stronger test of the awareness hypotheses than the first two in the awareness group. This hypothesis states:

H2c: The computer systems at companies with owner/managers who perceive EDI as forced upon the business and have an awareness of EDI benefits will be at the contagion or maturity stages of the Telem model.

To test this hypothesis the sample is first segmenting into low and high scoring groups for each variable with any respondent with a score equal to the median score excluded (twenty-one cases excluded). The remaining sample is then subdivided into groups based on combinations of both awareness scores and perception EDI forced scores. The resulting four groups represent a 2 X 2 matrix, previously illustrated in Figure 3.1, where the upper left panel is represented by group one and has high forced score and low awareness scores, group two has both high forced scores and high awareness scores which is the upper right panel in Figure 3.1, the lower left panel is group three and has both low forced scores and low awareness scores, and lower right panel is group four which has low forced and high awareness scores.

The means for the Telem stage scores are then compared for the four groups. Table 4.26 reports the results of an ANOVA analysis of the four groups. The mean Telem score for

TABLE 4.26
ANOVA Table - Telem Stage by Forced and Awareness

Description	Panel Number	Frequency	Percent	Valid %	Cum %
panel 1-high forced/low aware	1	49	25.9	29.2	29.2
panel 2-high forced/high aware	2	33	17.5	19.6	48.8
panel 3-low forced/low aware	3	39	20.6	23.2	72.0
panel 4-low forced/high aware	4	47	24.9	28.0	100.0
Total		168		100	
Not used for analysis		21	11.1		
Total		189	100.0		

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	18.845	6.2817	14.9733	0.000
Within Groups	164	68.8018	0.4195		
Total	167	87.6468			

Panel	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
1	49	1.6531	0.7095	0.1014	1.4493	TO	1.8569
2	33	1.9243	0.4509	0.0785	1.7644	TO	2.0842
3	39	1.0214	0.7649	0.1225	0.7735	TO	1.2694
4	47	1.8156	0.588	0.0858	1.643	TO	1.9883
Total	168	1.6052	0.7245	0.0559	1.4948	TO	1.7155

Mean	Group	1	2	3	4
1.6531	1	.	.	*	.
1.9243	2	.	.	*	.
1.0214	3	.	.	.	.
1.8156	4	.	.	*	.

* - means significantly differ
. - means do not significantly differ

group one is 1.6531 representing a Telem contagion stage. The predicted stage for panel one is the initiation stage. Group two has a mean Telem score of 1.9243, the Telem contagion stage, as predicted for panel two. The mean Telem score for group three is 1.0214. The predicted stage for panel three is either initiation or contagion. Finally, group four's mean Telem score is 1.8156, contagion. Panel four's predicted stage is either contagion or maturity. The predicted results for panels, two, three, and four are supported by the data, the predicted result for panel one is not. It appears that awareness of EDI benefits does influence the resulting Telem stage as hypothesized, but the perception that EDI is forced upon the dealer does not.

Tests of the Hypotheses Using Alternate Variables

The hypotheses can also be evaluated using the reduced factor composite variables for computer attitude and awareness determined earlier using factor analysis as the independent variables or by using the self-reported Telem stage variable as the dependent variable. Each relevant test conducted above is retested in this manner. Table 4.27 reports the results of those tests along with the initial test results for comparison purposes. In general, the conclusions reached from the results of tests using the

TABLE 4.27
Alternative Variable Results

Hypotheses/Description	F Ratio	F Prob.	95% Confidence Intervals Bottom Third Low	Bottom Third High	Top Third Low	Top Third High
H1a: Forced score by Attitude score						
CAS attitude score	0.0109	.9170	3.1660	3.6367	3.1646	3.6047
One dimension Attitude	0.0251	.8744	3.2738	3.6772	3.2573	3.6491
H1b/H1d: Telem Stage by Attitude						
Computed Telem Stage	18.5352	.0000	1.0208	1.5167	1.7338	2.0547
Self reported Stage	19.5595	.0000	1.2386	1.8838	2.1864	2.5893
One dimension Attitude	20.1681	.0000	1.1493	1.5420	1.7515	2.0038
H1c/H1e: Telem Stage by Forced score						
Computed Telem Stage	12.6531	.0005	1.1542	1.5502	1.6554	1.9214
Self reported Stage	8.4492	.0041	1.6167	2.0362	2.0544	2.3912
H2a: Awareness by Attitude						
Awareness using CAS score	43.7766	.0000	2.9757	3.2947	3.6970	3.9716
One dimension awareness and attitude scores	13.7014	.0003	3.2988	3.5894	3.6900	4.0475
H2b: Telem Stage by Awareness score						
Computed Telem Stage	26.2518	.0000	1.1176	1.5382	1.8240	2.0525
Self reported Stage	18.4071	.0000	1.5135	1.9486	2.1641	2.4942
One dimension Awareness	12.2228	.0007	1.1071	1.5535	1.6383	1.9412
H2c: Telem Stage by Forced and Awareness Scores						
Computed Telem Stage	14.9733	.0000				
Panel 1			1.4493	1.8569		
Panel 2			1.7644	2.0842		
Panel 3			0.7735	1.2694		
Panel 4			1.6430	1.9883		
Self reported Stage	11.0799	.0000				
Panel 1			1.7679	2.2866		
Panel 2			2.2017	2.6670		
Panel 3			1.0145	1.7035		
Panel 4			1.8714	2.1603		

alternative variables are the same as those from the original variables.

Hypotheses Interaction

To test the interaction, illustrated in Figure 3.2, between the two groups of hypotheses the data is again divided into four groups based on combinations of computer attitude scores and awareness scores. Group one represents the upper left panel of Figure 3.2, group two is the lower left panel, group three is the upper right panel, and group four is the lower left panel. These groups are then compared to determine if significant differences exist in the Telem stage mean scores. Table 4.28 reports the results of an ANOVA test of the groups. The Telem score means for groups three and four (high awareness) significantly differ from the mean for group 1 (low awareness and low attitude). The mean however indicates the average for the group is only at the contagion stage, rather than the maturity stage as postulated in the discussion of the hypotheses interaction. Also, the Telem score means for the remaining combination of groups do not significantly differ from one another. Table 4.29 provides a summary of the hypotheses tests results.

Supplemental Tests of the Data

Two supplemental procedures were performed in order to gain further insight regarding the association between the

TABLE 4.28
Computer Attitude and EDI Awareness Interaction

Description	Group Label	Frequency	Percent	Valid Percent	Cum Percent
neg. att. and low aware.	1	58	30.7	37.2	37.2
pos. att. and low aware.	2	25	13.2	16.0	53.2
neg. att. and high aware	3	19	10.1	12.2	65.4
pos. att. and high aware	4	54	28.6	34.6	100.0
Total		156		100.0	
Not used for analysis		33	17.5		
Total		189	100.0		

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	11.6553	3.8851	8.6514	0.000
Within Groups	152	68.2586	0.4491		
Total	155	79.9138			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
1	58	1.2730	0.8514	0.1118	1.0492	TO	1.4969
2	25	1.6066	0.4998	0.1000	1.4003	TO	1.8129
3	19	1.7544	0.4493	0.1031	1.5379	TO	1.9710
4	54	1.9044	0.5715	0.0778	1.7484	TO	2.0604
Total	156	1.6037	0.7180	0.0575	1.4901	TO	1.7172

Mean	Group	1	2	3	4
1.2730	1	.	.	.	.
1.6066	2	.	.	.	.
1.7544	3	*	.	.	.
1.9044	4	*	.	.	.

TABLE 4.29
Summary of Hypotheses Tests

Group One Attitude Hypotheses	Description	Tests of Hypotheses		
		Original Variables	Reduced Variables	Self Reported Stage
H1a	Owner/managers who have a negative attitude toward computers will also believe EDI systems were forced on them	Not supported	Not Supported	Not Supported
H1b	The computer systems at companies with owner/managers with a negative attitude toward computers will be at the initiation stage of the Telem model	Supported	Supported	Supported
H1c	The computer systems at companies with owner/managers who perceive EDI as forced upon the business will be at the initiation stage of the Telem model	Not Supported	Not Supported	Not Supported
H1d	The computer systems at companies with owner/managers with a positive attitude toward computers will be at the contagion or maturity stage of the Telem model	Supported	Supported	Supported
H1e	The computer systems at companies with owner/managers who do not perceive EDI as forced upon the business will be at the contagion or maturity stage of the Telem Model	Not Supported	Not Supported	Not Supported

(table con'd)

Group Two Awareness Hypotheses	Description	Tests of Hypotheses		
		Original Variables	Reduced Variables	Self Reported Stage
H2a	Owner/managers with a positive attitude toward computer technology will more likely have an awareness of EDI benefits	Supported	Supported	Supported
H2b	The computer systems at companies with owner/managers with an awareness of EDI benefits will be at the contagion or maturity stages of the Telem model	Supported	Supported	Supported
H2c	The computer systems at companies with owner/managers who perceive EDI as forced upon the business and have an awareness of EDI benefits will be at the contagion or maturity stages of the Telem model	One of four outcomes supported	One of four outcomes supported	One of four outcomes supported

intercompany effect of EDI and the level of AIS computerization and integration in small businesses. The first of these procedures employs regression analysis to control for possible confounding factors. The second procedure uses factor analysis to explore possible underlying relationships in the data not previously hypothesized. Each procedure and results are discussed below.

Supplemental Regression Analysis

Regression analysis is a method of explaining the variability of a dependent variable, in this case the Telem stage score, using information about other, independent, variables, such as attitude (Vogt 1993). Regression analysis is useful in this study for investigating the relationship of the study variables, other factors, and the Telem stage.

There are three other factors that may affect the level of AIS computerization for an ag dealer. This supplemental test uses them as control variables. They are: size of the dealer, affiliated manufacturer, and length of time the dealer has used EDI. Several researchers have noted that larger companies computerized their AIS before smaller ones (Cooley, Walz, and Walz 1987; Magal and Lewis 1995). The larger company may have additional internal incentives to utilize computers for

efficiency and information purposes than a smaller one. For example, a larger company may acquire a computer to perform payroll calculations and functions due to the large number of employee checks required, while a smaller company may not have enough employees to justify the cost of automating the process. Therefore, the size of the dealer may be an additional factor in determining the Telem stage. Size is measured by number of employees for this study. Information regarding the number of employees was previously reported in Table 4.5.

While many of the major manufacturers in the ag equipment industry are using EDI, not all are using it in the same manner or impose the same requirement on dealers regarding its use. Some, for example John Deere, require the use of EDI for all parts purchases.[10] Others provide incentives for EDI use in terms of discounts (Hoffman 1995) on EDI parts purchases or subsidizing the dealer's acquisition of EDI equipment. Still others either do not use EDI for dealer transactions or allow its use but offer no incentives for its use or non-use. Manufacturers may also influence other aspects of a dealer's operations, which may in turn affect the level of AIS computerization. Therefore, it may be interesting to investigate if dealer

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[10]Depending on the product line John Deere may require certain purchasing procedures, including EDI, and/or specific computer accounting procedures (McQuitty 1995).

affiliation affects the Telem stage level. Information regarding the respondents' manufacturer affiliations is provided in Table 4.30.

It is implied in the Nolan (1973; 1979) and Telem (1989) stage models that the passage of time is necessary to move from one stage to another. It is logical to assume therefore, that the length of time the dealer has been using a computer, or EDI, may be a factor in determining the extent of computerization and integration of the AIS. If a variable for this factor is included in the regression model, the extent the study variables contribute to the level of computerization and integration beyond that factor can be evaluated. Since this study is primarily interested in the effect of EDI, the number of years the dealer has been using EDI will be used as an indicator of this factor. Information regarding the length of time since the dealer started using EDI was previously provided in Table 4.10.

Regression analysis is a useful method for evaluating the individual effect multiple factors may have on one or more variables of interest. One advantage of using regression is that variables can be used to control for the influence of factors, such as size and manufacturer affiliation, that are not the interest focus of the study. An assumption is made that a linear relationship exists between the various factors of interest and that each

TABLE 4.30
Affiliated Manufacturers

Manufacturer	Count*	Pct of Responses	Pct of Cases
AGCO dealer	40	13.1	21.5
Case/IH Dealer	38	12.4	20.4
Caterpiller Dealer	4	1.3	2.2
Ford Dealer	25	8.2	13.4
Gehl Dealer	14	4.6	7.5
John Deere Dealer	67	21.9	36.0
Kubota Dealer	24	7.8	12.9
Massey Dealer	20	6.5	10.8
New Holland Dealer	31	10.1	16.7
Dealer - Other	43	14.1	23.1
Total responses	306	100.0	164.5

* - many dealers have multiple affiliations

factor makes a contribution to the overall level of the variable of interest. A regression formula which would investigate the relationships of the study variables and the three additional factors of size, years using EDI, and affiliated manufacturer may be stated as follows:

$$TS = \beta_0 + \beta_1 CA + \beta_2 PF + \beta_3 AI + \beta_4 EA + \beta_5 Y + \beta_6 S + \beta_{7-15} AM_{7-15} + \epsilon$$

Where:

TS = Computed Telem stage level, dependent variable
β_0 = Intercept constant
β_{1-15} = Beta coefficient determined by the regression procedure.
CA = Computer attitude score, study variable
PF = Perception EDI forced score, study variable
AI = Awareness of EDI issues score, study variable
EA = EDI attitude score, study variable
Y = Years using EDI, control variable
S = size as measured by number of employees, control variable
AM_{8-15} = Affiliated manufacturer - a zero/one variable for nine different major manufacturers, control variable
ϵ = Random error term

This regression model is tested in a three step process. First, regression analysis is performed using only the study variables as independent variables. In the second step, size and years using EDI are added to the analysis to control for those factors. Finally, the affiliated manufacturer variable is added to the analysis to determine how that affiliation influences the Telem stage. Any respondent surveys missing data for an independent variable are removed from the analysis, instead of replacing the missing data with the mean or other

arbitrary amounts. The data for seven surveys are removed for this reason. One hundred eighty-two cases are left in the analysis after this consideration.

The results of each step in the regression analysis are shown in Table 4.31. The first step of the analysis uses only the study variables and a variable for the intercept of the line with the vertical axis. The results of this step indicate that perception EDI is forced appears to have a statistically significant contribution to a linear relationship with the Telem stage along with the intercept constant. This indicates that some factor, not in the base model, has a significant influence on the relationship analysis. If this influence is due to size or length of time using EDI, an analysis using those two variables will show it. The analysis also indicates that the base model, plus the intercept, explains approximately 23% of the linear relationship.

The second step in the analysis includes size and years using EDI as variables. The results of this analysis are also provided in Table 4.31 and show that the model now explains approximately 46% of the relationship, as shown by the adjusted R^2. This is a significant improvement from the base model in step one, confirmed by the F statistic (35.57717) of the change between the models for step one

TABLE 4.31
Regression Results

Base Model Using Only Study Variables--All Data Cases

Multiple R	0.49939
R Square	0.24939
Adjusted R Square	0.23243
Standard Error	0.62505

Analysis of Variance

	DF	Sum of Squares	Mean Square	F	Signif F
Regression	4	22.97546	5.74387	14.70209	0.0000
Residual	177	69.15099	0.39068		

Variables in the Equation

Variable	B	SE B	Beta	Tolerance	VIF	T	Sig T
Comp Att	0.192588	0.105874	0.142910	0.687062	1.455	1.819	0.0706
Per Forced	0.246999	0.064732	0.271456	0.837893	1.193	3.816	0.0002 *
EDI Att	0.214116	0.126180	0.182303	0.367427	2.722	1.697	0.0915
Aware EDI	0.208715	0.119360	0.177205	0.412927	2.422	1.749	0.0821
(Constant)	-1.444657	0.427648				-3.378	0.0009 *

Model Using Study Variables, Size, and Years Using EDI--All Data Cases

Multiple R	0.68913		
R Square	0.47490	R Square Change	0.22551
Adjusted R Square	0.45689	F Change	37.57717
Standard Error	0.52577	Signif F Change	0.0000

Analysis of Variance

	DF	Sum of Squares	Mean Square	F	Signif F
Regression	6	43.75062	7.29177	26.37805	0.0000
Residual	175	48.37563	0.27643		

Variables in the Equation

Variable	B	SE B	Beta	Tolerance	VIF	T	Sig T
Comp Att	0.115981	0.089868	0.086064	0.674722	1.482	1.291	0.1986
Per Forced	0.079843	0.058479	0.087748	0.726431	1.377	1.365	0.1739
EDI Att	0.166145	0.106946	0.141460	0.361896	2.763	1.554	0.1221
Aware EDI	0.003537	0.103187	0.003003	0.390942	2.558	0.034	0.9727
Years of EDI	0.049448	0.008618	0.365502	0.706286	1.416	5.608	0.0000 *
Size	0.014136	0.002740	0.310376	0.829328	1.206	5.160	0.0000 *
(Constant)	-0.253142	0.386269				-0.655	0.5131

* - significant at 5%

(table con'd)

Model Using Study Variables, Size, Years Using EDI, and Affiliated Manufacturers

Multiple R	0.70971	R Square Change	0.02879
R Square	0.50369	F Change	0.95728
Adjusted R Square	0.45556	Signif F Change	0.4828
Standard Error	0.52641		

Analysis of Variance

	DF	Sum of Squares	Mean Square	F	Signif F
Regression	16	46.40333	2.90021	10.46592	0.0000
Residual	165	45.72312	0.27711		

Variables in the Equation

Variable	B	SE B	Beta	Tolerance	VIF	T	Sig T	
Comp Att	0.134788	0.091208	0.100020	0.656644	1.523	1.478	0.1414	
Per Forced	0.091613	0.062623	0.100684	0.635017	1.575	1.463	0.1454	
Aware EDI	0.024230	0.105061	0.020572	0.378038	2.645	0.231	0.8179	
EDI Att	0.116564	0.110591	0.099245	0.339265	2.948	1.054	0.2934	
Years of EDI	0.047208	0.009634	0.348940	0.593229	1.686	4.900	0.0000	*
Size	0.011473	0.002934	0.251902	0.724821	1.380	3.910	0.0001	*
AGCO	-0.035677	0.115374	-0.020765	0.667051	1.499	-0.309	0.7575	
Case/IH	0.073417	0.114490	0.041941	0.703145	1.422	0.641	0.5222	
Caterpiller	0.149440	0.277190	0.030795	0.921912	1.085	0.539	0.5905	
Ford	0.081592	0.149264	0.039477	0.576735	1.734	0.547	0.5854	
Gehl	-0.106661	0.166985	-0.039948	0.769012	1.300	-0.639	0.5239	
John Deere	0.272155	0.116131	0.183289	0.491731	2.034	2.344	0.0203	*
Kubota	0.012384	0.126128	0.005869	0.836045	1.196	0.098	0.9219	
Massey	0.154939	0.148661	0.068109	0.704348	1.420	1.042	0.2988	
New Holland	0.078924	0.140526	0.041701	0.545595	1.833	0.562	0.5751	
Other dealer	0.033615	0.128237	0.019565	0.539947	1.852	0.262	0.7935	
(Constant)	-0.343225	0.428536				-0.801	0.4243	

* - significant at 5%

and two. The null hypotheses of no significant difference between the two has a statistical probability of zero and can thus be rejected (Neter, Waserman, and Kutner 1983, p. 289-293). However, while both additional variables are now statistically significant, none of the study variables from the base model are. The intercept constant is also no longer significant.

The third step, which adds manufacturer affiliation to the model, further explores the factors that influence the Telem stage. The results, shown on the second page of Table 4.31, indicate that size, years using EDI, and affiliation with John Deere are now significant factors. However, adding affiliated manufacturer did not result in a significant improvement in the explanation of the relationship (significance of F for the change =.4828). Since no significant explanatory improvement is shown when affiliated manufacturer is added, indications are that this variable is related to size and years using EDI. It is logical to assume that manufacturers will encourage their dealers to implement EDI at the same time, and that each manufacturer will introduce the procedure at different times, therefore those two variables would be related.[11] Additional tests, not documented in this study, indicate

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[11]However, multicollinearity diagnostics do not indicate problems in the regression model. All variables have Variance Inflation Factors (VIF) values below 10.

that stratifying the sample data by number of years using EDI will cause different manufacturers to become significant to the model. For example, if only dealers using EDI within the past five years are analyzed, then AGCO becomes the significant manufacture instead of John Deere.

In contrast to the results of the previous tests of hypotheses, the results of the supplemental regression analysis suggests that an association may exist between perception EDI is forced and the Telem Stage. The mixed results appear to be associated with the focus of the tests. The focus of the regression analysis was on the significance of the overall model, including non-study variables, while the focus of the test of hypotheses was to evaluate the variables of interest in the context of the individual hypotheses of the study. The mixed results from the two methods suggest an area for future inquiry.

Supplemental Factor Analysis

Underlying factors, that were not explored by the study variables, may exist that explain the extent of computerization and integration of the AIS. To investigate this possibility, factor analysis is performed on the questions in section three of the survey, not related to

the self-reported Telem Stage.[12] The results from that factor analysis are reported in Table 4.32.

The analysis, using varimax rotation and the regression method in the SPSS procedure to create new variables, derives seven factors from the twenty-seven questions investigated. However, later regression analysis using the summary scores of these factors indicates that only four appear to contribute to the level of computerization of the AIS. These four factors are: Factor 1, factor 3, factor 4, and factor 5. Reviewing the survey questions comprising each factor indicates these factors appear to be related to a work reduction factor (factor 1), comfort factor (factor 3), perception EDI is forced factor (factor 4), and a life improvement factor (factor 5).

Regression analysis, similar to that described above, but substituting the seven factors in place of the study variables, was performed. The results of the analysis are listed in Table 4.33. When only a base model is tested, the four factors described above, along with the intercept constant are significant at the 5 percent level. Size and years using EDI are also significant when added to the

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[12]The factor analysis discussed earlier, in the data analysis section, was for the purpose of assessing the nature and reliability of the study variables, while the purpose of this supplemental factor analysis is to explore other relationships which may be explained by the data.

TABLE 4.32
Supplemental Factor Analysis

Survey Question	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Factor 1:							
44	0.76699	0.16246	0.05086	0.00761	0.21876	0.11449	-0.04829
42	0.74135	0.11665	0.10799	0.10724	0.05873	0.13936	-0.09073
36	0.71085	-0.03490	0.15253	-0.28436	0.14668	-0.08855	0.00114
38	0.69301	-0.05987	0.04523	0.00806	0.15111	0.11817	0.20451
37	-0.67995	-0.26806	-0.00063	0.05663	-0.01721	-0.30945	-0.04804
33	0.66752	0.13005	0.24779	-0.06769	0.17836	-0.04267	-0.09579
34	0.56953	0.13425	-0.08740	-0.13571	0.03121	0.07574	-0.27095
46	0.46899	0.02982	0.35927	0.18395	0.37327	0.05865	-0.00149
30	0.45175	0.40992	-0.02478	0.01859	0.16148	0.07174	-0.35427
Factor 2:							
56	0.08511	0.78837	0.12395	-0.13416	0.10563	-0.03090	0.03165
50	0.18125	0.73660	0.16305	-0.06205	0.05235	0.13961	-0.03904
55	0.10806	0.66530	0.31381	-0.09107	0.26098	-0.09699	0.11663
52	0.10125	0.65657	0.16222	0.06947	-0.23084	0.22711	0.09729
Factor 3:							
49	0.13332	0.30177	0.79361	0.00936	-0.04922	0.03055	0.13388
53	0.01561	0.44547	0.75094	-0.00749	-0.10747	-0.03301	0.17072
43	0.05087	0.03595	0.59638	0.08612	0.12063	0.10896	-0.20285
45	0.33468	0.17315	0.49486	0.01276	0.29358	0.32270	-0.00179
Factor 4:							
39	0.06174	-0.12010	0.12344	0.81153	0.02255	0.02217	0.12200
31	0.01212	-0.02128	0.05883	0.76393	0.00522	-0.05148	0.03285
35	-0.30447	0.01780	0.01028	0.57679	0.19571	0.06233	-0.28569
32	0.18859	0.13657	0.31475	-0.54559	0.29030	0.16953	-0.28867
Factor 5:							
54	0.18510	-0.02928	0.06388	0.06907	0.70954	0.17818	0.16429
51	0.28772	0.09297	-0.05518	-0.09767	0.67086	-0.13176	-0.06317
47	0.39825	0.21263	0.31239	0.16003	0.48759	0.25729	0.06554
Factor 6:							
40	0.18777	0.04908	0.05142	-0.17046	-0.10657	0.79112	-0.06265
41	0.13734	0.11759	0.14868	0.13790	0.34687	0.68078	0.04962
Factor 7:							
48	-0.09406	0.16765	0.00395	0.08530	0.14574	0.01412	0.73184

TABLE 4.33
Regression Using Factors

Base Model Using Only Factors

Multiple R	0.52294
R Square	0.27347
Adjusted R Square	0.24320
Standard Error	0.60882

Analysis of Variance

	DF	Sum of Squares	Mean Square	F	Signif F
Regression	7	23.43946	3.34849	9.03379	0.0000
Residual	168	62.2714	0.37066		

Variables in the Equation

Variable	B	SE B	Beta	Tolerance	VIF	T	Sig T
Factor 1	0.232249	0.045704	0.291046	0.999720	1.000	4.425	0.0000 *
Factor 2	0.068560	0.045794	0.086496	0.999175	1.001	1.497	0.1362
Factor 3	0.209315	0.045971	0.259601	0.999841	1.001	4.553	0.0000 *
Factor 4	0.152450	0.045890	0.189930	0.999731	1.000	3.344	0.0010 *
Factor 5	0.118001	0.045837	0.170437	0.999692	1.000	2.591	0.0104 *
Factor 6	0.056853	0.045842	0.081257	0.999363	1.001	1.246	0.2146
Factor 7	0.055289	0.045863	0.079279	0.999695	1.000	1.205	0.2294
(Constant)	1.637002	0.045915				35.653	0.0000 *

Model Using Factors, Size, and Years Using EDI

Multiple R	0.69755		
R Square	0.48655	R Square Change	0.21310
Adjusted R Square	0.45874	F Change	34.45023
Standard Error	0.51488	Signif F Change	0.0000

Analysis of Variance

	DF	Sum of Squares	Mean Square	F	Signif F
Regression	9	41.70476	4.63386	17.47999	0.0000
Residual	166	44.0061	0.2651		

Variables in the Equation

Variable	B	SE B	Beta	Tolerance	VIF	T	Sig T
Factor 1	0.106612	0.040402	0.153419	0.914963	1.093	2.639	0.0091 *
Factor 2	0.033961	0.039215	0.048790	0.974497	1.026	0.866	0.3877
Factor 3	0.126792	0.040145	0.181482	0.936743	1.068	3.158	0.0019 *
Factor 4	0.075161	0.040610	0.108459	0.901113	1.110	1.851	0.0659
Factor 5	0.041510	0.039672	0.059955	0.941972	1.062	1.046	0.2969
Factor 6	0.000184	0.039300	0.000265	0.963637	1.038	0.005	0.9963
Factor 7	0.032115	0.038944	0.046049	0.991699	1.008	0.825	0.4108
Years of EDI	0.046504	0.008830	0.349143	0.703729	1.421	5.266	0.0000 *
Size	0.013139	0.002700	0.296601	0.830546	1.201	4.866	0.0000 *
(Constant)	1.117662	0.073921				15.120	0.0000 *

* - significant at 5%

model, but factors four and five are not. However, factor four, perception EDI is forced, is significant at a 6 percent level. Variance inflation factors from multicollinearity analysis included in the regression procedure indicate no variables have a value above 10 (Neter, Wasserman, and Kutner 1985 p. 392). Further analysis of these factors should be included in any future research on the extent of computerization and integration of the AIS.

Summary-Data Analysis

The results of statistical tests that describe the nature of the data collected were reported first. These tests describe the nature of the data and those ag dealer companies who responded to the survey questionnaire. Following that, statistical tests were performed to evaluate whether the study hypotheses were supported by the data collected. The results of those tests indicate that of the eight study hypotheses, five were supported while three were not. The results of statistical tests performed to provide additional insight into the underlying elements of the respondent dealers were then reported.

SUMMARY

This chapter described various examinations of the data collected by the study survey questionnaire. The first section recounted statistical tests performed to

evaluate the effectiveness of the survey instrument and procedures. A response rate between 20% and 25% was achieved, dependent upon the base amount used. Tests for response bias indicated a bias may exist for one variable of interest, but not for the survey overall. The data collected, therefore, appears to be representative of the study population.

The second section described results of tests conducted on that data to determine if the study hypotheses were supported. These tests indicate that there does not appear to be an association between the attitude of owner/managers toward computers in general and a perception of being forced to adopt EDI by trading partners. Thus, hypothesis H1a is not supported by the data. Hypotheses H1c and H1d, which hypothesized that a perception that EDI was forced upon the dealers would limit the extent of AIS computerization also failed to be supported by results of the statistical tests performed. However, the two hypotheses that postulated about the influence of computer attitude on AIS computerization, H1b and H1d, were supported. This indicates owner/manager attitude toward computers in general affects the level of computerization and supports prior research in this area.

The final group of hypotheses deals with the owner/manager's awareness, or knowledge, of the benefits of

EDI usage. Tests of these hypotheses, H2a, H2b, and H2c indicate the data supports the contention that more knowledge of EDI issues is related to increased levels of AIS computerization. Respondents exhibiting a low awareness score had low levels of AIS computerization and those with high awareness scores had high levels.

Supplemental tests performed on the data provide more insight about the relationship of other factors and the study variables. These tests suggest that the relationship between owner/manager attitude may be more complex than those explored by the study hypotheses. Specifically, these tests indicate an interaction may exist between owner/manager attitude, perception EDI is forced on the trading partner, size of the dealer, years using EDI, and affiliations with specific manufacturers.

CONCLUSIONS

INTRODUCTION

The purpose of this chapter is to provide a summary and to discuss the implications of this research. The chapter is organized into the following sections: Summary, Implications, Limitations, Extensions, and Conclusion. A Bibliography and three Appendices follow this chapter.

SUMMARY

EDI is the exchange of electronic business documents between economic trading partners, computer to computer, in a standard format. Intercompany cooperation is required for implementation by the nature of EDI. The greatest advantage of using EDI is realized when EDI applications are fully computerized and integrated and with other accounting and operating applications. Large companies realize these benefits through larger transaction volumes and increased efficiency per transaction. However, such increases in volume and efficiency may not be possible for smaller companies. Therefore, the primary incentive for many small companies to adopt EDI is the continuation of trading partner relationships with larger companies who have adopted the technology. This external influence may then be a factor in determining the extent to which

computers acquired for EDI purposes are embodied into the AIS and other operations of the firm.

Models explaining computer growth have been developed by observing patterns of growth in large organizations. The growth in the use of computers has been shown to occur in stages. These stages generally occur as computers are first used as tools to improve the speed and efficiency of existing operations then progress into essential agents in the decision making process. The information accumulated by computerized AIS operations becomes the basis for both strategic and tactical decisions of management. A variation of the Nolan growth model which incorporates characteristics of small organizations and technology changes was developed by Telem (1989). The Telem model is used in this study to measure the magnitude of AIS computerization and integration.

Small organizations differ from large ones regarding computers and information technology in several key characteristics. These include the availability of resources and knowledgeable personnel, organizational structure, and decision time frames involved. Any research concerning the use of computers by small businesses must therefore take into account these differences. Another significant difference concerning small business use of

computers is the attitude and knowledge of the owner/manager (Magal and Lewis 1995).

This study investigated if an intercompany effect exists when computers are acquired at the request of a trading partner in order to implement EDI applications. This intercompany effect is examined by analyzing the association of owner/manager attitude toward computers, perception EDI was forced on the business, and awareness of EDI benefits with the level of AIS computerization and integration.

Two groups of hypotheses were proposed. The first group dealt with the owner/manager's attitude toward computers in general and perception of whether EDI had been forced upon their company by a larger trading partner. The hypotheses in this group asserted that the intercompany effect would be a factor in determining how these attitudes affected the level of AIS computerization and integration. The second group of hypotheses considered owner/manager knowledge, defined as awareness of EDI issues and benefits, may affect the level of AIS computerization.

To test the hypotheses, data was gathered from small businesses in the ag dealer industry using a survey questionnaire. Values for composite variables were determined from the data for computer attitude, perception EDI was forced, EDI attitude, and awareness. The data was

also used to determine the existing level of AIS computerization and integration based on the Telem model. Correlation analysis and one way ANOVA procedures were the primary methods use to test the study hypotheses. Supplementary analysis of the data used regression analysis and factor analysis procedures.

The test results suggest an association does exist between owner/manager attitude and the Telem stage of AIS computerization. However, the hypotheses testing for an association between a perception EDI was forced on the business and the Telem stage were generally not supported, unless manufacturer affiliation is considered. The tests generally supported the assertion of the second group of hypotheses that awareness of EDI issues and benefits is a determinant of AIS computerization and integration.

IMPLICATIONS

The results indicate that both general attitude toward computers and awareness of EDI benefits are associated with the level of AIS computerization and integration. The intercompany effect of EDI may therefore be limited to the extent the owner/manager becomes aware of the benefits of using EDI. The results of this study also indicate that awareness of EDI benefits appears to be more important than general attitude toward computers in determining the Telem stage of a dealership.

The general assertion of the hypotheses of the study was that an intercompany effect exists so that high perceptions of force by owner/managers would be associated with low levels of computerization. However, the initial results of the study suggest the opposite situation may exist. High levels of perceived force were most often associated with high levels of computerization, and low levels with low computerization. Supplemental examination of the data suggest that there may be some relationship between the owner/manager's perception EDI is forced, affiliated manufacturer, and the number of years the dealer has used EDI that makes it difficult to determine the nature of the intercompany effect. The results from a regression model which used variables from factor analysis and variables to control for years using EDI and manufacturer affiliation indicate perception EDI is forced may have an association with the Telem stage.

The mixed results may stem from the following possible scenario: It may be that as some manufacturers require increasing amounts of computerization for EDI, and other purposes, the owner/manager experiences less control over the level of computerization and becomes frustrated. This frustration over the inability to make decisions impacting the dealer's business may then result in a high perception EDI has been forced. The effect may be the reverse of what

the study hypothesized, instead of perception driving the Telem stage level, the Telem stage level is driving the feeling of being forced into decisions which would have not been taken otherwise. This scenario may also explain the response pattern determined when testing for response bias. It appears that those individuals that perceive EDI as being forced upon them appreciate an opportunity to vent their frustration by answering the survey. Future research is needed to determine if this interpretation is valid.

Many small businesses are adopting EDI at the behest of their trading partners. Since the primary benefits of EDI derive from computer automation and integration of accounting and operations functions both within a company and with its trading partners, it potentially acts as a catalyst for the growth of computerization of the AIS of these businesses. Accountants, as the custodians of the AIS, are among the most affected by this computerization. This study adds to the literature toward improving our understanding of the factors involved in the growth of computer use and will improve the accounting profession's ability to adjust to these changes and to aid small business managers to adjust. Interpretation of the results may improve the ability of the CPA to provide relevant suggestions that will be valued and adopted when a small business client is requested to implement or upgrade

technology by a trading partner. The results of this study provide new information regarding how much emphasis CPA/consultants should place on owner/manager attitude and knowledge in formulating implementation strategies.

The results of supplemental factor analysis provides insight into what underlying elements may be involved in the owner/manager's perspective regarding the use of computers and telecommunications in the AIS. These elements may provide clues for successful introduction of new technology in small businesses. They also provide clues regarding the direction future research may take.

LIMITATIONS

The use of participants from a single industry limits the interpretation of the results to some extent. The results may not be valid for small businesses in other industries. However, there are other industries similar to the ag dealer industry (e.g. auto dealers, other whole goods retailers) to which the results may be relevant. Characteristics, such as large dominant manufactures and closely identified manufacturer/dealer affiliations, may be important factors in determining the validity of this study's results to other areas.

While an analysis of the data indicated no serious problems of response bias, the analysis itself is limited in that it uses only the data collected (comparison of

early respondent's data to late respondent's data). Ideally, to test for response bias a comparison of population characteristics and sample characteristics should be made (Ferber 1948; Armstrong and Overton 1977) However, the nature of the businesses surveyed (small, privately owned) means there is little publicly available data for the entire population of ag dealers that can be used to compare with the respondents. Therefore, the inability to compare respondent data to non-respondent data may be considered a limitation of the study.

EXTENSIONS

This study extends prior research in three areas. First, it extends research in the area of small business computer usage. It follows through on the agenda proposed by Cooley, Walz, and Walz (1987) for small business computer research by applying a variation of the Nolan growth model to non-manufacturing small business concerns. In addition, it extends the CAS research of Magal and Lewis (1995), Nickell and Pinto (1986), and Nickell and Seado (1986) by applying the scale in another industry and another time period. It also extends Cragg and King (1993) into another industry and type of company. Secondly, this study applies the Telem variation of the Nolan growth model, to for-profit organizations. Finally, it extends the EDI usage research of Udo and Pickett (1994) and Walton

(1994) by investigating situations where EDI is required and why small businesses use EDI.

Results of this study imply future research is necessary in some areas. Additional research is needed to determine the effect of the owner/manager's perception that EDI is forced on the business. Is this perception created by the initial request of a trading partner, or by a decrease in the owner/manager's ability to determine the level of AIS computerization?

The supplemental factor analysis results also indicate future research is needed regarding owner/manager's understanding of EDI related issues. Do owner/manager's recognize the risks involved in EDI implementations? The reliability and factor analysis results indicate that owner/managers know about the benefits, but may be unaware of the risks. Do trading partners downplay the negative aspects to encourage EDI use?

Additional research is also needed regarding the relationship of manufacturer affiliation and the study variables. To what extent is manufacturer affiliation a factor in determining the level of AIS computerization, owner/manager computer attitudes, and awareness of EDI issues? What is the effect of different manufacturer approaches toward encouraging ag dealer participation in the use of technologies such as EDI? Which of these

approaches moderate the perception EDI is forced on the dealer?

CONCLUSION

This study investigated the intercompany effect of EDI as manifested by owner/managers attitudes and awareness of benefits in determining the level of AIS computerization and integration. Two groups of hypotheses were tested. The results indicate that an association exists between the level of computerization and integration of the AIS, as measured by the Telem stage, and both general attitude toward computers and awareness of EDI benefits. A perception that EDI has been forced on the business by a trading partner appears to have little affect on these two factors or the level of AIS computerization.

The study results suggest that future research is needed regarding the effect manufacturer affiliation has on the study variables, specifically perception EDI is forced on the business, and the level of AIS computerization and integration. Future research is also needed regarding owner/manager awareness of the risks involved in EDI. Additionally, the results of supplemental factor analysis suggest future research is needed to determine the extent other underlying factors may affect computerization and integration of the AIS.

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APPENDIX 1

The agriculture equipment industry consists of several thousand firms. Basically these firms have three type of sales: whole goods, parts, and service. Whole goods consists of tractors, harvesting equipment, and implements used in farm fields that use tractors as their power source. Parts sales are repair components for whole goods. Service sales consist of repair and maintenance of whole goods performed by service personnel of the firm.

One characteristic of the industry is that most dealers are typically associated with one of a small number of major suppliers in the agriculture equipment manufacturing industry, Caterpillar, John Deere and Company, AGCO, Case, New Holland, or a few others. Many are also associated with one or more of the numerous minor suppliers of specialty equipment or generic parts. In this respect, the industry is similar to the automobile industry. However, where the automobile manufacturers often prescribe accounting systems, internal control procedures, and operating procedures for their dealers, the agriculture equipment manufacturers, with possibly the exception of John Deere, typically do not. Most agriculture equipment dealers are closely held corporations

and many meet the Small Business Administration size criteria for small business.

In recent years most of the major suppliers have implemented some sort of electronic ordering system for parts orders. Many of the specialty suppliers probably will in the future, but most do not currently use electronic systems (Kramer 1995). Most of these systems have the characteristics of an EDI system, except that they each use a proprietary format instead of an industry or cross-industry standard format (Hoffman 1995). John Deere's current system has EDI characteristics but a future system, not yet implemented, differs significantly from EDI in that it will be a mandatory on-line real-time inventory/purchasing system that incorporates information from all John Deere ag. dealers (McQuitty 1995).

EDI implementations commonly have a history of proprietary systems by initial implementers in an industry followed by an industry standard format, and eventually cross industry standards to reduce redundancy and inefficiency. Early implementers of electronic ordering systems often use proprietary formats initially to capture a competitive advantage. As more partners implement systems however the proprietary format begins to limit expansion to new trading partners. If the industry follows previous patterns, the advent of specialty suppliers using

electronic ordering systems may create an environment in which EDI becomes more popular with dealers who need to trade with several partners. They may then pressure the major suppliers to convert their proprietary systems to an EDI system with standard formats.

One factor that may reduce the demand for standardized EDI is the small number of software companies that supply applications for the dealer industry and their willingness to-date to provide translating programs for each proprietary format. Two companies, Challenger Business Systems and HBS, currently are the major software suppliers for the dealer industry. The software they sell to dealers presents a common interface for ordering parts to dealer personnel, regardless of the parts supplier, then translates the input data into the proper format for the specific supplier. Since the translation into specific formats for each supplier is a background task, dealers may not clamor for standardized formats. Since the software companies affected are few in number, and may possess some monopolistic pricing ability, they may be willing to continue to provide customized translator programs as long as they are able to pass the development cost on to the dealers.

The software available to the dealers from the major software suppliers is primarily developed as modules of

applications. Each major system function, such as inventory or purchasing, is an application module. These modules can be purchased separately by the dealer or in bundled groups. Once purchased each application module is designed to be integrated with the other modules from the same supplier present on the dealer's computer system.

APPENDIX 2

The most important factor affecting response rates is the design of the questionnaire (Berdie, Anderson, and Niebuhr 1986; Dillman 1978; Childers and Ferrell 1979; Etzel and Walker 1974; Burns and Bush 1995). Making the questionnaire readable and interesting to the participant is more important than factors such as length and inducements in obtaining satisfactory response rates (Berdie, Anderson, and Niebuhr 1986; Dillman 1978; Childers and Ferrell 1979). Pre-testing the survey instrument is important in designing a readable, interesting, questionnaire. Poorly worded questions, questions with inappropriate responses, and formats that incorrectly emphasize one factor at the expense of another can be corrected based on the feedback obtained from pre-testing (Burns and Bush 1995).

Some studies of consumer surveys suggest that small monetary inducements may improve response rates in special circumstances (Armstrong 1975). Typically, these circumstances have not involved surveys of business professionals. Other studies indicate inducements may introduce response and composition biases into the survey results (Jones and Lang 1980). Some have even suggested that inducement offers included in follow-up procedures may

negatively impact response rates (Jones and Lang 1980; Armstrong 1975). Ease of reply is also important for an adequate response rate. Inclusion of a reply envelope is the most common means of achieving this. Studies in the 1960s seem to indicate that use of a regular envelope with a stamp attached was more effective than a business reply envelope (Veiga 1974; Berdie, Anderson, and Niebuhr 1986). However, Harris and Guffey (1978) show that the rate for business reply envelopes has been improving since that time, as the stigma of it being used for sales promotions has diminished.

Follow-up procedures are the second factor that most influence response rates (Berdie, Anderson, and Niebuhr 1986; Dillman 1978; Childers and Ferrell 1979; Etzel and Walker 1974; Jones and Lang 1980). The most common follow-up procedure is a second mailing at an appropriate time after the initial mailing. Other follow-up procedures include: mailing reminder postcards, telephone calls to non-respondents, and continued contact until a response is obtained. Follow-up procedures that are too persistent however may introduce bias into the response. For example, persistent follow-up may be perceived as harassment by the respondent who then completes the questionnaire without full consideration of the answers.

APPENDIX 3

Computer and Parts Purchasing Information Request

Section 1:

Please answer the following questions about computer usage at your company.

1) How many computers does your company own? ☐ None Number owned _____
If your answer is None, please skip to section 2 and answer the questions there.

2) How many years ago was the first computer acquired? (if greater than 20, please enter number)
☐ < 1 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10
☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20 ☐ >20._____

2.a) For what primary purpose was this first computer acquired? (Please check only one.)
☐ Accounting functions ☐ Parts purchases ☐ Word Processing
☐ Inventory functions ☐ Sales functions ☐ Tele-communications
☐ other, please describe _____

For purposes of answering the following questions, if multiple computers are owned please think of all of them as a single "system". The term "PC" refers to a personal computer, for example an IBM PC, clone, or Macintosh.

3) How many years ago was the current computer system acquired? (If current is the first, mark the same as above.)
☐ < 1 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10
☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20 ☐ >20

4) What type of computer system is the current system?
☐ A single, one user, computer ☐ A single computer with multiple terminals
☐ Multiple unconnected single user computers ☐ A remote computer with on-site terminals
☐ Multiple connected PCs using a DOS based network such as Lantastic
☐ Multiple connected PCs using Novell Netware, Microsoft LAN Manager or similar product.

4.a) What operating system is used? (check all that apply)
☐ MS-Dos w/o windows ☐ MS-Dos with Windows ☐ UNIX ☐ Unknown
☐ Windows 95 ☐ Windows NT ☐ IBM OS/2 ☐ Apple/Mac
☐ AS/400 or System 36 (IBM mid-range system) ☐ Other (please identify) _____

5) How many PCs and/or terminals are in the system? (if greater than 20, please enter number)
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10
☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20 ☐ >20. _____

6) Approximately what percentage of employees use this computer system on a regular basis?
☐ < 10% ☐ 20% - 29% ☐ 40% - 49% ☐ 60% - 69% ☐ 80% - 89% ☐ 100%
☐ 10% - 19% ☐ 30% - 39% ☐ 50% - 59% ☐ 70% - 79% ☐ 90% - 99%

7) Who uses this computer system on a regular basis? (check all that apply)
☐ parts employees ☐ accounting employees ☐ sales employees ☐ clerical staff
☐ parts management ☐ accounting management ☐ sales management ☐ owner/manager (yourself)
☐ all employees

8) Which of the following users have an individual PC or terminal for their regular use? (check all that apply)
☐ parts employees ☐ accounting employees ☐ sales employees ☐ owner/manager (yourself)
☐ parts management ☐ accounting management ☐ sales management ☐ all employees

9) What accounting activities are performed using the computer? (check all that apply)
☐ Accounts receivable ☐ Parts Inventory ☐ Parts orders (purchases)
☐ Sales invoicing-parts ☐ Whole goods Inventory ☐ Whole goods orders (purchases)
☐ Sales invoicing-whole goods ☐ Accounts Payable ☐ Fixed Assets
☐ General ledger/Statements ☐ Payroll ☐ Finance Contract Scheduling
☐ Other (please describe) _____

10) What other activities are performed using the computer? (check all that apply)
☐ Scheduling shop service ☐ Sales leads ☐ Word Processing
☐ Tracking leased equipment ☐ Scheduling personnel ☐ Marketing (sales promotions)
☐ Data base systems ☐ Spreadsheets (ex. Lotus 123) ☐ Parts Books
☐ Other (please describe) _____

11) How is access limited, if not all employees are allowed to use all programs on the computer? (check all that apply)
☐ Password required to get on to the computer ☐ Certain programs are password protected
☐ Keyboard locks/mechanical locks on computer ☐ Programs kept on removable disks
☐ Physical location of computer has restricted access ☐ No access limits used
☐ other (please describe) _____

12) How is the information on this computer backed up? (check all that apply)
☐ on diskettes ☐ on tape ☐ on another hard disk ☐ no backup necessary ☐ Other _____

13) Who is the principal software supplier for programs used on the system?
☐ Challenger Systems ☐ PFW ☐ HBS Systems ☐ Intuit (Quicken)
☐ Peachtree ☐ Affiliated manufacturer (ex. JDIS) ☐ Other (please identify) _____

Computer and Parts Purchasing Information Request

Section 2:
Please answer the following questions regarding parts purchases.

14) Who is/are authorized to place parts orders? (check all that apply)
- ☐ owner/manager ☐ service manager ☐ any service employee ☐ any employee
- ☐ parts manager ☐ purchasing agent ☐ any parts employee ☐ other _____

15) Who reviews parts orders for reasonableness and accuracy? (check all that apply)
- ☐ owner/manager ☐ service manager ☐ purchasing agent ☐ CPA, or other external reviewer
- ☐ parts manager ☐ purchasing manager ☐ person placing order ☐ no review necessary

16) Does your primary supplier want you to submit parts orders electronically? ☐ Yes ☐ No
If your answer is No, please skip to section 3 and answer the questions there.

17) Which of the following describes how that supplier encourages electronic parts orders?
- ☐ Required, will not accept non-electronic orders ☐ Discount applied for electronic orders
- ☐ Additional fees charged for non-electronic orders ☐ Supplier supplied computer equipment
- ☐ Other incentives used (please describe) _____

18) Did you have to purchase a computer to order parts electronically? ☐ Yes ☐ No

19) Did you have to purchase software programs to place orders? ☐ Yes ☐ No
If yes, was this software purchased
- ☐ from a computer supply company, or other company, you located?
- ☐ from a source recommended by your affiliated manufacturer or primary parts supplier?
- ☐ Same supplier that provides other software (identified in question 13 above).
- ☐ from another source? (please describe) _____

20) How many years ago did you start ordering parts electronically?
- ☐ < 1 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10
- ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20 ☐ >20

21) Approximately what percentage of your parts orders with THIS supplier are submitted electronically?
- ☐ < 10% ☐ 20% - 29% ☐ 40% - 49% ☐ 60% - 69% ☐ 80% - 89% ☐ 100%
- ☐ 10% - 19% ☐ 30% - 39% ☐ 50% - 59% ☐ 70% - 79% ☐ 90% - 99%

22) With electronic ordering did the frequency of your parts orders
- ☐ Increase ☐ Decrease ☐ Not change

23) With electronic ordering did the dollar amount of each order
- ☐ Increase ☐ Decrease ☐ Not change

24) What assurance is provided that an order has been received?
- ☐ electronic acknowledgment returned ☐ no assurance given or unknown what type is given
- ☐ paper acknowledgment mailed back ☐ other _____
- ☐ Confirmation number is provided

25) If an electronic acknowledgment is received, what is done with this acknowledgment? (Check all that apply)
- ☐ hard copy printed and filed ☐ stored on computer's hard disk
- ☐ stored on separate diskette and filed ☐ stored separately on backup tape
- ☐ Confirmation number is entered into a log book ☐ unknown
- ☐ other (please describe) _____

26) How is information regarding parts orders kept for future reference? (Check all that apply)
- ☐ Copy of each order is printed and filed ☐ Copy of order stored on computer's hard disk
- ☐ Inventory program tracks purchases ☐ Other _____

27) What alternative methods are available for submitting parts orders if the regular computer is broken?
- ☐ Alternative computer on-site can be used. ☐ Order can be phoned/faxed in.
- ☐ Alternative computer off-site can be used. ☐ Paper order sent through mail.
- ☐ Parts orders are delayed until computer repaired.

28) Do any of your other suppliers want you to submit purchase orders electronically? ☐ Yes ☐ No

29) Approximately what percentage of ALL parts orders are submitted electronically?
- ☐ < 10% ☐ 30% - 39% ☐ 60% - 69% ☐ 90% - 99%
- ☐ 10% - 19% ☐ 40% - 49% ☐ 70% - 79% ☐ 100%
- ☐ 20% - 29% ☐ 50% - 59% ☐ 80% - 89%

Computer and Parts Purchasing Information Request

Section 3:
For each statement below please check the box that most closely reflects your personal opinion

	strongly agree	agree	neither agree nor disagree	disagree	strongly disagree
30) Computers can eliminate a lot of tedious work for people.	☐	☐	☐	☐	☐
31) Parts suppliers require parts orders sent electronically without considering the costs to dealers.	☐	☐	☐	☐	☐
32) Using the computer to order parts increases the cost of operating the parts department.	☐	☐	☐	☐	☐
33) Using the computer to order parts enables quicker response to customer needs.	☐	☐	☐	☐	☐
34) Using the computer to order parts reduces paperwork.	☐	☐	☐	☐	☐
35) Parts suppliers consult with dealers before implementing electronic parts ordering.	☐	☐	☐	☐	☐
36) The ability to compete with other dealers is improved by ordering parts electronically.	☐	☐	☐	☐	☐
37) Using the computer to order parts reduces the possibilities for errors.	☐	☐	☐	☐	☐
38) Using the computer to order parts automatically makes it easier to review parts orders.	☐	☐	☐	☐	☐
39) Parts suppliers force the use of computers on dealers.	☐	☐	☐	☐	☐
40) The impact of minor errors are increased when computers are used to order parts.	☐	☐	☐	☐	☐
41) There is a greater chance of unauthorized orders when computers are used to order parts.	☐	☐	☐	☐	☐
42) Using the computer to order parts is easier than other methods.	☐	☐	☐	☐	☐
43) I am uncomfortable using the computer to order parts.	☐	☐	☐	☐	☐
44) Using the computer to order parts eliminates a lot of tedious work.	☐	☐	☐	☐	☐
45) Having to use the computer to order parts is an example of an overuse of computers.	☐	☐	☐	☐	☐
46) Inventory management is easier when the computer is used to order parts.	☐	☐	☐	☐	☐
47) Ordering parts through the computer requires extra work.	☐	☐	☐	☐	☐
48) Computers will never replace human life.	☐	☐	☐	☐	☐
49) Computers make me uncomfortable because I do not understand them.	☐	☐	☐	☐	☐
50) People are becoming slaves to computers.	☐	☐	☐	☐	☐
51) Computers are responsible for many of the good things we enjoy.	☐	☐	☐	☐	☐
52) Soon our lives will be controlled by computers.	☐	☐	☐	☐	☐
53) I feel intimidated by computers.	☐	☐	☐	☐	☐
54) There are unlimited possibilities of computer applications that have not even been thought of yet.	☐	☐	☐	☐	☐
55) The overuse of computers may be harmful and damaging to humans.	☐	☐	☐	☐	☐
56) Computers are dehumanizing to society.	☐	☐	☐	☐	☐

Computer and Parts Purchasing Information Request

Section 3: Continued

For each statement below please check the box that most closely reflects your personal opinion

57) Which of the following best describes the GENERAL use of computers by your company?"

- ☐ A few operations are computerized, mostly parts orders, and some basic accounting functions.
- ☐ The computer is used for many, but is not a critical tool for a majority, of the operations of the company.
- ☐ Almost all operations are computerized, the computer is an essential tool in all operations of the company.
- ☐ Not applicable

58) Which of the following best describes the AVAILABILITY of computers, or terminal, at your company?

- ☐ A single computer is, or a small number of computers are, shared by all users.
- ☐ Several computers, or terminals, are shared by most users, but a few users have exclusive use of a computer or terminal.
- ☐ All regular users have their own computer or terminal.
- ☐ Not applicable

59) Which of the following best describes any computer NETWORK used by your company?

- ☐ No network, any computers are stand-alone systems.
- ☐ A DOS based network such as Lantastic connecting 1 to 5 machines, or a 1 to 5 terminal multiuser computer.
- ☐ A network capable of connecting many computers such as Novell Netware or LAN Manager, or a multiuser computer with more than 5 terminals.
- ☐ Not applicable

60) Which of the following best describes the NUMBER of operating functions are computerized at your company?

- ☐ One to three applications are performed on the computer.
- ☐ Much of the accounting applications and one or two other applications are done on the computer.
- ☐ The computer is used in a majority of the operating applications of the company.
- ☐ Not applicable

61) Which of the following best describes WHO uses the computers at your company?

- ☐ Computer is primarily used by parts personnel and clerical staff. Location manager rarely uses the computer.
- ☐ Computer is used by close to 50% of personnel. Location manager uses regularly but not on daily basis.
- ☐ Majority of personnel use computers in some function of their work. Location manager uses computer on a daily basis.
- ☐ Not applicable

62) Which of the following best describes the TYPE of operations that are computerized at your company?

- ☐ Only basic accounting functions are computerized along with parts orders. Some word processing is done.
- ☐ Most accounting functions are computerized. Some non-accounting functions are. Spreadsheets and other general computer tools are used.
- ☐ A wide variety of functions are computerized. The computer is a vital tool in almost all operating areas.
- ☐ Not applicable

Section 4:

General questions about your dealership

63) Is your dealership organized as a:

☐ Proprietorship ☐ Partnership ☐ Corporation

64) What year did the dealership begin operations? _____

65) How many full time employees? (If more than 70, please enter actual number.)

☐ <10 ☐ 10 - 19 ☐ 20 - 29 ☐ 30 - 39 ☐ 40-49 ☐ 50-59 ☐ 60-70 ☐ > 70. _____

66) How many part-time employees? (If more than 25, please enter actual number.)

☐ None ☐ <5 ☐ 5 - 9 ☐ 10 - 14 ☐ 15 - 19 ☐ 20 - 25 ☐ > 25. _____

67) How many employees were hired primarily for their computer knowledge?

☐ None ☐ only 1 ☐ 2 - 4 ☐ 5 - 9 ☐ 10 - 15 ☐ > 15

68) What equipment manufacturer is your dealership primarily identified with?

☐ AGCO ☐ Case/IH ☐ Caterpillar ☐ Ford ☐ Gehl ☐ John Deere ☐ Kubota
☐ Massey ☐ New Holland ☐ Other, please identify _____

69) What other manufacturer's lines do you carry? (including separate lines of the manufacturer identified above)

_____

70) What is your position in the company (Your title)?

_____

71) What other comments would you like to make regarding computers, electronic orders, or this questionnaire?

_____

_____

VITA

Maurice George Durler was born in Dodge City, Kansas. He graduated from Kansas State University *cum laude* in 1977 with a Bachelor of Science in Business Administration majoring in accounting. He received the Master of Accountancy degree from Kansas State University in 1978. While at Kansas State he was a charter member of Beta Alpha Psi, accounting honorary fraternity, and a chapter officer in Alpha Kappa Psi, professional business fraternity.

Mr. Durler is a Certified Public Accountant in the states of Kansas and Missouri. He was employed in Kansas City, Missouri as an auditor for Troupe, Kehoe, Whiteaker, and Kent, CPAs from 1978 until he joined the faculty at Kansas State University in 1980 as an instructor of accounting. In 1982 he joined Koch Industries, Inc. in Wichita, Kansas as a microcomputer support specialist. He was a management consultant in the Wichita office of Grant Thornton, CPAs from 1989 until 1991.

Mr. Durler was a graduate teaching assistant in the Department of Accounting at Louisiana State University while working on his Doctor of Philosophy degree. During the 1994/1995 academic year he was on the faculty at Emporia State University in Emporia, Kansas. He is a member of the American Accounting Association and the American Institute of Certified Public Accountants.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Maurice George Durler

Major Field: Accounting

Title of Dissertation: An Empirical Analysis of the Association between the Intercompany Effects of Electronic Data Interchange and the Level of Computerization and Integration of the Accounting Information System in Small Businesses

Approved:

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

Date of Examination:

March 4, 1997