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IS AUDITOR PARTICIPATION IN DEVELOPING ELECTRONIC COMMERCE SYSTEMS: THE IMPACT ON SYSTEM SUCCESS

Sandra Cherie Henderson

A Dissertation

Submitted to

the Graduate Faculty of

Auburn University

in Partial Fulfillment of the

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Doctor of Philosophy

Auburn, Alabama

May 11, 2002

IS AUDITOR PARTICIPATION IN DEVELOPING

ELECTRONIC COMMERCE SYSTEMS:

THE IMPACT ON SYSTEM SUCCESS

Except where reference is made to the work of others, the work described in this dissertation is my own or was done in collaboration with my advisory committee.

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Sandra Cherie (Castleberry) Henderson, daughter of Samuel Lawton and Pat (Bryant) Castleberry was born in Moultrie, Georgia. She graduated from Hardaway High School in Columbus, Georgia. She attended Albany State University in Albany, Georgia and graduated summa cum laude with a Bachelor of Science degree in Accounting in May, 1992. Immediately upon graduation, she entered Graduate School, Florida State University in May, 1992. She graduated with a Master's in Accountancy with a concentration in Accounting Information Systems in December, 1993. After working in industry for three years, she entered Graduate School, Auburn University in January, 1997. She is married to Bruce Henderson, Jr., son of Bruce and Ouida (Aldrich) Henderson. She has two children, Trey and Stacy.

DISSERTATION ABSTRACT

IS AUDITOR PARTICIPATION IN DEVELOPING

ELECTRONIC COMMERCE SYSTEMS:

THE IMPACT ON SYSTEM SUCCESS

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In the modern day business environment, organizations are under increasing pressure to develop new electronic commerce (e-commerce) systems in order to remain competitive. Under this pressure to produce new systems, the potential exists for organizations to compromise their traditional internal control systems. To date, very few empirical studies have been conducted to investigate information systems (IS) auditor participation in the development process of e-commerce systems. Most of the studies that have been conducted simply identify the determinants of internal or IS auditor involvement in the systems development process. While many authors state that IS

auditor involvement or participation in the systems development process is a foregone conclusion, few venture to quantify the results.

Organizational data are becoming increasingly vulnerable with recent advances in technology and the increasing use of e-commerce systems. Control procedures are essential to help safeguard valuable organizational assets such as data. IS auditor participation in the development process is one way to ensure that adequate control procedures are considered from the beginning of the systems development process.

An organization's IS auditors are in a unique position to help ensure that the changes in business models, processes, or systems support the organization's business objectives and that adequate control procedures are an integral component from the beginning of the systems development process. In many organizations, in order to mitigate the risks associated with an information system, the internal audit department is assigned the responsibility of implementing a system of internal controls. Because of the additional risks inherent in e-commerce systems and the resulting need for strong controls, it is important that management appreciates the significance of having IS auditors participate in the e-commerce systems development process.

This study developed a framework to assist management in gauging the effectiveness and necessity of IS auditor participation in the e-commerce systems development process with regards to the effectiveness of internal controls and system success. Prior research had not examined the relationships between IS auditor participation in the development process, its antecedents, and the impact on the effectiveness of internal controls and system success from the organizations perspective.

The model developed in this study and an understanding of the factors determining IS auditor participation in e-commerce systems development have the potential to impact future management decisions concerning the allocation of IS audit resources in developing these systems as well as other systems in the organization.

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Computer software used WordPerfect version 10.0; SPSS version 10.0; PLSGraph version 3.00

CHAPTER I

INTRODUCTION

Electronic commerce (e-commerce) is revolutionizing economies, markets, and industry structures (Drucker, 1999). According to Drucker (1999), e-commerce is to the Information Revolution what the railroad was to the Industrial Revolution: a totally new, totally unprecedented, totally unexpected development creating a new and distinct boom. The advances in information technology (IT) that have enabled the growth of e-commerce, in essence, have altered the economy, the way we do business, and the way we create value. E-commerce has been the driving force behind new business processes and business models. E-commerce has been employed in an effort to lower costs, improve customer service, and increase productivity (Buckley, 1999).

The impact of e-commerce on organizations extends far beyond the dollar value of e-commerce activity (Buckley, 1999). In many cases, traditional "brick and mortar" organizations have created their own online stores in an attempt to keep up with the Internet-only businesses (or e-businesses) such as Amazon.com, eBay, and eTrade. Such a transition to e-commerce can affect all aspects of a business from purchasing to marketing and from finance to audit (IFAC, 1999). Since the transition to e-commerce often entails new business models and/or new business processes and most definitely new systems, it is possible that any associated risks may increase proportionately. According

to Martin (2000), when considering risks associated with e-commerce systems, two factors must be considered: (1) the number of people involved and (2) the value of the transactions (payments or contracts). As a rule, the greater the number of people involved, the greater the risk. Similarly, the higher the value of the transaction, the greater the risk (Martin, 2000). Since e-commerce potentially exposes a business to customers world-wide, the potential risks to the business increase accordingly. Some of the risks an e-commerce company could be exposed to include: theft of intellectual property and information, denial of service, negative publicity, and malicious code such as viruses. Thus, it is essential that management take steps to manage these risks by implementing adequate control procedures.

An organization's internal or information systems (IS) auditors are in a unique position to ensure that the changes— whether they be new business models or processes or new systems— support the organization's business objectives and that adequate control procedures are an integral component from the beginning of the systems development process. In many organizations, in order to mitigate the risks associated with an information system, the internal audit department is assigned the responsibility of implementing a system of internal controls. Because of the additional risks associated with e-commerce systems and the resulting need for strong control procedures, it is important that management appreciates the significance of having IS auditors participate in the systems development process.

The IS Auditor's Role

According to the Institute of Internal Auditors, "internal auditing is an independent appraisal function established within an organization to examine and evaluate the adequacy and effectiveness of the organization's internal control system and its overall quality of performance" (The IIA, 2000). Within the literature base, several studies show that internal or IS auditors should be involved in or participate in developing an organization's information systems. One possible way for internal or IS auditors to be involved is to serve as control specialists in systems development (Aggarwal, 1994; Wu, 1992). Internal or IS auditors need to ensure that controls and the internal control environment are adequate, that systems being developed are appropriately auditable, and help identify design weaknesses in the systems (Greenburg & Murphy, 1989; Morris & Pushkin, 1995). IS auditor involvement in developing an information system (IS) from the start, provides a far greater chance of detecting functional shortcomings or internal control weaknesses (Kothari, 1988). Clague (1995) cautions that auditors who do not get involved as early as the planning phase will find themselves potentially faced with the difficult and costly task of adapting systems to include necessary checks and balances after the system is implemented. IS auditor involvement or participation in developing e-commerce systems is especially important because of the additional complexities and risks (e.g., distributed architecture and software, replicated databases, increased exposure to outsider access to corporate data, hackers, etc.) inherent in these types of systems.

In the past, IS auditors dealt with a more easily controlled environment where processing was handled centrally and connections to others outside the organization were

rare. Simple physical security, such as monitored access, sufficiently controlled many of the risks. Within this operational environment, other types of controls such as those that minimize exposure from loss of confidentiality, unauthorized transactions, and communications errors were often relatively unimportant since most processing was performed internally. According to Kalakota and Whinston (1997), with the Internet and the World Wide Web (WWW), there has never been so much potential for electronic connectivity between organizations. Businesses are moving toward e-commerce at an increasing rate, trying to gain a competitive advantage, increase market share, or just trying to stay in the race (Krantz, 1998).

The changes in IT that have enabled the explosive growth of e-commerce create many new opportunities and additional risks for the organization and its IS auditors. Not only is organizational information at risk from users within the organization, but often external users including customers, suppliers, and even competitors have access to an organization's databases. More conservative organizations and individuals are finding security, control, and other audit issues are either being left behind or are acting as inhibitors to e-commerce systems development (Jameison & Baird, 1999). For organizations embracing e-commerce, it is critical that these issues be addressed and adequate controls be implemented. IS auditor involvement or participation in systems development is one way of increasing internal control over the design/development process and thereby improving the auditability of the resulting system (Rittenberg & Davis, 1979; Schneider, 1995).

Conceptual Framework

Both academic and practitioner research have addressed the critical nature of IS auditor involvement and participation in developing information systems (Aggarwal & Rezaee, 1994; Clague, 1995; Grabski et al., 1987; Greenburg & Murphy, 1989; Helms & Weiss, 1983; Prawitt & Romney, 1997; Wu, 1992). However, empirical research examining the impact of IS auditor involvement or participation on the actual success of the system is rare. Even with the perceived benefits of IS auditor involvement or participation in the development process, organizations cannot assume that IS auditors adequately participate or become involved in all systems development projects, especially in newer systems embracing e-commerce. IS auditor involvement and participation in developing information systems is influenced by several factors.

Previous studies identified the factors influencing the level of IS auditor involvement in system. The Morris and Pushkin (1995) study yielded several determinants of internal audit involvement in EDI systems development. The authors found that strategic motivation was the most significant factor related to increased internal auditor involvement in the systems development process. Higher levels of formality in the organization, more management support, and the number of internal auditors employed by the firm also positively impacted internal auditor involvement in the development process. Organizations with smaller IS audit staffs were less likely to involve IS auditors in the systems development process.

Schneider (1995) further expanded the Morris and Pushkin model by proposing four other factors that possibly play a role in determining internal audit involvement in

systems development. These antecedents to internal auditor involvement include: firm size, internal audit tradition, competing needs for internal audit staff, and the skill and experience levels of the systems developers (Schneider, 1995).

In developing a conceptual framework for IS auditor participation and involvement in developing e-commerce systems and the resulting impact on system success, it was necessary to draw from and extend previous models of user participation and involvement in systems development. Hartwick and Barki (1994) posited that user participation and involvement in systems development leads to beliefs "that the system is both important and personally relevant, and the feeling that the system is good."

Tait and Vessey (1988) used contingency theory to explain the direct effects of contingent variables on system success and the effect of user involvement as a mediating variable between the contingent variables and system success. Their model used three contingency variables: user system, technical system, and development process (see Figure 1.1).

The contingency variable, *System Use*, from Tait and Vessey's (1988) model (see Figure 1.1) can be related to the characteristics of the user. Previous research has found that certain individual characteristics impact user involvement in the systems development process. Hunton and Beeler (1997) proposed that user involvement, user attitude, and user self-efficacy impact a user's desired participation in systems development. In addition, the authors proposed that users with an instrumental voice in the development process result in improved user involvement, attitude, and performance.

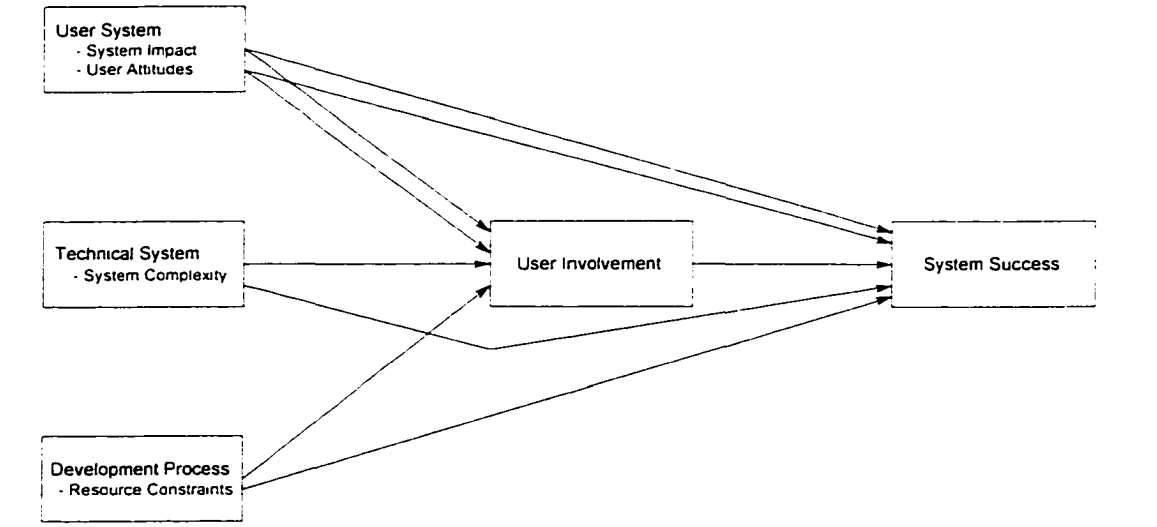

Figure 1.1: Contingency Model of User Involvement and Successful System Design and Implementation

Note. Adapted from "The Effect of User Involvement on System Success: A Contingency Approach," by P. Tait and I. Vessey, 1988, MIS Quarterly, 12(1), p. 93.

System complexity, defined as the perceived complexity associated with the analysis and design of a system, may also contribute to the involvement of the user in the systems development process and impact its success (Tait & Vessey, 1988). The more complex the system, the more the risk of problems in the analysis and specification of the system requirements, thus increasing the risk of an unsuccessful design and implementation. Participative decision making literature suggests that more user participation is required as the task becomes more complex because of the increased knowledge and flexibility necessary for decision making (Morse & Lorsch, 1970; Shaw & Blum, 1966).

Resource constraints may also impact user and IS auditor participation and involvement in the development process. Resource constraints frequently contribute to system failure (Ein-Dor & Segev, 1978). If an organization does not have adequate resources, system designers may have to take shortcuts, thereby increasing the risk for system failure (Tait & Vessey, 1988). User involvement in the development process increases the consumption of both time and financial resources (Boland, 1978; Locke & Schweiger, 1979). There is no evidence that IS auditor participation or involvement increases the consumption of time and financial resources. However, if financial resource constraints are extreme, the budget, disregarding desired auditability, may dictate the amount of IS auditor participation or involvement in the development process.

Research Problem

To date, very few empirical studies have been conducted to investigate IS auditor participation or involvement in the systems development process. Most of the studies that have been conducted involve identifying the determinants of internal or IS auditor involvement in systems development. While many authors state that IS auditor involvement in the systems development process is a foregone conclusion, few venture to quantify the results.

Organizational data are becoming increasingly vulnerable with recent advances in technology and the increasing use of e-commerce systems. Control procedures are essential to help safeguard this valuable asset of the organization. IS auditor participation or involvement in the development process is one way to ensure that adequate control procedures are considered from the beginning of the systems development process.

The primary contribution of this study is the development of a framework designed to assist management in gauging the effectiveness and necessity of IS auditor participation or involvement in the systems development process. Prior research has not examined the relationships between IS auditor participation or involvement in the development process, the antecedents, and the impact on the effectiveness of internal controls and system success from the organization's perspective. In absence of the framework, management could conceivably decide to restrict IS auditor participation or involvement in developing e-commerce systems solely on the basis of time and/or resource constraints.

The second purpose of this study is to better understand the relationships between the antecedent variables, IS auditor participation, the effectiveness of internal controls, and system success by testing a causal model of the relationships. Structural equation modeling improves upon more traditional types of data analysis (i.e., multiple regression analysis) in two basic ways: (1) it accommodates multiple interrelated dependence relationships; (2) it incorporates variables that cannot be measured directly and accounts for measurement error in the estimation process (Hair, Anderson, Tatham, & Black, 1995).

Research Questions and Overall Significance

This study poses several questions concerning the role of IS auditors in developing e-commerce systems:

1. To what degree do IS auditors participate in e-commerce systems development?

2. Does the complexity of the e-commerce system determine the participation of IS auditors in the development of the system?
3. Do organizational factors, practices, or constraints determine IS auditor participation in developing e-commerce systems?
4. Do individual factors such as knowledge, skill, experience, and attitudes play a role in IS auditor participation in e-commerce systems development?
5. Does IS auditor participation in developing e-commerce systems impact system success?

The phenomenal growth of e-commerce and the potential impact of this phenomenon on organizations drives the above research questions. E-commerce systems are being rapidly deployed as a result of this growth. From a control perspective, the propensity to get a Web site up and running quickly in order to gain or maintain a competitive advantage may be inviting disaster if adequate control procedures to protect customer and organizational data are not in place. For example, in January 2000, an individual hacked into the Web servers of an online music seller and stole 300,000 credit card numbers. The hacker then demanded $100,000 or he would release the credit card numbers on the Web. The music seller did not pay, so the hacker posted 250,000 of the numbers. Incidents like this could have disastrous results on a firm's consumer loyalty.

The first research question seeks to determine the extent of IS auditor participation in developing e-commerce systems from two perspectives. First, do IS auditors participate in developing e-commerce systems? With the need to get e-commerce systems operational quickly, is time being taken to ensure that adequate

controls are in place? The objective of the second perspective is to determine in what stages of the systems development life cycle IS auditors participate and to what degree they participate in each stage.

The second research question seeks evidence concerning the complexity of the e-commerce system and IS auditor participation in developing the system. For instance, does a Web site that only provides information to consumers need IS auditor participation in the development process? This research question investigates whether an IS auditor is more likely to participate in developing large and complex systems as opposed to the smaller, simpler systems.

Organizational factors, practices, and resource constraints often dictate the feasibility of systems development projects in general. The third research question seeks to determine whether these same organizational factors influence IS auditor participation in developing e-commerce systems.

The fourth research question investigates whether any individual characteristics of the IS auditor determine his or her participation in the development process. Previous research indicates that individual characteristics such as skill, experience, and attitude play a role in information system use and acceptance (Agarwal & Prasad, 1999; Compeau, Higgins, & Huff, 1999; Compeau & Higgins, 1995; Harrison & Rainer, 1992; Nickell & Pinto, 1987; Robey, 1979). User involvement literature also indicates that individual factors, especially attitude, affect user involvement in the systems development process (Barki & Hartwick, 1994; Hunton & Beeler, 1997; Tait & Vessey, 1988). This

study seeks to determine whether these effects also apply to IS auditor participation in developing e-commerce systems.

Previous research on user participation and involvement in systems development has yielded mostly inconclusive results (Hunton & Price, 1994; Tait & Vessey, 1988). Although several studies from the accounting literature state that internal or IS auditor participation or involvement in systems development is critical, little empirical research has been conducted to confirm that any benefits actually exist (Wu, 1992).

The overall purpose of the study is to determine the antecedents of IS auditor participation in developing e-commerce systems and the impact of that participation on the effectiveness of internal controls and the success of the system through the use of structural equation modeling. Assuming an impact on the effectiveness of internal controls and/or system success, the resulting model should be an important aid in helping top management and internal audit managers determine which systems should have IS auditors participate in the development process. In addition, they should be assisted in deciding which IS auditors (based on their individual characteristics) would have more of an impact on the process, and at what level of participation the most impact is created. Thus, the model would allow internal audit managers to make more effective and efficient allocation of scarce resources such as IS auditors to those systems that would benefit the most from IS auditor participation in the development process, with the ultimate goal being system success.

Organization of the Dissertation

Chapter I presents an overview of the research problem under investigation. The chapter presents the conceptual framework for the investigation. The specific research questions being studied are also introduced. Chapter I concludes with the overall organization of the dissertation.

Chapter II provides a review of relevant literature published prior to this study. The chapter begins with a discussion of electronic commerce followed by a discussion of internal controls, and finally, electronic data interchange. System success and user involvement/participation literature bases as they relate to the conceptual model are also discussed.

Chapter III introduces the conceptual model and the associated research hypotheses. The components of the conceptual model are discussed in the light of previous research. Each hypothesis is derived from this discussion of the previous literature.

Chapter IV discusses the research methodology used to address the research questions. The chapter presents the operational definitions of the variables used in the study. Measurement and structural models are presented, along with an explanation of the partial least squares (PLS) approach to structural equation modeling. The chapter also presents the results of the pilot study.

Chapter V presents the results of the statistical analysis of the data, specifically the responses from the survey. The chapter provides the results of the analyses relating to the hypotheses presented in Chapter III.

Chapter VI discusses the results of the study. The chapter provides the summary and conclusions to the study and presents some ideas for future research.

CHAPTER II

REVIEW OF RELATED LITERATURE

A review of the related literature is presented in this chapter. The first sections of this chapter discuss electronic commerce and internal controls. Since there is very little literature describing the relationship between electronic commerce and internal controls, electronic data interchange (EDI)– a subset of e-commerce– is discussed as it relates to controls and IS auditor participation in the development process. The remaining literature review is devoted to system success and user participation and involvement.

Electronic Commerce

Definitions of e-commerce vary considerably, but in general, e-commerce refers to all forms of commercial transactions involving organizations and individuals that are based upon the processing and transmission of digitized data, including text, sound, and visual images (DOC, 2000; OECD, 1997). In its most basic form, e-commerce includes telephone, facsimile, automated teller machines (ATMs), electronic funds transfer (EFT), and electronic data interchange (EDI). More often, though, e-commerce is simply thought of as the buying and selling of goods and services through the Internet, particularly the World Wide Web (WWW). For the purposes of this study, the latter is the definition that will be used since it is the World Wide Web through the Internet that spawned the phenomenal growth of e-commerce.

Estimates of the size of the Internet vary greatly, but by any standard the growth is remarkable. Worldwide, fewer than 40 million people had access to the Internet in 1996, more than 100 million had access by the end of 1997, an estimated 171 million were connected as of May 1999, and an unprecedented 275 million were online as of February 2000 (Nua, 2000). From 1998 to 1999, the number of Internet users worldwide rose by 55 percent, the number of Internet hosts increased by 46 percent, the number of web servers rose by 128 percent, and the number of new web addresses increased by 137 percent (Thompson, 1999). Consumers shopping online generated $2.4 billion in business-to-consumer (B2C) revenues in 1997, $8.0 billion in 1998, and $20.2 billion in 1999 (Zapf, 2000). Worldwide, business-to-business (B2B) e-commerce totaling $145 billion in 1999, is expected to reach $7.29 trillion in 2004 (McCall, 2000a, 2000b).

The two most common forms of e-commerce that are at the core of the phenomenal growth mentioned in the preceding paragraph are business-to-consumer (B2C) and business-to-business (B2B) e-commerce. B2C e-commerce may be thought of as the basic type of e-commerce because it was first exploited by retail "e-businesses" such as Amazon.com, eTrade, and eBay that were created as Internet-only versions of traditional bookstores, brokerage firms, and auction houses. These e-businesses could deliver almost unlimited content on request and could react and make changes in near real time because of the freedom from the geographic confines and costs of running actual stores (Buckley, 1999). These factors soon caused traditional "brick and mortar" stores to launch their own online stores (e.g., Barnes and Noble, Merrill Lynch, Southebys).

B2B e-commerce has many of the same advantages that hold for B2C e-commerce organizations such as the ability to increase the services they can offer their business customers. Internet technology has helped to create new relationships and to streamline and augment supply chain processes. The role of many intermediaries is obviated and there is a large scale disintermediation in many industries.

E-commerce is not without risks or barriers. Market conditions constantly change as new competitors can easily enter the market with new business models. Customer loyalty is precarious as competitors are only a mouse click away. Competitive advantage is short-lived as traditional barriers are rendered irrelevant by technological advances (Oracle, 1999). The very architecture of the Internet makes an organization's data more vulnerable to attack from outsiders (i.e., hackers) or viruses. Adequate control systems are especially important with interorganizational systems such as e-commerce systems. Establishing controls that can help mitigate risks can mean the difference between success and failure for not only the e-commerce system, but also for the organization as a whole. Therefore, having the internal auditing department, which is generally responsible for implementing control procedures, participate in the development of the e-commerce system would seem to be a logical management decision.

Internal Controls

Controls are activities performed to eliminate or minimize risks to an acceptable level (Hollander, Denna, & Cherrington, 2000). In most cases, it is cost prohibitive to implement every type of control in an effort to eliminate all elements of risk. Thus, IS auditors must be aware of an organization's objectives and must weigh the costs of

implementing a control against the potential benefits of that control. Maximizing organizational benefits through the judicial use of controls in e-commerce systems can enhance control over the systems and reduce the costs of implementing those controls.

Internal Control– Integrated Framework

Accounting professionals refer to the rules, policies, and procedures involved in managing an organization's risks as the system of internal controls. The way accountants should view internal controls was changed in 1992, as a result of a study, *Internal Control— Integrated Framework* (the Integrated Framework), issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). According to the Integrated Framework, "internal control is...designed to provide reasonable assurance regarding the achievement of objectives in the following three categories: effectiveness and efficiency of operations, reliability of financial reporting, and compliance with applicable laws and regulations" (COSO, 1992). COSO also identified five interrelated components of an internal control system: the control environment, risk assessment, control activities, information and communication, and monitoring. These five components are described in Table 2.1. IS auditors and system developers can use the Integrated Framework to assess inherent risks in e-commerce systems, thereby allowing auditors to address controls that minimize the potential risks of deploying e-commerce applications (Aggarwal, Rezaee, & Soni, 1998).

Table 2.1
Interrelated Components of an Internal Control System

Component	Description
Control environment	The control environment sets the tone of an organization, influencing the control consciousness of its people. Control factors include integrity, ethical behavior and competence of the organization's people.
Risk assessment	Risk assessment is the identification and analysis of relevant risks to achievement of objectives as well as determining any necessary controls to manage them.
Control activities	Control activities are the policies and procedures followed to ensure actions are taken to minimize any risks associated with achieving organizational objectives.
Information and communication	Information and communications involve methods for identifying, capturing, and communicating pertinent information in an appropriate time frame that makes it possible to run and control the business.
Monitoring	Monitoring is the process of assessing, reviewing, and correcting internal controls over time.

Note. Adapted from "Internal Control—Integrated Framework," Committee of Sponsoring Organizations of the Treadway Commission, 1992.

The first component an IS auditor considers is the control environment. If top management creates an environment with a commitment to competence, a high degree of integrity and ethical behavior, and so forth, we would expect IS auditors to be able to rely more on the system of internal controls.

Identifying risk associated with the implementation of an e-commerce system and the organization's objectives is a major IS auditor task. Risk assessment involves determining what risks need to be controlled and the required internal controls to manage the risks. Some of the risks that are associated with an e-commerce environment include:

fraud, loss of privacy and/or confidentiality, lack of authentication, repudiation, corruption of data, business interruptions, and inadequate funding (Martin, 2000, February 1).

Control activities are the actual actions taken to minimize risks. At this stage, IS auditors involved in the development of the e-commerce system can help ensure that controls are built into the system and business processes associated with the e-commerce system. The important categories of control activities include: separation of duties, physical controls, information processing controls, and performance reviews (Hollander et al., 2000).

The information and communication component of the internal control system involves recording, maintaining, and reporting the events of the organization, as well as communicating internal control related information to the appropriate parties. The IS auditor should ensure that the system provides accurate and complete information that correctly reports results of the system. The communication aspect of this component relates to the understanding of the roles and responsibilities of individuals as they pertain to the internal controls built into the system (Hollander et al., 2000).

The monitoring component involves assessing the quality of internal controls over time. IS auditors can accomplish this task by conducting periodic evaluations to review the internal controls of the e-commerce system, evaluate their effectiveness, report the results, and provide recommendations to management.

Control Objectives for Information and Related Technology

Another framework that addresses the need for management and control of information and IT is the Control Objectives for Information and Related Technology (COBIT) Framework. COBIT was first released in 1996 by the Information Systems Audit and Control Foundation (ISACF). COBIT helps bridge the gaps between business risks, control needs, and technical issues (IT Governance Institute, 2000).

COBIT is based on the premise that management must ensure that the internal control system or framework which supports the business processes is in place. In addition, management must make clear how each individual control activity satisfies the information requirements and impacts the IT resources (IT Governance Institute, 2000). The COBIT Framework provides a tool that facilitates the implementation of this responsibility.

The underlying theory behind COBIT purports that there are three levels of IT effort in considering the management of IT resources: domains, processes, and activities/tasks. Starting at the bottom, activities and tasks are needed to achieve measurable results. COBIT consists of 34 high-level Control Objectives, one for each of the processes, grouped into four domains: planning and organization, acquisition and implementation, delivery and support, and monitoring. Figure 2.1 illustrates the COBIT processes defined within the four domains. These domains are identified using wording that management would use in day-to-day operations. Definitions of the four domains provided by the IT Governance Institute (2000) are:

Planning and Organization. This domain covers the strategical and tactical identification of the way IT can best contribute to the achievement of the organization's business objectives. The strategic vision should be planned, communicated, and managed for different perspectives. Finally, a proper organization and the technological infrastructure must be in place.

Acquisition and Implementation. In order to realize the IT strategy: IT solutions must be identified, developed or acquired, implemented, integrated into the business process, and maintained.

Delivery and Support. This domain involves the actual delivery of required services, which range from traditional operations over security and continuity aspects to training. In order to deliver services, any necessary support processes must be in place.

Monitoring. This domain involves regularly assessing IT processes over time for their quality and compliance with control requirements. It thus addresses management's oversight of the organization's control processes and independent assurance provided by internal and external audit functions or obtained from alternative sources.

By addressing the Control Objectives with reference to the organization's policies and standards, management can ensure that an adequate control system is provided for the IT environment. In addition, audit guidelines corresponding to the 34 Control Objectives enable auditors in reviewing IT processes against COBIT's recommended control objectives that provide management assurance and/or advice for improvement (Lainhart, 2001). Table 2.2 provides the 34 Control Objectives contained within the four domains of the COBIT Framework.

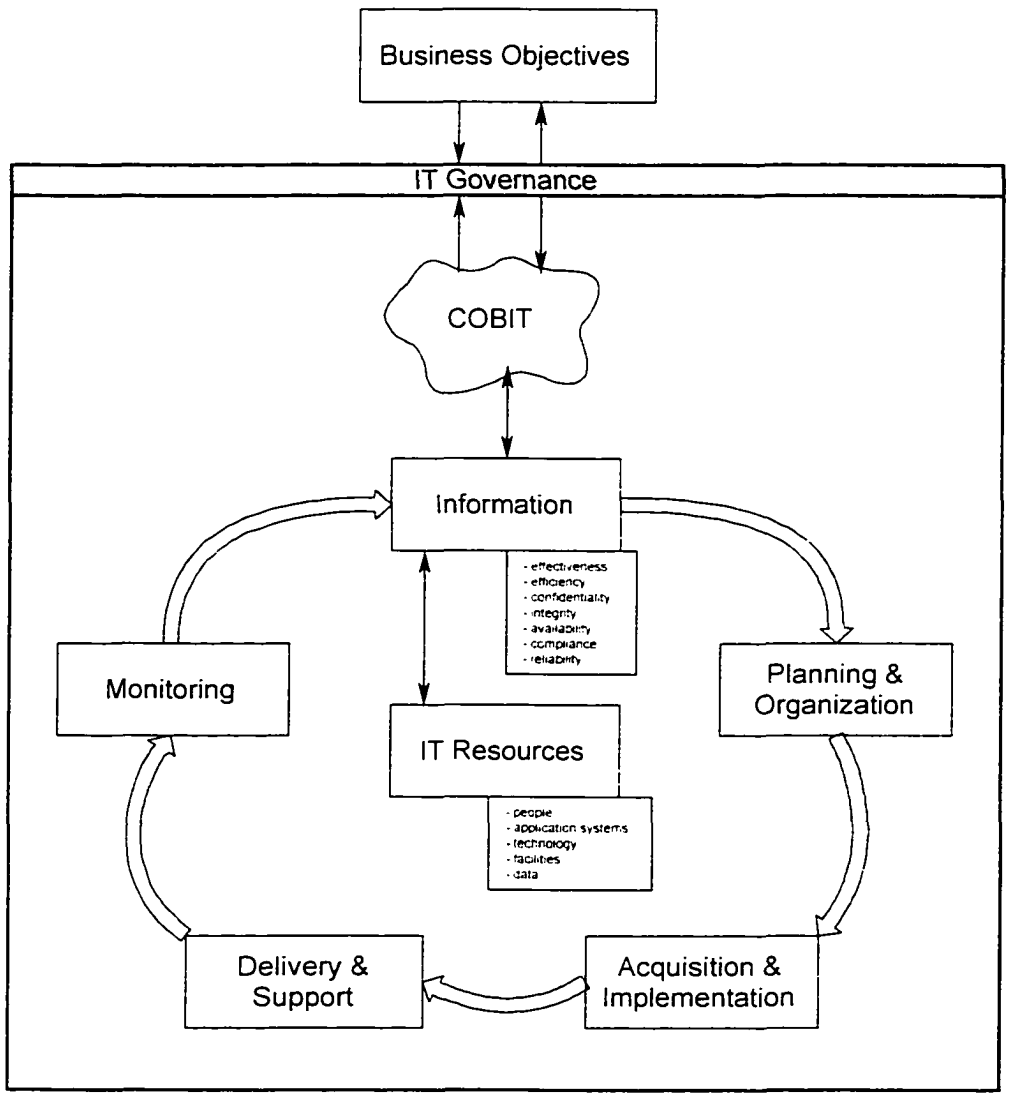

Figure 2.1. The COBIT Framework.

Note. Adapted from "COBIT Framework," 3rd Edition, Released by the COBIT Steering Committee and the IT Governance Institute, 2000, p. 7.

Table 2.2
COBIT Control Objectives Within the Four Domains.

Planning and Organization	
PO1	Define a strategic IT plan
PO2	Define the information architecture
PO3	Determine the technological direction
PO4	Define the IT organization and relationships
PO5	Manage the IT investment
PO6	Communicate management aims and direction
PO7	Manage human resources
PO8	Ensure compliance with external requirements
PO9	Assess risks
PO10	Manage projects
PO11	Manage quality

Acquisition and Implementation	
AI1	Identify solutions
AI2	Acquire and maintain application software
AI3	Acquire and maintain technology architecture
AI4	Develop and maintain IT procedures
AI5	Install and accredit systems
AI6	Manage changes

Table 2.2 (Continued.)

Delivery and Support	
DS1	Define service levels
DS2	Manage third-party services
DS3	Manage performance and capacity
DS4	Ensure continuous service
DS5	Ensure systems security
DS6	Identify and attribute costs
DS7	Educate and train users
DS8	Assist and advise IT customers
DS9	Manage the configuration
DS10	Manage problems and incidents
DS11	Manage data
DS12	Manage facilities
DS13	Manage operations

Monitoring	
M1	Monitor the progress
M2	Assess internal control adequacy
M3	Obtain independent assurances
M4	Provide for independent audit

Electronic Data Interchange (EDI) Literature

EDI is the movement of information electronically between a buyer and a seller for the purpose of facilitating a business transaction (Hansen & Hill, 1989). Similar to e-commerce, the benefits of EDI include: reduced order lead times; fast and efficient communications with customers, suppliers, and other trading partners; shorter response time, tight inventory controls, better cash management, and elimination of much paperwork; improved communications about promotions, price changes, and product availability; better accuracy in ordering, shipping, and receiving; availability of data instantly from all subsidiaries and trading partners; and reductions in labor costs (Aggarwal et al., 1998; Stern & Kaufman, 1985). Firms are finding it necessary to adopt EDI in order to remain competitive (Aggarwal et al., 1998; Peters, 1987).

Risks in an EDI Environment

However, use of EDI technology– as with most technologies– brings its own set of risks and exposures to a business. This is especially true in cases where EDI is rapidly being implemented by organizations without regard to risks and controls due to pressures from customers to adopt the technology (Mehta, 1998). According to Mehta (1998), there are various control concerns associated with EDI:

(1) Total System Dependence. Once an organization depends totally on the system to perform tasks associated with exchanging documents electronically, the knowledge and ability to perform these tasks manually diminish.

(2) Loss of Confidentiality of data. Data typically travels over third-party value added networks (VANs) or over the Internet. Since messages may not be

encrypted. VAN providers have the ability to read/delete/modify the EDI contents intentionally or unintentionally. When the Internet is used for EDI, confidentiality of the messages cannot be guaranteed.

(3) Unauthorized Transactions and Fraud. The potential negative impact of executing unauthorized transactions and fraud is greater in an electronic environment due to the various logical access paths typically available in a networked environment. This type of activity, without proper controls, leaves no trace. For example, a dishonest employee or outsider who gains access to a transaction could potentially edit the transaction through logical access before it is transmitted. Unless there are adequate controls to mitigate this risk, such fraud may not be detected and/or prevented.

(4) Concentration of Control. In a typical control environment, there is a general separation of duties. For instance, in an accounts receivable transaction, one person will record the sale, another person will receive payment, and a third person will deposit the money in the bank. With an EDI system, greater reliance is placed on the system, thus there is less of a paper audit trail and fewer people involved in a transaction. Consequently, if there are control deficiencies in the EDI environment, the negative impact on the business could be potentially greater. However, many feel that concentration of control cannot be viewed as a negative. The computer system, being less prone to error, can perform various duties automatically that previously required different employees for a "manual" separation of duties.

(5) Reliance on Third Parties. In an EDI environment, reliance of having appropriate control over information is often placed on third parties such as business partners. Therefore, the boundary of control expands to incorporate the third parties.

(6) Data Processing, Application and Communications Errors. Errors can be introduced at the origination of the message, the VAN provider(s), and/or while in transit.

(7) Potential Legal Issues. There are many questions that can arise out of an EDI transaction. For example: Does the business have to accept the order received? Is this a valid transaction with legal standing? Who will bear the loss? Will electronic records hold up in court? The questions become even more perplexing when international trade is involved. With global trade, businesses not only have to deal with United States federal and state laws, but also with the legal systems of multiple countries. The question then becomes which country's jurisdiction applies to the transaction (Mehta, 1998).

Controls Used in an EDI Environment

As with any business environment, a logical and commonly used approach to controlling EDI begins with developing control objectives that define what threats/risks need to be prevented, detected or corrected. Then, control procedures that satisfy the control objectives can be identified (Joseph & Engle, 1996). Control objectives can be grouped into five categories: timeliness; accuracy/integrity; security; recoverability/

retention; and processing (Aggarwal, 1994; Bort & Bielfeldt, 1995; Joseph & Engle, 1996).

Timeliness means that messages are dispatched without delays, and are made available for processing rapidly. Preserving accuracy/integrity involves reducing errors or distortion, ensuring message completeness, and reducing the chance of accepting duplicate messages. Security involves protecting messages, and the systems that create and receive EDI messages, from compromise. The recoverability/retention objective relates to the ability to retransmit or recover damaged or lost messages, while meeting operational, legal, or other mandated needs. The processing objective focuses on correctly interpreting a message's purpose and content, and protecting applications from outside compromise (Joseph & Engle, 1996).

Table 2.3 lists the 31 control procedures that can be used to fulfill each of the five control objectives mentioned above. Some of the control procedures are unique to EDI, while others can be used in non-EDI environments such as e-commerce. The approach of first identifying control objectives and then identifying the necessary control procedures ensures that:

(1) Threats are not overlooked by the internal control structure;

(2) Controls are installed only when threats actually exist;

(3) The need for a specific control can be justified; and

(4) Control procedures achieve the stated control objectives, and that all parts of each control objective are addressed by a control (Joseph & Engle, 1996).

IS Audit Function in an EDI Environment

Morris and Pushkin (1995) examined the factors that are related to internal audit involvement in the development of information systems for EDI. The authors found several factors that were significantly related to IS auditor involvement in EDI systems development. In large U.S. corporations, strong relationships exist between strategy, organizational structure, and the use of IS auditors (Morris & Pushkin, 1995). Morris and Pushkin (1995) found that the best predictor of IS auditor involvement in developing EDI systems was the strategic motivation.

Table 2.3
EDI Control Objectives Matched to Control Procedures

Control Objectives*					
T	A/I	S	R/R	P	Control Procedures
X		X			1. Centralized network administration membership and connectivity (handshaking) controls
		X	X	X	2. Message sequence numbers
X	X		X		3. Message date/time stamps
X		X			4. User-ID and terminal-ID tags on messages
	X				5. Standardized communications formats and interchange structures
	X		X		6. Batch totals, checksums in interchange structure
				X	7. Standardized distinction of transaction and functional group codes
		X			8. Security header/trailer segments in the interchange structure
		X			9. Network access controls
		X			10. Digital signatures and non-repudiation assurances
		X			11. Enforcing the separation of incompatible functions
	X	X			12. Message receipt confirmation and acknowledgment
	X				13. Edits and message screening in VAN and trading partner EDI systems

Table 2.3 (Continued)

Control Objectives*					
T	A/I	S	R/R	P	Control Procedures
	X	X	X		14. Message log files at sender, receiver, and VAN
	X	X			15. Parceling large messages into smaller units
				X	16. Period processing and VAN message warehouse
				X	17. Clear distinction of EDI system software components: communications, translation, mapping
	X			X	18. Controlling software development
X	X			X	19. Through-the-system tests and audits of EDI applications
		X			20. Encryption techniques: strengths and weaknesses
		X			21. Message authentication codes
X		X			22. Trading partner agreements
		X			23. Contractual audit rights and third-party internal control assurances
		X			24. Embedded audit modules
				X	25. Computer assisted audit techniques
				X	26. Computerized reconciliation with outside data sources
		X			27. Auditor electronic confirmation requests
			X		28. Establish/publish retention standards and policies
X	X				29. Network monitoring and periodic equipment checks/tests
X	X				30. Line conditioning to reduce noise levels
				X	31. Computer infector scanning

* Control Objective Codes:

T = Timeliness

A/I = Accuracy/Integrity

S = Security

R/R = Recoverability/Retention

P = Processing

Note. Adapted from "Controlling an EDI Environment," by G. W. Joseph and T. J. Engle, 1996, Journal of Systems Management, (July/August), p. 44.

In addition to strategic motivation for adopting EDI, Morris and Pushkin (1995) found that the number of IS auditors employed by the firm, the extent of formal policies and procedures, and management concern for the IS audit and control function all impact IS auditor involvement in the development process. They also found that firms with smaller IS audit staffs were less likely to involve IS auditors in systems development.

System Success

Early research efforts in assessment of the value of the IS function were based on economic considerations and introduced the idea that multiple assessment measures were essential in developing a clear picture (Ahituv, 1980; King & Schrems, 1978; Matlin, 1979). Most early attempts at assessing the IS function considered measures of system availability and performance (Myers, Kappelman, & Prybutok, 1997). McLean (1973) was one of the first to shift the IS function success measurement focus from efficiency to effectiveness. Efficiency is concerned with doing things right; effectiveness is concerned with doing the right thing (McLean, 1973). Lucas (1972) first introduced the ideas of including users when assessing the IS function.

Knutsen and Rolan (1974) were among the first researchers to operationalize the benefits of computer systems. Swanson (1974) identified 16 items constituting manager appreciation of the information system. Gallagher (1974) identified four major dimensions of the value of a MIS: quantity, reliability, quality format, and timeliness. Schultz and Slevin (1975) developed an instrument to measure system implementation success yielding seven dimensions. Ginzberg (1979) introduced a taxonomy of benefits

resulting from changes in organizational processes and the information produced. Zmud (1978) used these dimensions to empirically derive eight IS success dimensions.

Larcker and Lessig (1980) developed an instrument that measured the perceived usefulness of information. The two main dimensions were perceived importance and perceived usefulness. Davis (1989) developed and validated scales for perceived usefulness and perceived ease of use.

Other authors attempted to focus on the economic benefits of IS success with little success (Melone, 1990). Difficulties with measurement and computation have impeded research progress in the area, thus it has been necessary to find other dimensions important in assessing IS success. Research literature has exhibited a preference for perceived, rather than objectively measured success (Robey, 1979). A number of studies have used system usage as a surrogate for system success (Baroudi, Olson, & Ives, 1986; Lawrence & Low, 1993; Robey, 1979; Schewe, 1976; Srinivasan, 1986; Torkzadeh & Doll, 1994). User information satisfaction has also been a popular surrogate for system success (Bailey & Pearson, 1983; Bernard, Satir, & Satir, 1993; Henry, 1990; Ives & Olson, 1983).

However, user information satisfaction has been criticized for having an inadequate definition of the key constructs, a poor theoretical base, a narrow scope, and it does not take the modern IS environment properly into account (Doll & Torkzadeh, 1988; Galletta & Lederer, 1989; Melone, 1990). Saarinen (1996) extended the user information satisfaction measure to include the development process and the impact of the information system on the organization. Measurement scales for four dimensions of IS

success were developed by Saarinen (1996): the development process, use process, IS product quality, and impact of the IS on the organization.

DeLone and McLean (1992) created an IS success model based upon the premise that researchers should "systematically combine individual measures from IS success categories to create a comprehensive measurement instrument." Their model depicts the relationships of six IS dimensions. They contend that

> *System quality* and *information quality* singularly and jointly affect both use and *User satisfaction*. Additionally, the amount of *use* can affect the degree of *user satisfaction* - positively or negatively - as well as the reverse being true. *Use* and *user satisfaction* are direct antecedents of *individual impact*; and lastly, this *impact* on individual performance should eventually have some *organizational impact*.

Delone and McLean's (1992) model is an important contribution to the IS success literature because it was the first study that tried to impose some order on the choice of success measures (Seddon, Staples, Patnayakuni, & Bowtell, 1999). Seddon's (1997) respecification of the DeLone McLean (1992) model posits that different individuals are likely to evaluate the consequences of IT use in different ways. IS success is conceptualized as a value judgement made by an individual, from the point of some stakeholder (Seddon, 1997). Seddon et al. (1999) posited that the evaluation of IS effectiveness is generally based on one or more of five points of view:

- The independent observer who is not involved as a stakeholder (a person or group in whose interest the evaluation of IS success is being performed)
- The individual who wants to be better off
- The group, which also wants to be better off

- The managers or owners who want the organization to be better off, and
- The country which wants society as a whole to be better off.

In determining the appropriate measures from the six dimensions of IS success, research should be conducted by systematically combining individual measures to develop a comprehensive measurement instrument, while considering contingency variables such as the independent variables being researched: the organizational strategy, structure, size, and environment of the organization being studied: the technology: and the task and individual characteristics of the system being studied (DeLone & McLean, 1992).

Mirani and Lederer (1998) found several strategic benefits of an IS project including competitive advantage, alignment, and customer relations. The authors cautioned that their findings were appropriate if the focus was on success at the organizational level.

User Involvement and User Participation Literature

User involvement has been defined as participation in the development process by a member or members of the target user group (Olson & Ives, 1981). It is often referred to as a set of operations or activities that users have or have not performed (Baroudi et al., 1986; Franz & Robey, 1986). User involvement in information systems development is often assumed to be an important element in improving system quality and ensuring successful implementation (Barki & Hartwick, 1989, 1994; Baroudi et al., 1986; Cushing, 1990; Hartwick & Barki, 1994; Hunton & Beeler, 1997; Keen & Gerson, 1977; King & Rodriguez, 1978; Kling, 1977; Lawrence & Low, 1993; Locander, Napier, & Scamell,

1979; Olson & Ives, 1981; Swanson, 1974; Tait & Vessey, 1988). Previous research has focused on the relationship between user involvement and either system usage or user satisfaction with the resulting system (Ives & Olson, 1984; Olson & Ives, 1981). However, few empirical studies have found significant relationships between user involvement and system success and/or user satisfaction (Baroudi et al., 1986; Ives & Olson, 1984; Olson & Ives, 1981).

In an extensive review of research attempting to demonstrate the relationship between user involvement and a number of indicators of IS success, Ives and Olson (1984) found the evidence to be inconclusive. Only five of 12 studies investigating user involvement and user satisfaction found a significant relationship. One of six studies investigating user involvement and system usage reported a significant relationship. Two of six studies investigating user involvement and system quality found a significant positive relationship. The results of Ives and Olson's (1984) review (summarized in Appendix A) highlighted the need for further research into the user involvement construct.

Studies finding significant benefits of the effects of user involvement in information systems development have generally taken a descriptive, case study approach (Hirschheim, 1989; Mumford, 1979). Inconclusive evidence of the benefits of user involvement in the development process have generally consisted of quantitative, cross-sectional survey approaches attempting to show a correlation between user involvement and system success or satisfaction (Baroudi et al., 1986; Tait & Vessey, 1988). Ives and Olson (1984) provided two reasons to explain the inconclusiveness of the results from

previous studies: (1) methodological weaknesses of past studies, and (2) the presence of intervening or moderating variables among user participation and important outcome criteria.

Two studies followed Ives and Olson's (1984) dictum by addressing the methodological problems found in many of the earlier studies and using rigorously developed instruments (Baroudi et al., 1986). Baroudi et al. (1986) found significant relationships between the measure of user involvement and measures of both information satisfaction and system usage. However, the relationships were considered weak. In the second study, Franz and Robey (1986) obtained significant correlations between their measures of user involvement and perceived system usefulness. Once again, the relationships were small in magnitude. The results of these two studies suggest the need for research that attempts to delineate any intervening mechanisms that exist between user involvement and the various indicators of system success (Barki & Hartwick, 1989).

Such proposed intervening mechanisms or contingencies which should be addressed by researchers included: (1) antecedents of user involvement such as the role of participants and differences in system types; (2) characteristics of the involvement process itself such as the degree and type of interaction; and (3) cognitive and motivational factors that moderate the relationship between user involvement and predicted outcome variables (Ives & Olson, 1984). Building on the involvement construct in the fields of psychology, marketing, and organizational behavior, Barki and Hartwick (1989) found that involvement is consistently defined as a subjective psychological state, reflecting the importance and personal relevance of an object or

event. The authors go on to recommend that the term "user participation" should be used instead of "user involvement" when referring to the behaviors and activities that the target users perform in the development process (Barki & Hartwick, 1989). According to Barki and Hartwick (1989) the term user involvement "should be used to refer to a subjective psychological state of the individual and defined as the importance and personal relevance that users attach either to a particular system or to IS in general, depending on the users' focus."

After the publication of the Barki and Hartwick (1989) article, several studies developed and used measures of user involvement consistent with the recommended definition (Barki & Hartwick, 1994; Kappelman & McLean, 1991; King & Lee, 1991). Hartwick and Barki (1994) further tested the proposition that user involvement is a different construct from user participation. The authors not only found evidence to support this proposition, but also that user involvement is more important than user participation in explaining system use. Given this, identifying antecedents of user involvement became an important issue. Hartwick and Barki (1994) identified several possible antecedents of user involvement including personality characteristics, experience, organizational status, organizational culture, and user participation.

Several studies have been published using multiple-item behavioral measures of user participation since the Ives and Olson (1984) review. Franz and Robey (1986) assessed user participation by evaluating the extent users performed six design-related activities and seven implementation-related activities. Baroudi et al. (1986) identified 47 development-related activities, 20 general activities, and 27 activities related to one of

three stages of the development life cycle: systems definition, systems design, and systems implementation.

Robey, Farrow, and Franz (1989) used a three-item scale to assess the amount of participation time during project meetings. The users assessed the amount of time spent preparing for, the extent to which their opinions were consulted, and the number of questions they asked during project meetings. Doll and Torkzadeh (1989) used an eight-item measure of end-user software involvement that assessed the amount of time users spent in each of eight development activities including project initiation, determining system objectives and user information needs, and developing input/output forms. Barki and Hartwick (1994) developed a 59 item scale measuring user participation, user involvement, and user attitude. Items were identified from four categories: one category for participative activities of a general and non-stage-specific nature, and three categories for the stage-specific activities that occur during systems definition, physical design, and implementation.

When user participative behaviors have been studied in combination with user need-based activities, the relationship between user participation and system success has been found to be stronger than when only user participation is considered (Baronas & Louis, 1988; Doll & Torkzadeh, 1989; Franz & Robey, 1986; McKeen, Guimaraes, & Wetherbe, 1994; Tait & Vessey, 1988). This contingent approach has been adapted by many researchers in an effort to explain mixed results in the early user participation literature.

Figure 2.2 illustrates the evolution of the major user participation/system success theoretical models. The basic model, originally proposed by Swanson (1974), represents the partial theory of information systems development that provided the basis for most of the research concerning user participation as a determinant of system success. Several other researchers reinforced the research and model development (Baroudi et al., 1986; Doll & Torkzadeh, 1989; Franz & Robey, 1986; Ives & Olson, 1984; Tait & Vessey, 1988; Zmud & Cox, 1979).

Because of the lack of predictive power of the basic model as evidenced by Barki and Hartwick (1989), Kappelman and McLean (1991) proposed a refined model. This refined model shown in Figure 2.2 proposed a behavioral and an attitudinal component for explaining the impact of user involvement on system success. In the extended model (Figure 2.2), contingency factors were introduced to enhance the understanding of the impact of user participation on system success.

The contingency approach is based on the theory that certain variables may affect the outcome of a particular process. Contingency theory itself is not domain specific. It is merely a framework for organizing knowledge in a given area. Therefore, it is possible for IS research to draw on contingency theory for developing theories regarding the impact of user participation or involvement on system success (Tait & Vessey, 1988).

Prior research reveals a plethora of potential contingency factors believed to impact user participation. The contingency factors found in previous research include *system complexity* (Edstrom, 1977; Ginzberg, 1979; Kim & Lee, 1986), *stage of development* (Edstrom, 1977; Franz & Robey, 1986; Ginzberg, 1979; Kim & Lee, 1986;

Olson & Ives, 1981; Robey & Farrow, 1982; Tait & Vessey, 1988), *desired versus actual level of participation* (Doll & Torkzadeh, 1989; King & Lee, 1991), *semantic gap* (DeBrabander & Thiers, 1984), *mediation* (DeBrabander & Thiers, 1984), *task and decision environment* (Edstrom, 1977; Franz & Robey, 1986), *degree of influence* (Edstrom, 1977; Robey & Farrow, 1982), *communication* (DeBrabander & Thiers, 1984; Edstrom, 1977), *degree of involvement* (King & Lee, 1991), *user attitude* (Kim & Lee, 1986; Tait & Vessey, 1988), *top management support* (Kim & Lee, 1986; Morris & Pushkin, 1995), *degree of programming in the system environment* (Edstrom, 1977; Ginzberg, 1979), *type of involvement* (Doll & Torkzadeh, 1989), and *organizational characteristics and MIS department characteristics* (Franz & Robey, 1986; Tait & Vessey, 1988).

In summary, there are many risks inherent in e-commerce systems. IS auditors can begin to ensure the effectiveness of the internal controls designed to help mitigate the risks to the organization from e-commerce systems by participating in the development of these systems. Pulling from system success, user involvement, and user participation literature, Chapter III develops a conceptual model and associated hypotheses.

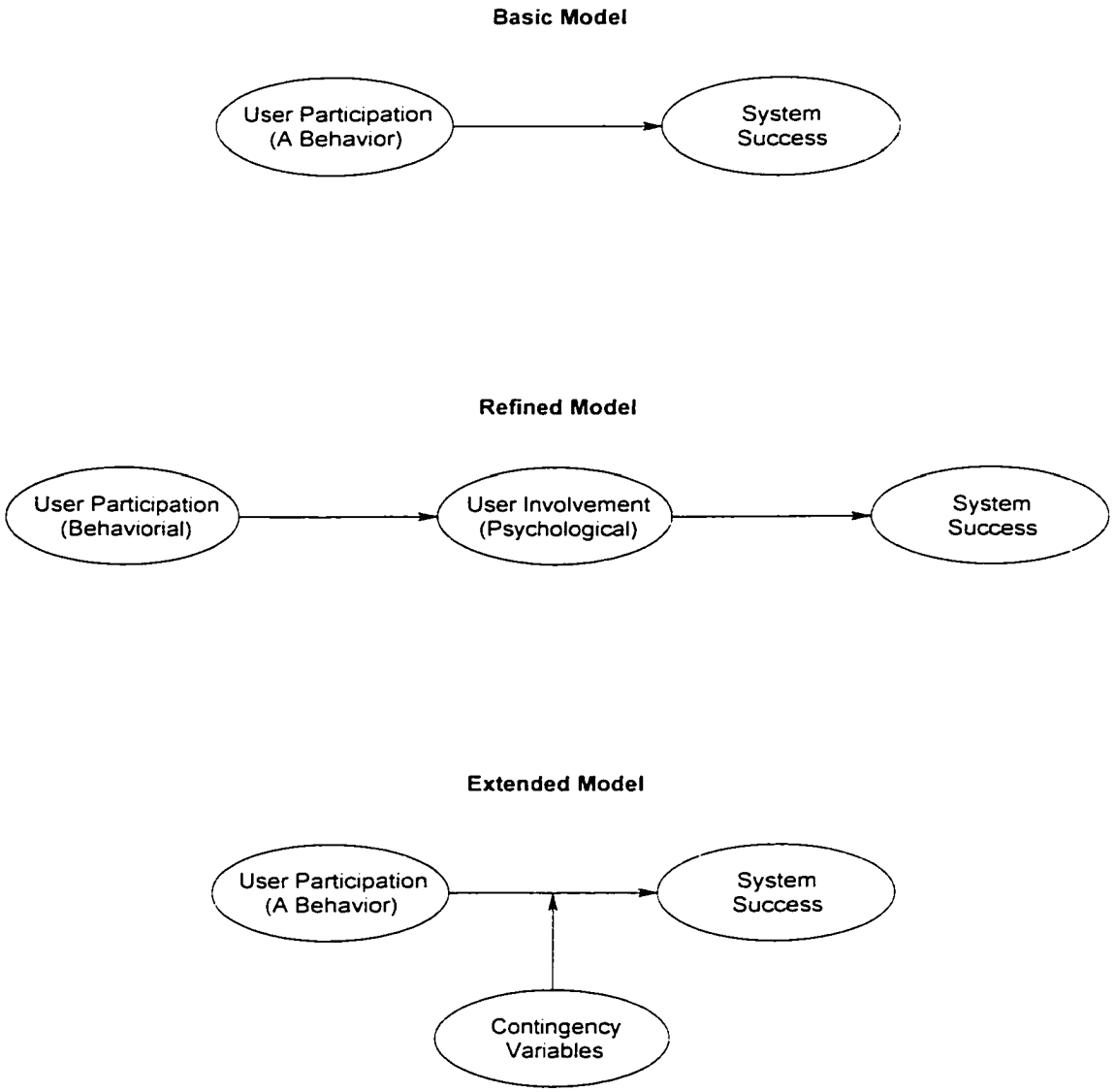

Figure 2.2. User Participation/System Success Theoretical Models

Note. Adapted from "The Relationship Between User Participation and User Satisfaction: An Investigation of Four Contingency Factors," by J. D. McKeen, T. Guimaraes, and J. C. Wetherbe, 1994, MIS Quarterly, 18, 4, p. 429.

CHAPTER III

THE MODEL AND RESEARCH HYPOTHESES

Based on the literature review, it was hypothesized that IS auditor participation will positively impact system success and the perceived effectiveness of the internal controls. Three major categories of contingencies further impact IS auditor participation in the development process. These categories include: IS auditor characteristics, system complexity, and resource constraints. Other organizational factors also impact IS auditor participation in the development process as well as system success. These factors include outsourcing, the IS audit department size, the organization size, top management support of the IS audit and control function, and the organization's e-commerce readiness. Figure 3.1 illustrates a path model of the components contained in the conceptual model. The following sections of this chapter discuss each component of the model and present the hypotheses. Figure 3.2 maps each of the hypotheses to the appropriate path on the conceptual model.

Figure 3.1. Conceptual Model of the Relationships Between the Antecedent Variables, IS Auditor Participation, the Effectiveness of Internal Controls and System Success.

System Success, Internal Controls, and IS Auditor Participation

One of the dependent variables for the study was the success of the e-commerce system. There are several measures of system implementation success. System success is inherently a difficult variable to assess directly and many surrogate measures have been developed. Two of the more popular measures of system success include: system use (Baroudi et al., 1986; Lawrence & Low, 1993; Robey, 1979; Schewe, 1976) and user information satisfaction (Bailey & Pearson, 1983; Ives & Olson, 1983). IS literature tends to view user information satisfaction as the preferred measure of system success.

DeLone and McLean (1992) classified IS success measures into six categories based on a review of 180 studies. The categories were system quality, information quality, use, user satisfaction, individual impact, and organizational impact. DeLone and McLean's 1992 paper was an important step toward recognizing that there are differences in individual and organizational impact. Seddon's (1997) re-specification of DeLone and McLean's model took this one step further and posited that different individuals view IS success in different ways. Grover, Jeong, and Segars (1996) classified evaluation perspectives into four different classes: users, top management, IS personnel, and external entities.

Figure 3.2. Conceptual Model with Hypotheses Mapped to Diagram Paths

Organizational objectives serve as the basis of Weill's (1992) IT investment classifications: strategic, informational, and transactional. Mirani and Lederer (1998) further extended and operationalized a framework composed of these three types of organizational objectives. Another study that considered organizational needs as an important factor of system success posited that such factors as the ability to provide new business capability, add business value, reduce operating costs, and enhance competitiveness should be addressed (Alexander & Ambrose, 1999). Alexander and Ambrose (1999) theorized two basic groups for customers for an IS: users and stakeholders. The stakeholders consist of owners, indirect users (those who do not directly manipulate data but use information generated by the system), and strategists. Strategists ensure that organizational needs and vision are met by the system (Alexander & Ambrose, 1999). While all measures of system success are important, this investigation considers the strategic objective the most appropriate measure of the success of an organization's e-commerce system from an IS auditor's perspective. The system is successful from an IS auditor's perspective when it meets management's objectives and goals or organizational needs.

IS auditors help mitigate the risk of system failure (not meeting management's objectives and goals or organizational needs) through a system of internal controls; the better the internal control system, the better the technological system. The more an IS auditor can rely on the system of internal controls, the less substantive testing required of the technological system. One way to ensure that the IS auditor can better rely on the system of internal controls (perceive the internal controls to be effective) is to participate

in the development and implementation of those controls by having them built into the system itself. Thus, the first hypothesis was:

> *Hypothesis 1*: The higher the degree of IS auditor participation in e-commerce systems development, the more likely the IS auditor will perceive the system of internal controls to be effective.

IS auditor participation is defined as participation in systems development for the purpose of ensuring security, control, and auditability of a system. There are several levels at which an IS auditor may participate in the development process (Hunton & Beeler, 1997; Hunton & Price, 1994; Ives & Olson, 1984; Tait & Vessey, 1988). An IS auditor can participate in the development process in one or more of the stages in the systems development life cycle (SDLC). The SDLC typically involves a step-by-step method of developing a system. The different stages include: planning, analysis, design, and implementation. An IS auditor may also participate at different levels within each stage. Ives and Olson (1984) categorized the extent of user involvement to be: no involvement, symbolic involvement, involvement by weak control, involvement by doing, involvement by strong control. This categorization was adapted for this study as follows:

1. No participation. IS Auditors unwilling or not invited to participate.
2. Symbolic participation. IS Auditors input requested but ignored.
3. Participation by advice. Advice solicited through interviews or questionnaires.

4. Participation by weak control. IS Auditors have "sign-off" responsibility at each stage of the development process.
5. Participation by doing. IS Auditor is a development team member or is the liaison with the IS group.
6. Participation by strong control. Cost of new development comes out of IS audit budget or IS auditor's performance evaluation depends on the outcome of systems development effort.

This investigation assessed the extent of an IS auditor's participation in an e-commerce systems development process by using these six categories. Although it would seem that the very nature of the IS audit function would preclude participation by "strong control," it remained in this investigation to see if there was any such IS auditor participation. The primary reason that participation by strong control might be dysfunctional is because exhibiting strong control could possibly compromise the independence of the whole internal audit department of the organization.

The relationship between user participation, the systems development process, and system success has been the subject of several studies (Barki & Hartwick, 1994; Blili, Raymond, & Rivard, 1998; Hartwick & Barki, 1994; Ives & Olson, 1984; McKeen & Guimaraes, 1997; Powers & Dickson, 1973). Accounting literature claims that IS audit participation or involvement in systems development results in better planned, better controlled, more easily maintained, and less costly systems (Grabski, Reneau, & West, 1987; Hannye, 1977; Helms & Weiss, 1982; Wu, 1992). The second hypothesis was:

Hypothesis 2: The higher the degree of IS auditor participation in e-commerce systems development, the higher the likelihood of system success.

According to Das (1986), the effectiveness of the organization in most cases seems dependent on the ability of organizational members to design and maintain appropriate control systems. As related to this investigation, system success is tied closely to the effectiveness of internal controls from an internal auditing perspective. It follows that there is a correlation between system success and the effectiveness of internal controls. Thus, the following were hypothesized:

Hypothesis 3a: There is a significant positive correlation between system success and the effectiveness of internal controls from the perspective of the IS auditor.

Hypotheses 3b: The effectiveness of internal controls has a positive impact on e-commerce systems success.

Contingency Factors

Many studies suggest that it is critical to consider contextual factors in order to determine the influence of user or IS auditor participation in the development process on system success (Blili et al., 1998; Ives & Olson, 1984; McKeen & Guimaraes, 1997; Tait & Vessey, 1988). It follows that the contextual factors influencing IS auditor participation in the systems development process not only directly impact the success of the system, but also are mediated by the degree of IS auditor participation in developing

the system. This study proposed that there were four contextual or contingency factors that impact the degree of IS auditor participation in developing information systems: IS auditor characteristics, organizational structure, system complexity, and resource constraints. The four proposed contingency factors mediate the degree of IS auditor participation in e-commerce systems development and the resulting effect on system success.

IS Auditor Characteristics

IS auditor characteristics such as skills, experience, and attitude play a large role in the IS auditor's desire (or a user's desire) to participate in systems development (Compeau et al., 1999; Hartwick & Barki, 1994; Hunton & Beeler, 1997; Robey, 1979; Taylor & Todd, 1995). Schneider (1995) suggests that consideration of the skill and experience of an IS auditor would be a factor in deciding whether to participate in the development process. It then follows that higher levels of skills, more experience, and more positive attitudes toward the system would make an IS auditor more likely to participate in the systems development process. Based on the preceding literature, the fourth hypothesis was:

> *Hypothesis 4*: The higher the levels of an organization's IS auditor IT skills, experience, and attitude, the more likely the IS auditors will participate in e-commerce systems development.

Other Organizational Factors

Several researchers have found that top management support or commitment has been regarded as an important variable in successful systems development (Doll, 1985; Saunders & Wiek, 1985; Vanlommel & DeBrabander, 1975). Other authors have found that organizational structure may also have a direct effect on system success (Anderson, 1995; Ein-Dor & Segev, 1978; Hwang, Windsor, & Pryor, 2000; Lees, 1987; Rademacher, 1989; Shields, 1995).

Morris and Pushkin (1995) found that management support for the audit and control function of the internal audit department had a positive impact on IS auditor involvement in systems development. In his discussion of the Morris and Pushkin study, Schneider (1995) posits that an organization's strategy toward the internal audit function or audit tradition plays a role in whether IS auditors are involved in systems development. Based on previous findings, the following hypotheses were proposed

Hypothesis 5a: Top management support for the IS audit and control function has a positive impact on IS auditor participation in e-commerce systems development.

Hypothesis 5b: Top management support for the IS audit and control function has a positive direct impact on system success.

Hypothesis 5c: Audit policies have a positive direct impact on IS auditor participation in developing e-commerce systems.

Currently, there is very little academic literature on the benefits of e-commerce initiatives. However, there are several studies investigating IT productivity and business performance. Several studies found that IT contributed to firm productivity (Bharadwaj, 2000; Brynjolfsson & Hirr, 1996; Lee & Barua, 1999; Loveman, 1994). Lee (2001) found an indirect and complex causal relationship between IT and profit. Chircu and Kauffman (2000) illustrated the difficulties facing organizations in making their investments in e-commerce systems pay off.

Iacovou, Benbasat and Dexter (1995) explored organizational readiness in EDI adoption in small firms. The authors found that small businesses reap limited benefits of adopting EDI unless they are willing and capable of integrating the system within their organizations. Barua, Konnana, Whinston, and Yin (2001a, 2001b) indicated that an organization's e-commerce initiatives depend on not only its own efforts but also on the readiness of its customers and suppliers. Thus, the following hypothesis was proposed.

Hypothesis 5d: The higher the e-commerce readiness of the organization, the higher the e-commerce system success.

Control Variables

Other research has indicated that organization size and the size of the IS department both have an impact on IS auditor participation and system success (Lee & Kim, 1992; Morris & Pushkin, 1995). Lee and Kim (1992) found that organization size had a significant impact on MIS success. Morris and Pushkin (1995) found that the size

of the IS department had a positive impact on IS auditor involvement in systems development.

Outsourcing has expanded greatly over the past decade. Companies choose to outsource their systems development for various reasons. Whether the reason for outsourcing is simply a cost savings measure or a vote of non-confidence in the internal IS department, outsourcing typically changes the role of the IS professionals in the organization (Martinsons & Cheung, 2001). Often outsourcing reduces the organization's need for its own analysts, programmers, and other IS specialists such as IS auditors (Martinsons & Cheung, 2001). Based on these studies, the following hypotheses were proposed.

Hypothesis 6a: The size of the IS audit department has a positive impact on IS auditor participation in e-commerce systems development.

Hypothesis 6b: The size of the organization has a positive impact on system success.

Hypothesis 6c: Outsourcing of the e-commerce systems development has a negative impact on IS auditor participation in developing e-commerce systems.

Hypothesis 6d: Outsourcing of the e-commerce systems development has a positive impact on system success.

System Complexity

The size and complexity of the system should play a role in the participation of IS auditors in developing the system. Previous IS literature suggests that system complexity plays a role in whether users are involved in systems development (Kim & Lee, 1986; McKeen et al., 1994; Tait & Vessey, 1988). Schonberger (1980) posited that a higher degree of user participation is necessary for the successful development of complex systems. Kim and Lee (1986) found that a participative system strategy is more successful when the system is complex in nature.

Accounting literature also has purported that system complexity may help determine internal audit involvement in developing information systems (Morris & Pushkin, 1992). Larger and more complex systems often need more controls in place to help ensure security, reliability, and integrity of the system. Also, systems that are distributed over any type of network, such as an e-commerce system, may need more and stronger controls than do systems that are maintained on only one computer (Aggarwal et al., 1998; Jameison & Baird, 1999; Prawitt & Romney, 1997). Any system that is networked has increased vulnerability; therefore, the controls and auditability are more important. The following hypotheses were based on the above literature:

Hypothesis 7a: IS auditors are more likely to participate in the development of an e-commerce system that is relatively complex.

Hypothesis 7b: System complexity has a negative direct effect on system success.

Resource Constraints

Involving users in the systems development process may actually cause delays in the process. Often involving more people in a project makes it harder to reach consensus. Thus, time constraints on development may precipitate substantial decreases in user participation or users may even be precluded from participating in the development process (Cavaye, 1995; Hirschheim, 1985; Tait & Vessey, 1988).

Since the 1980s, many U.S. businesses have struggled in an effort to reduce costs in order to remain competitive in the global business arena. One major solution has been the reduction of labor costs through the reduction of the number of employees within an organization. This downsizing has occurred even within organizations' internal audit departments. Many internal audit departments have had to reduce staff without a corresponding reduction in audit responsibilities (Dallas, 1999).

Availability of IS auditors for assignment to e-commerce systems development may be affected by other organizational demands on the IS audit resource (Schneider, 1995). Systems development projects typically must compete with other internal resources (Greenburg & Murphy, 1989). When there are insufficient resources, the degree of user or IS auditor participation in the development process may be decreased to stay within the budget (Cavaye, 1995; Doll, 1987). According to Greenburg and Murphy (1989), the primary reasons for IS auditor noninvolvement in systems development include: (1) objectivity and independence concerns; (2) staff and resource constraints; and (3) lack of technical expertise.

Ein-Dor and Segev (1978) suggested that resource availability problems are a frequent contributor to the failure of information systems. They suggest that the inadequate budgeting of sufficient resources increases the likelihood of system failure. Based on the above premises, the following hypotheses were proposed:

Hypothesis 8a: The more resources are constrained, the less likely IS auditors will participate in the development process for e-commerce systems.

Hypothesis 8b: Resource constraints have a negative direct effect on e-commerce system success.

To test the hypotheses, a survey instrument was utilized in the study. The next chapter provides operational definitions of the variables used in the survey instrument. Results of the pilot study are also discussed in the next chapter.

CHAPTER IV

RESEARCH METHOD

Operational Definitions of Variables

This study used a survey instrument to collect data on the variables identified in the conceptual model presented in Figure 3.1. The following subsections outline definitions of the variables and the source of the individual survey instruments adapted and integrated into the design of the study instrument. Table 4.1 summarizes the variables and measures used in the instrument. The actual survey can be found in Appendix B.

System Success. Success is a difficult variable to measure. Thus, many surrogate measures have been developed to measure the concept of success. This study viewed success as the positive strategic benefits of the e-commerce system(s) on the organization from an organizational viewpoint. The constructs of interest in this study were (1) the competitive advantage of the system, (2) alignment of the system with organizational goals, (3) the direct organizational impact of the system, (4) the enhancement of customer relations, and (4) the enhancement of supplier/vendor relations. The five-point Likert-type scale used for measuring system success was adapted from Mirani and Lederer (1998), Lee and Kim (1992), and Tallon, Kraemer, and Gurbaxani (2000).

Effectiveness of Internal Controls. The effectiveness of internal controls deals with how well the system's internal controls provide reasonable assurance that the organization is achieving effectiveness and efficiency of operations, reliability of financial reporting, and compliance with applicable laws and regulations. The five-point Likert type scale for measuring the effectiveness of the system of internal controls was developed based on the general definition of the system of internal controls, Romney and Steinbart (2000), and Wise (1990).

IS Auditor Participation. IS auditor participation in developing e-commerce systems was designed to measure the development lifecycle stages in which IS auditors participated and the degree of participation. The lifecycle stages used to measure IS auditor participation were adapted from Morris and Pushkin (1995). The stages included the following: (1) planning, (2) analysis, (3) design, (4) immediately before implementation, (5) implementation, and (6) post-implementation. IS auditors rated the extent of their participation based on the categories proposed by Ives and Olson (1984): (1) no participation, (2) symbolic participation, (3) participation by advice, (4) participation by weak control, (5) participation by doing, and (6) participation by strong control.

IS Auditor Characteristics. IS auditor characteristics used in this study included skills, experience, and attitude toward the organization's e-commerce initiatives. The five-point Likert-type scale used in this study was developed on a basic set of skills used by Byrd and Turner (2000). IS auditor skills were ascertained from questions that addressed internal control design skills, systems development skills, audit skills, system

development experience, audit experience, and e-commerce technology skills of the organization's IS auditors. The experience of the organization's IS auditors was measured by the average number of years experience in IS auditing, systems development, and accounting experience. A five-point Likert-type scale measured attitude by using general questions concerning the attitude of the organization's IS auditors toward the organization's e-commerce initiatives and the value of the e-commerce initiatives to the organization.

Other Organizational Factors. Management support for IS audit and control function is defined as the extent to which top management is cognizant and supportive of the need for internal controls and IS audit recommendations concerning internal controls. Management support was measured by adapting a five-point Likert-type scale developed by Morris and Pushkin (1995). The items from this scale included management's views on establishing and maintaining a system of internal controls, allocating funds to implement IS audit recommendations, and knowledge of IS controls.

E-commerce readiness is an important consideration in measuring the success of an organization's e-commerce initiatives. Barua, Konana, Whinston, and Yin (2001) was one of the limited number of studies to focus on the business value of e-commerce initiatives. The items used in the e-commerce readiness five-point Likert-type scale were adapted from this study. The different categories included (1) internal readiness, customer readiness, and supplier/vendor readiness.

The audit policies construct was measured by developing questions based on the literature concerning the audit function and traditions associated with past IS auditor participation in systems development (Schneider, 1995).

Control Variables. The IS department size was determined by the number of IS auditors in the internal or IS audit department. Organization size was determined by the number of employees in the organization. Outsourcing was assessed by the degree to which the organizations' e-commerce systems development was outsourced.

System Complexity. A complex system can be defined as one in which the desired output, processing, and output requirements among the interrelated parts are not easily defined (McFarlan, 1981). A complex system can be considered difficult to develop because of the large number of interacting components (Tait & Vessey, 1988). In this study, system complexity was defined as the perceived complexity associated with designing and implementing an e-commerce system. A three-question five-point Likert-type scale was adapted from Barki, Rivard, and Talbot (1993) to assess system complexity. An additional question was added that addresses system complexity from an e-commerce perspective (i.e., is the system purely informational or is it a full scale store front).

Resource Constraints. Resource constraints include such sources as time and funds available to complete the project and the availability of trained manpower, hardware, and software (Ein-Dor & Segev, 1978). The resource constraints factor was measured by a five-point Likert-type scale designed to determine the time, budget,

manpower, and other restrictions that may be placed on the e-commerce system development process.

Table 4.1
Variables and Measures

Substantive Variable	Research Component	Operational Variable	Measure
Individual	IS Auditor Characteristics	Skills Experience Attitude	Byrd & Turner, 2000 Compeau, Higgins, & Huff, 1999 Barki & Hartwick, 1994
Information System	System Success	System Success	Mirani & Lederer, 1998 Lee & Kim, 1992 Tallon, Kraemer, & Gurbaxani, 2000
	System Complexity	System Complexity	Barki, Rivard, & Talbot, 1993
Organization	Control Variables	IS Dept. Size Org. Size Outsourcing	Morris & Pushkin, 1995 Based on Schneider, 1995 Barua, Konana, Whinston, & Yin, 2001
	Organizational Structure	Mgt. Support Audit Tradition E-Commerce Readiness	Morris & Pushkin, 1995 Based on Schneider, 1995 Barua, Konana, Whinston, & Yin, 2001
	IS Auditor Participation	IS Auditor Participation	Morris & Pushkin, 1995 Ives & Olson, 1984
	Resource Constraints	Resource Constraints	Ein-Dor & Segev, 1978

Pilot Study

Overview

The purpose of the pilot study was to validate the questionnaire developed for the study. The pilot study was conducted in the summer of 2000. 1,000 surveys were mailed to IS audit managers and IS auditors in the United States. A reminder was mailed four weeks after the original survey was mailed (see Appendix C). 130 surveys were returned representing a 13 percent response rate. The respondents came from organizations ranging from four employees to over 280,000 employees and represented 21 different industries as shown in Table 4.2. The bulk of the respondents (57.7 percent) were at the IT audit manager or higher level position in the organization with an average of 3.88 years in their current positions and an average of 7.25 years with the firm as shown in Table 4.3.

Validity and Reliability

Validity measures the extent to which an indicator measures the underlying construct. Reliability measures the stability of the scale. Tests of both were necessary in this research since: (1) the instrument was used to measure constructs in a different context than originally intended, (2) new measures were introduced into the instrument, and (3) measures were adapted from other instruments on which validity and reliability results were not reported in the resulting articles.

Content validity, in which items making up the measure are a representative sample associated with the domain of the variable being measured, was established by means of a pre-test questionnaire. Twelve questionnaires were distributed to faculty

members and doctoral students in the management and accounting departments in the College of Business at Auburn University. The participants were asked to review and evaluate the instrument. Minor revisions were made to the instrument to clarify questions.

Table 4.2
Industry Demographics of Pilot Study Respondents

Industry	Respondents
Agriculture	1
Banking	23
Business Services	12
Communications	2
Construction	1
Education	2
Finance	8
Government	15
Health Services	10
Insurance	13
Investment	1
Manufacturing	16
Retail	6
Transportation	3
Utilities	6
Wholesale	3
Other	5
Total	127

Table 4.3
Pilot Study Respondent Profiles

Title	Number	Years Current Position	Years Experience with Firm	Years IS Audit Experience
VP IS Audit	9	2.72	6.11	12.22
IS Audit Manager/Director	66	4.10	8.43	11.43
Senior IS Auditor	24	4.33	8.38	7.91
IT Auditor	20	3.25	3.89	4.42
Consultant	6	4.58	6.58	9.50
Other	5	2.60	7.70	7.60
Total	130	3.88	7.45	9.52

Construct validity was established by showing that a measure has an appropriate operational definition of the construct it purports to measure. The construct being validated relates in hypothesized ways to other variables and does not correlate with other theoretically unrelated constructs and variables. Construct validity was evaluated using factor analysis with varimax rotation to determine if all the items cluster together and load on a single factor.

To ensure a simplified factor structure for each multi-item construct in the research model proposed in Chapter 3, separate exploratory factor analyses were conducted for each construct. A copy of the original survey instrument is included in Appendix B. Factors with eigenvalues greater than 1.00 were retained. All of the scales loaded on one factor except the System Success construct. This construct yielded five

factors as expected. The five factors were identified as: (1) competitive advantage (CompAdv), (2) alignment (Align), (3)organizational impact (OrgImp), (4) customer relations (CustRel), and (5) supplier/vendor relations (SupRel). The factor loadings are reported in Table 4.4.

Cronbach's alpha was used to determine the reliability based on internal consistency for multi-item scales. Nunally (1978) suggested Cronbach's alpha coefficients be above 0.70 for hypothesized measures of a construct. All the multi-item scales are above this suggested cutoff. Table 4.5 indicates sufficiently high reliabilities for each of the multi-item scales used in the survey instrument.

Measurement and Structural Models

The hypotheses presented in this paper were tested using the set of causal relationships illustrated in the conceptual model. The partial least squares (PLS) approach to structural equation modeling was used to estimate the model.

Structural equation modeling (SEM) can be divided into two basic types: (1) covariance-based methods as exemplified by such software as LISREL, EQS, and AMOS, and (2) the partial least squares (PLS) method.

The covariance-based SEM methodology represents "causal" processes that generate observations on multiple variables (Bentler, 1988). The term structural equation modeling conveys two important aspects of the SEM procedure: (1) that the causal processes under study are represented by a series of structural (i.e., regression) equations, and (2) that these structural relations can be modeled pictorially to enable a clearer

Table 4.4
Factor Loading for System Success Questionnaire Items

Item	CompAdv	Align	OrgImp	CustRel	SupRel
Success1	.709				
Success2	.846				
Success4		.847			
Success5		.802			
Success7		.562			
Success3			.749		
Success8			.647		
Success14			.704		
Success9				.468	
Success10				.772	
Success11				.773	
Success12				.737	
Success13				.425	
Success6					.611
Success15					.750
Success16					.895
Success17					.757

conceptualization of the theory under study. The hypothesized model can then be tested in a simultaneous analysis of the entire system of variables to determine the extent to which it is consistent with the data (Byrne, 1994). Using covariance-based SEM, the researcher is able to check the overall goodness of fit of the proposed model and to

compare the relative goodness of fit of competing models, thereby assessing the need for, and strength of, different path models (Barki & Hartwick, 1994; Bentler, 1990).

Table 4.5
Cronbach's Alpha for Model Constructs

Construct	Number Items	Alpha Coefficient
Management Support (MgtSup)	3	.9063
Audit Policies (AudPol)	3	.9199
E-Commerce Readiness (ECR)	8	.8802
Skills (Skills)	8	.8982
Attitude (Att)	2	.8590
System Complexity (SysComp)	3	.8216
Resource Constraints (RC)	4	.8259
Internal Control Effectiveness (ICEff)	6	.9147
System Success:		
Competitive Advantage (CompAdv)	2	.8708
Alignment (Align)	3	.8205
Organizational Impact (OrgImp)	3	.7974
Customer Relations (CustRel)	5	.9122
Supplier/Vendor Relations (SupRel)	4	.8598

PLS differs from covariance-based SEM in that the analysis places minimal demands on measurements scales (i.e., do measures need to be at an interval or ratio level?), sample size, and residual distributions (Chin, 1998). The purpose of PLS is to help the researcher obtain determinate values of latent variables for prediction (Chin &

Newsted, 1999). In traditional covariance-based SEM, the model is used for explaining the covariation of all the indicators. The goal of PLS is minimizing the variance of all dependent variables. Parameter estimates are obtained based on the ability to minimize the residual variances of the dependent variables (Chin, 1998).

Two types of models are used in the PLS approach: the outer model (measurement) and the inner model (structural) (see Figure 4.1). The outer model relates measures to theoretical variables or factors. It contains information about how theoretical variables are operationalized (Maruyama, 1998). The inner model is the regression part of the latent variable SEM (Maruyama, 1998). Latent variables are those representing theoretical constructs that cannot be observed directly and are presumed to underlie certain observed measures in the model (Byrne, 1994). Each latent variable is approximated by its respective block of indicators by creating latent variable component scores based on a weighted sum of their indicators (Chin, 1998).

The latent variables (factors) are indicated by the circles designated F1 and F2 in Figure 4.1. The observed variables are in the boxes V1-V5. The one-way arrows in the model indicate the impact of one variable on another. The unidirectional arrows leading from the latent variables (factors) to the observed variables suggest that the scores on the latter are "caused" by the factors. Similarly, the arrow leading from F1 to F2 implies that F1 causes F2 (Byrne, 1994).

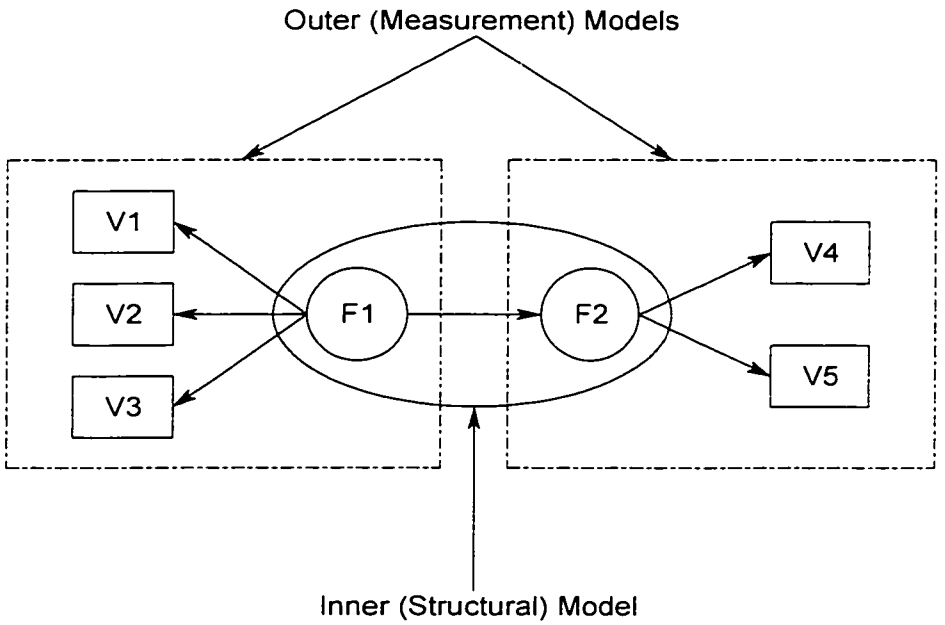

Figure 4.1. Two-Block Model: Inner and Outer Models in the PLS Structural Equation Modeling Approach.

Note. Adapted from "Basics of Structural Equation Modeling," by G. M. Maruyama, Thousand Oaks, CA, Sage Publications.

Table 4.6 maps the indicator variables used in the outer models to the latent variables used in this study. These models reflect the hypothesized relationships between the observed variables and the constructs they were designed to measure. The structural model (see Figure 4.2) illustrates the hypothesized relationships between the independent and dependent variables.

Table 4.6
Questionnaire Items Mapped to Model Constructs

Construct	Item	Questionnaire Items
Management Support	MgtSup1	Our top management places a high priority on establishing and maintaining an adequate system of internal controls.
	MgtSup2	Our top management is willing to allocate funds to implement information system audit recommendations.
	MgtSup3	Top management of our firm is very knowledgeable about IS controls.
Audit Policies	AP1	IS auditors in our firm participate in information systems development.
	AP2	IS auditors in our firm participate in the design of internal controls for information systems.
	AP3	Our top management requires IS audit participation in information systems development.
E-Commerce Readiness	ECR1	Our customers feel comfortable regarding security and privacy in e-commerce with our organization.
	ECR2	Our customers consider it important to engage in e-commerce.
	ECR3	Our suppliers/vendors have Internet-based systems to engage in e-commerce.
	ECR4	Our suppliers/vendors feel comfortable (regarding security, privacy, etc.) engaging in e-commerce.
	ECR5	Our suppliers/vendors consider it important to engage in e-commerce.
	ECR6	Our organization has adequate knowledge of the e-commerce business models.
	ECR7	Our organization has adequate knowledge of the e-commerce marketplace, competitive forces, and strategic awareness of this market.
	ECR8	Our organization is aware of the risks with e-commerce deployment.

Table 4.6 (Continued)

Construct	Item	Questionnaire Items
Skills	Skill1	Our IS auditors are skilled in designing internal controls.
	Skill2	Our IS auditors are skilled in internal auditing.
	Skill3	Our IS auditors are skilled in systems development.
	Skill4	Our IS auditors are skilled in IS/EDP auditing.
	Skill5	Our IS auditors are encouraged to learn new e-commerce technologies.
	Skill6	Our IS auditors closely follow the trend in current e-commerce technologies.
	Skill7	Our IS auditors understand the e-commerce business environment.
	Skill8	Our IS auditors understand our organization's e-commerce policies and plans.
Attitude	Att1	Our IS auditors have a positive attitude toward the organization's e-commerce initiatives.
	Att2	Our IS auditors feel that our e-commerce initiatives are valuable to our organization.
System Complexity		*Referring to your organization's e-commerce initiatives, please indicate how you would evaluate the technical complexity of each of the following elements ranging from not complex to highly complex:*
	Comp1	The hardware
	Comp2	The software
	Comp3	The connectivity of the applications
Resource Constraints	RC1	Adequate time was provided for the completion of the development process for most of our systems in the e-commerce initiatives.
	RC2	An adequate budget was provided for the development process for most of our systems in the e-commerce initiatives.

Table 4.6 (Continued)

Construct	Item	Questionnaire Items
Resource Constraints (continued)	RC3	Adequate IS personnel were available for the development process for most of our systems in the e-commerce initiatives.
	RC4	Adequate IS staff members were available to participate in the development process for most of our systems in the e-commerce initiatives.
IS Auditor Participation		*Please indicate the typical degree of IS auditor participation in the development of the systems comprising the e-commerce initiatives in your organization ranging from no participation to participation by strong control:*
	PLPar	Planning stage
	AnPar	Analysis stage
	DePar	Design stage
	BImPar	Immediately before implementation stage
	ImPar	During implementation stage
	PImPar	Post-implementation stage
Internal Control Effectiveness	ICEff1	Our security provisions protect computer equipment, programs, communications, and data from unauthorized access, modifications, or destruction.
	ICEff2	Our program development and acquisition is performed in accordance with management's general and specific authorization.
	ICEff3	Our program modifications have the authorization and approval of management.
	ICEff4	Our processing of transactions, files, reports, and other computer records is accurate and complete.
	ICEff5	Our source data that is inaccurate or improperly authorized is identifies and handled according to prescribed managerial policies.
	ICEff6	Our computer data files are accurate, complete, and confidential.

Table 4.6 (Continued)

Construct	Item	Questionnaire Items
System Success:		*Benefits from our organization's e-commerce initiatives:*
Competitive Advantage	CompAdv1	Enhance the competitiveness or create strategic advantage.
	CompAdv2	Enable the organization to catch up with competitors.
Alignment	Align1	Strengthen strategic planning.
	Align2	Align well with stated organizational goals.
	Align3	Enable the organization to respond more quickly to change.
Organizational Impact	OrgImp1	Improve internal communication and coordination.
	OrgImp2	Enhance the credibility and prestige of the organization.
	OrgImp3	Enable the organization to carry out its work more easily and efficiently.
Customer Relations	CustRel1	Change the way the organization conducts business.
	CustRel2	Improve customer relations.
	CustRel3	Enhance the flexibility and responsiveness to customer needs.
	CustRel4	Enhance the ability to attract and retain customers.
	CustRel5	Provide added value to the organization.
Supplier/Vendor Relations	SupRel1	Help establish useful linkages with other organizations.
	SupRel2	Help develop close relationships with suppliers/vendors.
	SupRel3	Enable electronic transactions with suppliers/vendors.
	SupRel4	Improve monitoring of the quality of products and services from suppliers/vendors.

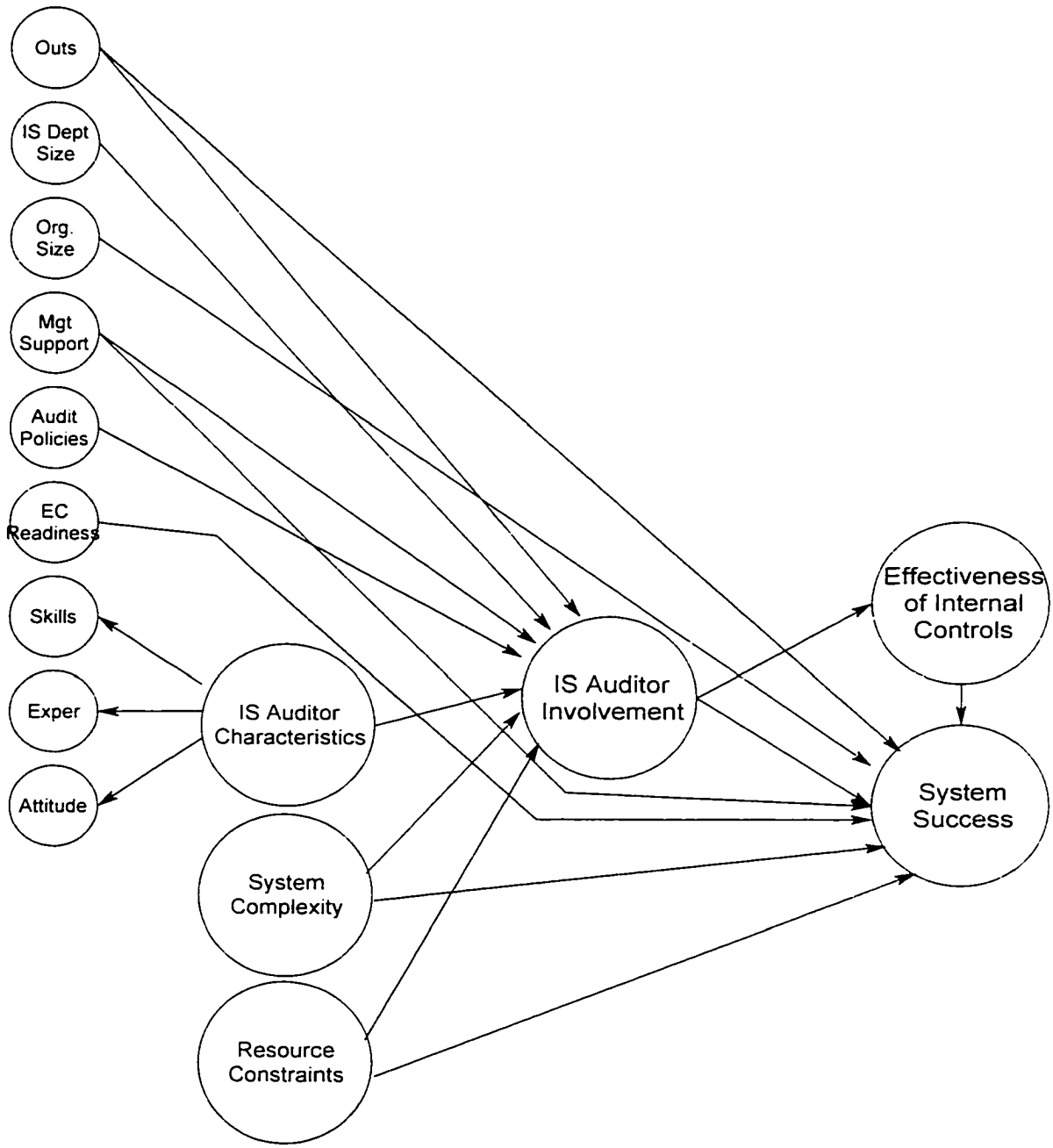

Figure 4.2. Structural Model for the Relationships Between the Antecedent Variables, IS Auditor Participation, the Effectiveness of Internal Controls, and System Success

Study Sample

Data were collected from three individuals per organization from within a sample of organizations in the United States. The organizations were public and private, large and small, and from a wide variety of industries. The IS auditors were originally contacted during the pilot study via a membership list provided by a professional organization. IS auditors from 93 organizations agreed to participate in the study. Survey packets consisting of three questionnaires, letters, and return envelopes were mailed to the IS auditors in the 93 organizations (see Appendix D). Instructions were included that requested the IS auditor to fill out the IS audit questionnaire and forward the other two to the appropriate persons: a member of top management and a member of the IS department. The IS auditor was also asked to collect the completed surveys and mail them in the included stamped and addressed envelope. After three weeks, phone calls were placed to those who had not returned the packets.

IS auditors were surveyed to measure (1) the effectiveness of the internal control system, (2) the degree of participation in the development process, (3) the IS auditor group characteristics, the management support of the IS audit and control function, (5) the organization's audit policies, and (6) basic demographic information. Members of management were surveyed to determine (1) the success of the e-commerce initiatives, (2) the e-commerce readiness of the organization, and (3) basic demographic information. IS department members were sent questionnaires designed to measure (2) the complexity of the e-commerce systems, (2) resource constraints, and to obtain (3) basic demographic information.

Sample Size

As a general rule, the sample size requirements for the PLS approach is much less than that required for covariance-based SEM. For a sense of the sample size, one simply looks at the graphical model and determines the largest of two possibilities: (1) the block with the largest number of formative indicators or (2) the dependent latent variable with the largest number of independent latent variables influencing it. Using a heuristic of 5 or 10 cases per predictor, the sample size would be 5 to 10 times either (1) or (2), whichever is greater (Chin, 1998; Chin & Newsted, 1999). In this study, there were no formative indicators and System Success had 8 other latent variables influencing it. Thus, a sample size of between 35 and 80 was adequate for the research model in this study.

After the pilot study was completed and the sample size needed for the actual study was determined, the study was conducted. Chapter V presents the results of the study.

CHAPTER V

RESULTS

This chapter presents the results of the analysis of the data collected. First, the demographics of the sample are described. Then reliability and validity of the measures are discussed. Finally, the results of the PLS are presented.

Demographics of the Sample

Surveys were sent to IS auditors and IS audit managers who expressed an interest in participating in the study. A total of 93 survey packets were mailed in October 2001. The IS auditor or IS audit manager was asked to fill out the IS audit department survey and distribute the other two to a member of top management and a member of the IS department. Copies of the surveys can be found in Appendix D. During the five-week response period, three participants withdrew from participation in the survey and a total of 47 survey sets were returned, representing an overall response rate of 50.5 percent. Table 5.1 shows the demographic profiles of the respondents. Fifty-five percent of the IS Audit respondents classified themselves as IS Audit Managers with slightly over 11 years IS audit experience. From the IS department, 51 percent were IS department managers and 32 percent were in the CIO/CTO position. The respondents' organizations were from 13 different industries. Table 5.2 provides a breakdown of the industries and the number of matched sets of surveys from each.

Table 5.1
Respondent Demographic Profiles

Title	Number	Years Current Position	Years Experience with Firm	Years IS Audit Experience
IS Audit Department				
VP IS Audit	2	.5	3.75	9.50
IS Audit Manager/Director	26	4.37	8.79	11.42
Senior IS Auditor	9	4.31	7.06	7.69
IT Auditor	6	2.75	4.42	6.42
Other	4	5.13	8.13	10.75
Management				
Vice President	7	7.00	18.67	-
Manager	32	3.24	10.27	-
Director	2	3.00	12.67	-
Controller	1	10.00	20.00	-
IS Department				
CIO/CTO	15	3.5	22.38	-
IS Department Manager	24	9.14	10.33	-
Director IT Software	1	12.00	2.00	-
IT Audit Specialist	2	2.00	4.50	-

Table 5.2
Industry Demographics of Study Respondents

Industry	Respondents
Agriculture	1
Banking	13
Business Services	7
Construction	2
Education	1
Finance	1
Government	4
Health Services	1
Insurance	2
Manufacturing	6
Retail	2
Transportation	2
Utilities	3
Other	2
Total	47

Method of Analysis

The partial least squares (PLS) approach to structural equation modeling using PLSGraph version 3.00 software was used to test the hypotheses presented in Chapter 3 of this study. PLS is a structural equation modeling approach for estimating determinate values of the latent variables for predictive purposes (Chin, 1998). Estimation is based on ordinary least squares (OLS) fixed point iterations on subsets of model parameters.

thus requiring few distributional assumptions (Chin, 1998; Fornell & Bookstein, 1982; Fornell & Larcker, 1981). PLS is more appropriate than covariance-based SEM methods such as LISREL or EQS when the goal of the research is prediction or assumptions regarding multivariate normality of the data might not hold (Fornell & Bookstein, 1982). In addition, PLS is more appropriate when the sample size is small (Chin, 1998; Chin & Newsted, 1999).

Reliability and Validity

Composite reliability was used to test the internal consistency for the different scales used in the study. Composite reliability considers the ratio of non-random variance associated with all measures of a construct to total variance associated with these measures using the following calculation:

$$\rho_c = \frac{(\Sigma\lambda_i)^2}{(\Sigma\lambda_i)^2 + \Sigma_i var(e_i)}$$

where λ_i is the component loading to an indicator and $var(e_i) = 1 - \lambda_i^2$ (Chin, 1998). ρ_c tends to be a closer approximation of internal consistency than Cronbach's alpha as the composite reliability does not assume tau equivalency among the measure with its assumption that all indicators are weighted equally (Chin, 1998). In this study, the composite reliabilities range from 0.77 to 0.95 (see Table 5.3) which are all above Nunally's (1978) guidelines.

The average variance extracted (AVE) is the amount of variance that is captured by the construct relative to the amount of variance due to measurement error (Fornell & Larcker, 1981). AVE is calculated as follows:

$$AVE = \frac{\Sigma \lambda_i^2}{\Sigma \lambda_i^2 + \Sigma_i var(e_i)}$$

where λ_i is the component loading to an indicator and $var(e_i) = 1 - \lambda_i$ (Chin, 1998; Fornell & Larcker, 1981). Fornell and Larcker (1981) recommend that the AVE should be greater that 0.50. If the AVE is less than 0.50, the variance due to measurement error is larger than the construct, and the validity of the individual indicators and the construct is questionable (Fornell & Larcker, 1981). The AVEs in this study range from 0.53 to 0.87 as shown in Table 5.3.

Table 5.3
Composite Reliability and Average Variance Extracted (AVE)

Construct	Composite Reliability	AVE
Management Support	.954	.874
Audit Policies	.944	.849
E-Commerce Readiness	.912	.568
IS Auditor Characteristics	.768	.533
System Complexity	.893	.678
Resource Constraints	.886	.661
IS Auditor Participation	.943	.738
Internal Control Effectiveness	.947	.751
Competitive Advantage	.913	.840
Alignment	.899	.748
Organizational Impact	.883	.716
Customer Relations	.932	.734
Supplier/Vendor Relations	.887	.664

The validity of the measurement model was assessed by examining the loadings of indicators (see Table 5.4). Each indicator should share more variance with the component score than with the error variance. This implies that standardized loadings should be greater than 0.70 (Chin, 1998). In this study, most standardized loadings were greater that 0.70. Loadings of 0.5 or 0.6 may still be acceptable if additional indicators in the block exist for comparison (Chin, 1998).

Table 5.4
Item Weights and Loadings

Construct	Item	Weight	Loading
Management Support	MgtSup1	.2591	.9079
	MgtSup2	.4105	.9583
	MgtSup3	.3964	.9370
Audit Policies	AP1	.3339	.8937
	AP2	.3773	.9261
	AP3	.3781	.9439
E-Commerce Readiness	ECR1	.1242	.6138
	ECR2	.1814	.6831
	ECR3	.1104	.6276
	ECR4	.1620	.8221
	ECR5	.1288	.7076
	ECR6	.2236	.8957
	ECR7	.212	.8759
	ECR8	.1601	.7470
System Complexity	SComp	.3340	.6727
	Comp1	.3365	.8850
	Comp2	.1893	.8590
	Comp3	.3913	.8591
Resource Constraints	RC1	.2523	.7595
	RC2	.3198	.8253
	RC3	.3064	.8537
	RC4	.4122	.8096

Table 5.4 (Continued)

Construct	Item	Weight	Loading
IS Auditor Participation	PlPar	.1593	.8135
	AnPar	.1931	.8956
	DePar	.2423	.9414
	BImPar	.2165	.8976
	ImPar	.2091	.9383
	PImPar	.1293	.6268
Internal Control Effectiveness	ICEff1	.1888	.7989
	ICEff2	.2012	.8857
	ICEff3	.2232	.8470
	ICEff4	.1834	.8845
	ICEff5	.1490	.8621
	ICEff6	.2090	.9153
Competitive Advantage	CompAdv1	.5873	.9348
	CompAdv2	.5022	.8979
Alignment	Align1	.3708	.8733
	Align2	.3421	.8680
	Align3	.4450	.8523
Organizational Impact	OrgImp1	.3488	.8145
	OrgImp2	.4707	.8854
	OrgImp3	.3574	.8371
Customer Relations	CustRel1	.2238	.8190
	CustRel2	.2324	.8410
	CustRel3	.2544	.9290
	CustRel4	.2244	.8503
	CustRel5	.2309	.8406
Supplier/Vendor Relations	SupRel1	.2505	.7227
	SupRel2	.3823	.8600
	SupRel3	.2135	.7870
	SupRel4	.3659	.8804

To examine discriminant validity, the AVE was compared to the square of the correlation among the constructs (Chin, 1998). Table 5.5 provides the correlations for the constructs with the AVEs in the diagonals. An indicator of discriminant validity is to have all AVEs be larger than the correlations squared. With a couple of exceptions, discriminant validity was demonstrated.

Tests of Hypotheses

The results of the PLS estimation are illustrated in Figure 5.1 and Table 5.6. The significance of the path coefficients was assessed using PLS bootstrapping (Chin, 1998). Using PLSGraph, 200 resamples were generated. A t-test, based on the mean and standard error of each coefficient, was used to determine the significance of each path coefficient. All but two of the coefficients were significant. The results of the model showed a substantial R-square of 0.72 for System Success, a more moderate level of 0.45 for IS Auditor Participation, and a weak level of 0.04 for Internal Control Effectiveness. The estimation provides support for several of the hypotheses. Table 5.7 provides a list of the hypotheses and indicates whether or not the hypotheses were supported.

IS Auditor Participation. Hypothesis 1 was significant effective (coefficient = .195, t = 21.31, P < .000). The higher the degree of IS auditor participation in e-commerce systems development, the more likely the IS auditor will perceive the system of internal controls to be Hypothesis 2 was not significant (coefficient = -.012, t = .535, p = .595). IS auditor participation was found to have a negative impact on the success of the e-commerce systems initiatives.

Table 5.5
Correlation Among Construct Scores (AVE in Diagonals and Squared Correlations in Parentheses)

	MgtSup	AudPol	ECRead	ISAChar	SysComp	RC	ISAPart	ICEff	SysSuc
Management Support	**.874**								
Audit Policies	.508 (.258)	**.849**							
E-Commerce Readiness	.618 (382)	.485 (.235)	**.568**						
IS Auditor Characteristic	.636 (.404)	.539 (.291)	.367 (.135)	**.533**					
System Complexity	.038 (.001)	.167 (.028)	.214 (.046)	-.164 (.027)	**.678**				
Resource Constraints	.430 (.185)	.517 (.267)	.462 (.213)	.442 (.195)	-.069 (.005)	**.661**			
IS Auditor Participation	.296 (.088)	.554 (.307)	.375 (.141)	.295 (.087)	.379 (.144)	.150 (.023)	**.738**		
Internal Control Effectiveness	.871 (.759)	.502 (.252)	.654 (.428)	.626 (.392)	-.018 (.000)	.580 (.336)	.195 (.195)	**.751**	
System Success	.484 (.234)	.367 (.135)	.792 (.627)	.280 (.078)	.277 (.077)	.437 (.191)	.312 (.312)	.488 (.238)	**.729**

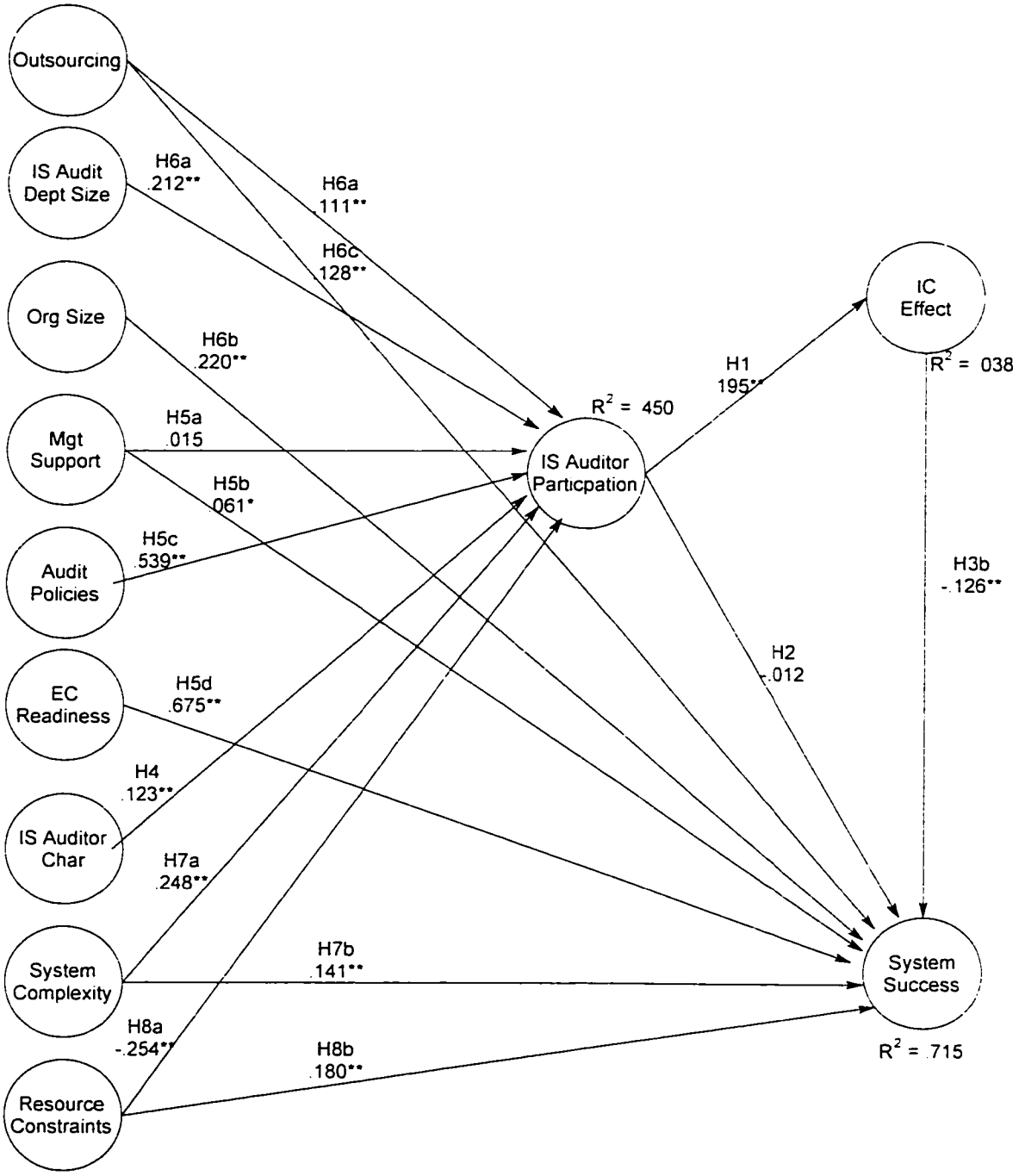

Figure 5.1. Structural Model with Path Coefficients and R^2.

Note: * p < .05, ** p < .000.

Table 5.6
Results of the PLS Model

Paths	Coefficient	Standard Error	t-Statistic
Outsourcing to IS Auditor Participation	.111	.010	11.37
Outsourcing to System Success	.128	.010	14.30
IS Audit Dept. Size to IS Auditor Participation	.212	.010	19.81
Organization Size to System Success	.220	.010	29.22
Management Support to IS Auditor Participation	.015	.012	0.74
Management Support to System Success	.061	.018	2.34
Audit Policies to IS Auditor Participation	.539	.014	37.51
EC Readiness to System Success	.675	.010	81.72
IS Auditor Characteristics to IS Auditor Participation	.123	.013	12.89
System Complexity to IS Auditor Participation	.248	.018	6.97
System Complexity to System Success	.141	.014	16.16
Resource Constraints to IS Auditor Participation	-.254	.013	4.31
Resource Constraints to System Success	.180	.010	17.33
IS Auditor Participation to Internal Control Effectiveness	.195	.011	21.32
IS Auditor Participation to System Success	-.012	.010	0.53
Internal Control Effectiveness to System Success	-.126	.020	4.63

Internal Control Effectiveness and System Success. As predicted in Hypotheses 3a, the model showed that there was a significant positive correlation between the Internal Control Effectiveness from the perspective of the IS auditor and Systems Success (correlation = .488, $t = 3.751$, $p < .001$). Hypothesis 3b was not supported in that the findings indicate that there is a negative direct impact of the internal control effectiveness on e-commerce systems success (coefficient = -.126, $t = 4.63$, $p < .000$).

IS Auditor Characteristics. The structural model provided significant support for Hypothesis 4 (coefficient = .123, t = 12.89, p < .000) that the higher the levels of an IS auditor's skills, experience, and attitude towards the e-commerce systems initiatives, the more likely the IS auditor will participate in e-commerce systems development.

Management Support. Only one of the hypotheses concerning top management support of the IS audit and control function was supported. Hypothesis 5a that top management support for the IS audit and control function has a positive impact on IS auditor participation in e-commerce systems development was not supported (coefficient = .015, t = .741, P = .461). However, support was shown that top management support for the IS audit and control function (Hypothesis 5b) has a direct impact on the success of the e-commerce initiatives (coefficient = .061, t = 2.34, p = .022).

Audit Policies. The impact of audit policies on IS auditor participation in developing e-commerce systems (Hypothesis 5c) was significant (coefficient = .539, t = 37.51, p < .000). An IS auditor is more likely to participation in e-commerce systems development if audit policies are in place that require IS auditor participation in the development process.

E-Commerce Readiness. The effect of e-commerce readiness, while a construct early in the development process, had a significant impact on system success (Hypothesis 5d) in that the higher the e-commerce readiness of the organization, the higher the success of the e-commerce system initiatives (coefficient = .675, t = 81.72, p < .000).

Control Variables. Hypotheses 6a, 6b, 6c, and 6d were formulated around control variables that have an effect on IS auditor participation in developing e-commerce

systems and the success of the e-commerce initiatives. As posited in Hypothesis 6a, the larger the IS audit department, the more likely IS auditors will participate in developing e-commerce systems (coefficient = .212, t = 19.81, p < .000). The size of the organization (Hypothesis 6b) was found to have an impact on e-commerce system success (coefficient = .220, t = 29.22, p < .000). The larger the organization, the more likely IS auditor's will participate in e-commerce systems development.

Hypothesis 6c suggested that outsourcing the e-commerce systems development process would have a negative effect on IS auditor participation in developing e-commerce systems. The opposite was found. Outsourcing was found to have a positive effect on IS auditor participation in developing e-commerce systems (coefficient = .111, t = 11.37, p < .000). Hypothesis 6d was supported. Outsourcing was found to have a positive effect on the success of the e-commerce systems initiatives (coefficient = .128, t = 14.30, p < .000).

System Complexity. Both Hypotheses 7a and 7 b were supported. The higher the complexity of the system, the more likely IS auditors will participate in the e-commerce systems development process as proposed in Hypothesis 7a (coefficient = .248, t = 6.97, p < .000). System complexity (Hypotheses 7b) also had a direct impact on the success of the e-commerce systems initiatives (coefficient = .141, t = 4.31, p < .000). The more complex systems resulted in increased system success.

Resource Constraints. Hypothesis 8a posited that the more resources were constrained, the less likely IS auditors would participate in the e-commerce systems development process. Resource constraints had a negative effect on IS auditor

participation in the development process, thereby supporting the hypothesis (coefficient = -.254, t = 16.16, p < .000). However, resource constraints did not show a negative direct effect on system success. Hypothesis 8b that resource constraints have a negative effect on system success was not supported (coefficient = .180, t = 17.34, p < .000).

A summary of the hypotheses and the study's findings are shown in Table 5.7.

Table 5.7
Hypotheses and Findings

Hypothesis	Findings
H1: The higher the degree of IS auditor participation in e-commerce systems development, the more likely the IS auditor will perceive the system of internal controls to be effective	Supported
H2: The higher the degree of IS auditor participation in e-commerce systems development, the higher the likelihood of system success.	Not supported
H3a: There is a significant positive correlation between system success and the effectiveness of internal controls from the perspective of the IS auditor.	Supported
H3b: The effectiveness of internal controls has a positive impact on e-commerce systems success.	Not supported
H4: The higher the levels of an organization's IS auditor skills, experience, and attitude, the more likely the internal auditor will participate in e-commerce systems development.	Supported
H5a: Top management support for the IS audit and control function has a positive impact on IS auditor participation in e-commerce systems development	Not supported
H5b: Top management support for the IS audit and control function has a direct impact on system success.	Supported
H5c: Audit policies have a direct impact on IS auditor participation in developing e-commerce systems.	Supported

Table 5.7 (Continued)

Hypothesis	Findings
H6a: The size of the IS audit department has a positive impact on IS auditor participation in e-commerce systems development	Supported
H6b: The size of the organization has a positive impact on system success.	Supported
H6c: Outsourcing of the e-commerce systems development has a negative impact on IS auditor participation in developing e-commerce systems.	Not supported
H6cd: Outsourcing of the e-commerce systems development has a positive impact on system success.	Supported
H7a: IS auditors are more likely to participate in the development of an e-commerce system that is relatively complex.	Supported
H7b: System complexity has a direct on system success.	Supported
H8a: The more resources are constrained, the less likely IS auditors will participate in the development process for e-commerce systems.	Supported
H8b: Resource constraints have direct effect on e-commerce system success.	Not supported

This chapter presented the results of the study of IS auditor participation in developing e-commerce systems and the resulting impact of that participation, or lack thereof, on the effectiveness of internal controls and system success. Most of the hypotheses were supported. However, the results showed that IS auditor participation in the development process did not contribute to the success of the system. The next chapter discusses this and other findings of the study.

CHAPTER VI

CONCLUSION

This investigation improves on previous studies of the determinants of IS auditor participation in developing information systems. Not only does this study consider the determinants of IS auditor participation in developing e-commerce systems, but it also looks at the impact of IS auditor participation in the development process on the success of the system. Currently, there is no available literature on the impact of IS auditor participation in developing e-commerce systems. Using user participation and user involvement literature, this study explored several hypotheses concerning the impact of IS auditor participation in the development process on the success of the resulting e-commerce system.

The degree of IS auditor participation in e-commerce systems development and the IS auditor's resulting reliance on the system of internal controls has not been tested in academic literature. Theoretically, if an auditor can rely more on the system of internal controls, less substantive testing will be necessary. Additionally, more reliance may be placed on controls that the IS auditor helped design, develop, and implement. If an IS auditor participating in the development process cannot place more reliance on the system of internal controls, a fundamental re-evaluation of IS auditor participation in the organization's systems development processes must be performed. Based on the findings

of the study, many IS auditors seem to be aware that their participation in developing e-commerce systems is of benefit to the organization through increased effectiveness of the system of internal controls for the organization's e-commerce initiatives.

The relationship between IS auditor participation and system success has not been examined in other studies to any extent. Based on previous literature, the relationship between user participation or involvement and system success has yielded mixed results. Part of the problem may be the system success measures used in the previous studies. For this study, an appropriate measure of system success was meeting the objectives and goals of management, thus systems success was measured at the organizational level. If an IS auditor is able to participate effectively in the design, development, and implementation of adequate internal controls for a system under development, the system should be successful in meeting the objectives and goals of the organization. Unfortunately, the findings of this study do not support this relationship between IS auditor participation in the development process and e-commerce systems success.

IS auditor participation in developing e-commerce, while not statistically significant, had a negative impact on the success of the system. The negative impact could be due to several reasons including: (1) IS auditors tend to slow down the development process in order to provide reasonable assurance that the system of internal controls is adequate, (2) IS auditor participation in developing the e-commerce systems is not particularly wanted, (3) top management does not understand the benefits of effective internal controls or care if adequate internal controls are in place, (4) the fallout from the general e-commerce problems of the early 2000s may have impacted the effects of IS

auditor participation, or (5) the economic recession occurring during the time of the study may have had an unplanned impact on the results. As a remedy, the process of IS auditors participating in system development projects should be scrutinized, or the qualifications of the IS auditors might be evaluated with the goal of their participating more effectively in the development process. In addition, another study during better economic conditions should be conducted to see whether the results would be different.

Contradictory results were found in examining the relationship between internal control effectiveness and e-commerce system success. There was a significant positive correlation between internal control effectiveness and system success. However, internal control effectiveness had a negative direct impact on e-commerce system success. The reasons for this fact could be similar to the reasons for negative impact of IS auditor participation in the development process. Internal controls are implemented to help minimize risk. E-commerce systems are inherently associated with higher risk. The more internal controls that are implemented in a system, the tighter the constraints on the system. E-commerce systems need to be flexible because of the nature of the customer-driven business environment. If a system causes too much inconvenience to the customer or user because of stricter internal controls, they are likely to go to another Web site, thus decreasing the success of the system in question.

Theoretically, IS auditor skills, experience, and attitude, should impact the level of IS auditor participation in the systems development process. Negative attitudes toward the system being developed possibly would make IS auditors unable to participate or uncomfortable in taking part in systems development. One would hope that this would

not be the case for an IS auditor. The skills and experience necessary to help design, develop, and implement internal controls should preclude negative attitudes. The study did find that higher skill levels, experience, and a positive attitude toward the system tended to positively impact IS auditor participation in the e-commerce systems development process. However, if this were not the case, the organization would most likely benefit from a training program to assist the IS auditor in becoming more adept in the role of systems development team member.

The organizational factors included in the study, for the most part, had an impact on IS auditor participation in the e-commerce systems development and on the success of the e-commerce systems from on organizational viewpoint. Top management support for the IS audit and control function did not appear to affect IS auditor participation in the development process. However, the organization's audit policies had the largest impact on IS auditor participation in the e-commerce systems development process. These findings indicate the audit policies dictate the participation of IS auditors in developing e-commerce systems whether or not top management supports the IS audit and control function. Top management support for the IS audit and control function did appear to impact system success.

E-commerce readiness is a relatively new concept just starting to be researched. However, it was not surprising to find that the more ready for e-commerce an organization was, the more benefits that were reaped from implementing e-commerce initiatives. Currently, the environment is ripe for e-commerce. Customers/consumers want to find information and make purchases online. Suppliers are looking for ways to

promote their products online in order to better meet the needs of their customers. With so much pressure from outside the organization to participate in e-commerce initiatives, an organization has to look inward to make sure the organization itself is prepared for e-commerce. Thus, readiness for e-commerce should have a very significant impact on the success of the systems that make up an organization's e-commerce initiatives.

A surprising result regarding the control variables used in the study dealt with the proposed decrease in IS auditor participation with increased levels of outsourcing. Findings in the study indicated that increased outsourcing actually led to higher levels of IS auditor participation in the e-commerce systems development process. This could be due to one of several factors: (1) top management perceives the need to have IS auditors look over the shoulders of third party developers, (2) external auditors required IS auditor participation, or (3) audit policies dictate more IS auditor participation when dealing with outsourced systems development.

Results regarding the other control variables were expected. Logically, larger IS audit departments have a larger number of IS auditors that can participate in systems development projects. Also larger organizations would tend to have more formality in their policies and procedures and more management support for the IS audit and control function, therefore, potentially leading to greater system success.

IS auditors are more likely to be involved in the development of e-commerce systems if the system is relatively complex. In addition, the complexity of the system has a direct impact on system success. The existing literature base has shown that complex systems, in general, are more likely to be unsuccessful. This could possibly build a

stronger case for IS auditor participation in developing the system. Of course, it depends on the main reason for the lack of success. One possible reason explaining system failure that supports IS auditor participation in the development process could be the lack of adequate controls integrated into the system. However, this study did not indicate a negative impact on the success of the system. One possible reason for this could be that e-commerce systems are inherently complex, but organizations cognizant of this fact could have policies and procedures in place to minimize the risk of system failure.

Resource constraints had a negative impact on IS auditor participation in developing e-commerce systems. This outcome was expected in that IS auditors typically have more duties than they can perform and IS audit resources are not sufficient to participate in a project that might tie up the auditor for long periods of time as might be required with complex e-commerce systems. Surprisingly, resource constraints did not have a significant impact on system success. In fact, the relationship was positive instead of the posited negative relationship. This result could be due to the necessity of companies getting e-commerce sites up and running in order to compete in today's business environment, despite any constraints that might normally put the project on hold.

In general, resource constraints can mean the death of a project or the failure of a system. Lack of time or money are probably the hardest constraints to overcome. Without these two, the remaining resource constraints are not relevant because it takes time and money to acquire adequate staff and technical training. Recognizing that not many companies have unlimited resources for system development, it is necessary for

management to understand the importance of IS auditor participation in the development process so the adequate resources can be allocated.

In summary, while it was hypothesized that all of the components in the conceptual model would impact IS auditor participation in e-commerce systems development and, ultimately, system success, there were some surprising results. There are many reasons why there were not significant relationships between some of the variables. Other issues such as the need for an e-commerce site to be up and running rather quickly in order to maintain a competitive advantage or just to keep up with the competition may be the driving force behind e-commerce systems development. If this is the case, further research needs to be done in order to understand the strategic motivation for developing systems that may not have adequate controls designed to protect one of the organization's most valuable assets– its data.

Future Research

This investigation confirmed many of the hypotheses regarding the success of an organization's e-commerce systems. However, impacts on the effectiveness of internal controls were very weak. In reviewing the correlations among the variables, many had high correlations with internal control effectiveness. Further research should be conducted in order to explore these correlations and determine the effects of the variables other than IS auditor participation on the effectiveness of internal controls.

Although more effective internal controls, by definition, should make systems more successful from an organizational viewpoint, this was not found to be the case in this study. One possible solution to the problem could be to measure the effectiveness of

internal controls on system success based on financial performance. An in-depth investigation into the correlation between internal control effectiveness and system success should be conducted in future studies.

E-commerce readiness is another variable that could bear further scrutiny. Investigation into this area is so new, there was not much available theory. Once again, correlations were relatively high between e-commerce readiness and some of the other constructs such as internal control effectiveness and IS auditor participation in the e-commerce systems development process. Further investigation should be conducted into these correlations in an effort to understand the impact of e-commerce readiness on these other constructs.

Future research should also be conducted to determine if there is any difference in IS auditor participation in the systems development of e-commerce systems by industry, as some industries such as banking and insurance must have more restrictive internal controls than other industries. This study did not have a sufficient sample size to explore the differences among the various industries.

Another factor that could have been added to this model was risk. Since e-commerce has such inherent risk associated with it, it makes sense to investigate the effects of risk on IS auditor participation in developing e-commerce systems, the effectiveness of internal controls, and e-commerce systems success.

Since the study was conducted in a recessionary business environment and one in which e-commerce was still recovering from the drastic fall of technology stocks in the early 2000s, further investigation into the issues presented in this study should be

conducted in a more robust economic environment. It is possible that the degree of the successes of the e-commerce systems may be viewed as greater once the economy turns around. With more successful e-commerce initiatives, it is also possible that IS auditor participation in e-commerce systems development may become more of a positive issue than the negative one it is currently. In addition, the measure of e-commerce system success may be under more scrutiny after some spectacular business failures. These failures focused attention on audibility and controls. Therefore, the business environment may exert an extraordinary influence on the attitude about IS auditor participation in the future.

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APPENDIX A

Table A.1
Summary of Results of Ives and Olson Review

Study	System Success Measures		
	System Quality	System Usage	Information Satisfaction
Edstrom (1977)			mixed
Franz (1979)			+
Kaiser & Srinivasan (1980)			+
Maish (1979)		n.s.	mixed
Powers & Dickson (1973)	n.s.		mixed
Olson & Ives (1981)			mixed
Schewe (1976)		n.s.	
Vanlommel & DeBrabander (1975)	n.s. or -		
Guthrie (1972)			+
Satore (1976)	n.s. or -		n.s.
Gallagher (1974)	+		+
Swanson (1974)		+	+
Lucas (1976)		n.s.	
Spence (1978)		n.s.	
Lucas (1975)		mixed	n.s.
King & Rodriquez (1978, 1981)	n.s.	mixed	
Boland (1978)	+		
Total Positive Results	2	1	5

Note. Adapted from "User Involvement and MIS Success: A Review of Research," by B. Ives and M. H. Olson, 1984, Management Science, 30, p. 597.

APPENDIX B

PILOT STUDY QUESTIONNAIRE

Auburn University

Auburn University Alabama 36849-5241

Department of Management
415 W. Magnolia Suite 401
Lowder Business Building

Telephone (334) 844-4071

INFORMATION SHEET
FOR
IS Auditor Participation in Developing E-Commerce Systems

You are invited to participate in a study of IS auditor participation in developing e-commerce systems to be conducted by Sandra C. Henderson, a Ph.D. candidate under the supervision of Dr. Thomas E. Marshall, associate professor and Dr. Charles A. Snyder, Woodruff Endowed Professor of Management in the Department of Management at Auburn University. You were selected as a possible participant either because of your company's initiative in electronic commerce or because you work in internal or IS auditing, the IS department, or are a member of management.

If you decide to participate, please fill out the attached questionnaire on IS auditor participation in the e-commerce systems development process and the impact of that participation on the success of the system. The questionnaire will take approximately 10-20 minutes to complete. You do not have to answer any questions that you do not wish to answer. The questionnaire may be returned in the enclosed stamped envelope. As an alternative, you may fill out the questionnaire on the Web at http://ecomm.business.auburn.edu/isapec. You may request a copy of the results to be sent to you upon completion of the survey by filling out your name and address on the enclosed postcard and mailing it separately from the questionnaire.

The questionnaire used in this study will potentially be an important aid in helping top management and internal audit managers determine which systems should have IS auditors participation in the development process, which types of IS auditors have more of an impact on the process, and at what level of involvement the most impact is created. There is no expected direct benefit to you as an individual participant.

Any information obtained in connection with this study will remain anonymous. Information gathered will be disseminated in a non-identifiable manner in the dissertation of the principal investigator and at least one scholarly journal publication. You may withdraw from participation at any time; however, after you return the questionnaire you will be unable to withdraw your data since there will be no way to identify individual information.

Your decision whether or not to participate will not jeopardize your future relations with Auburn University or the Auburn University Department of Management.

If you have any questions, the principal investigator, Sandra Henderson will be happy to answer them. She can be reached by telephone at (334) 844-6421 or (229) 888-3743 or via e-mail at chenderson@business.auburn.edu. In addition, you may contact Dr. Thomas Marshall at (334) 844-6509 or marshall@business.auburn.edu or Dr. Charles Snyder at (334) 844-6515 or snyder@business.auburn.edu. For more information regarding your rights as a participant you may contact the Office of Research Programs, Ms. Jeanna Sasser at (334) 844-5966 or sassejb@auburn.edu or Dr. Steven Shapiro at (334) 844-6499 or shapisk@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THE RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, THE DATA YOU PROVIDE WILL BE SURVEYED. YOUR AGREEMENT TO DO SO. THIS LETTER IS YOURS TO KEEP.

Sandra C. Henderson

Sandra C. Henderson 7/16/01
Investigator's Signature Date

HUMAN SUBJECTS
OFFICE OF RESEARCH
PROJECT #01-075EX0106
APPROVED 5/31/01 TO 5/31/02

IS Audit Questionnaire

The purpose of this survey is to assess IS auditor participation in the development of e-commerce initiatives within your organization. Please complete all sections by selecting the best response for each question based on your view of the organization. Thank you in advance for your participation.

This section contains questions about the person completing the questionnaire and the organization. Please answer each question in the space provided or check the appropriate box.

What is your current title or position?_____

How many years have your worked in your current position?_____years

How many years have you worked for this organization?_____years

How many years experience do you have in IS auditing?_____years

What is the average number of years IS audit experience of your organization's IS auditors?_____years

What is the average number of years systems development experience of your organization's IS auditors?_____years

What is the average number of years accounting experience of your organization's IS auditors?_____years

What is the number of IS auditors in your organization?_____

What is the number of employees in your organization?_____

How many years and months has your organization been involved in e-commerce?_____years_____months

Which of the following components make up your organization's e-commerce initiatives? (please check all that apply)

- ☐ Internet presence providing information to customers/ vendors/investors
- ☐ Company Intranet
- ☐ Online storefront (e-shop) selling goods and/or services
- ☐ Electronic mall (collection of e-shops)
- ☐ Electronic auction
- ☐ Electronic procurement (seeking suppliers)
- ☐ Virtual community focused on added value of communication between members
- ☐ Electronic Data Interchange (EDI)
- ☐ Value/supply chain integration
- ☐ Search agent
- ☐ Information brokerage
- ☐ Other _____

Please check the primary business activity of your organization (please check only one):

☐ Agriculture	☐ Banking	☐ Business services	☐ Communications	☐ Construction
☐ Education	☐ Finance	☐ Government	☐ Health services	☐ Insurance
☐ Investment	☐ Legal	☐ Manufacturing	☐ Mining	☐ Real estate
☐ Retail	☐ Transportation	☐ Utilities	☐ Wholesale	Other_____

To what degree is the development of e-commerce systems outsourced?

☐ Not at All ☐ Some ☐ About Half ☐ Most ☐ Nearly All/All

Please indicate the typical degree of **IS auditor participation** in the development of the systems comprising the e-commerce initiatives in your organization by circling the appropriate number on the associated scale. The numbers on the scale range from 1 to 6 as defined below:

1 = ***No* Participation** - unwilling or not invited to participate
2 = ***Symbolic* Participation** - input requested but ignored
3 = **Participation by *Advice*** - advice solicited through interviews or questionnaires
4 = **Participation by *Weak Control*** - have "sign-off" responsibility at a particular stage of development process
5 = **Participation by *Doing*** - development team member or a liaison with the IS group
6 = **Participation by *Strong Control*** - cost of new development came out of your department or your performance evaluation depended on the outcome of the systems development effort

Development Stage of E-Commerce Systems	None	Symbolic	Advice	Weak Control	Doing	Strong Control
1. Planning stage - feasibility investigation	1	2	3	4	5	6
2. Analysis stage - determine system requirements and model the system	1	2	3	4	5	6
3. Design stage - identify outputs, inputs, interfaces, and processes, and design internal and external controls	1	2	3	4	5	6
4. Immediately before implementation stage	1	2	3	4	5	6
5. During implementation stage - programs are written, tested, and documented, and the system is installed	1	2	3	4	5	6
6. Post-implementation stage	1	2	3	4	5	6

Please consider the following attributes of your organization's **e-commerce initiatives** and evaluate the **benefits** attained within your organization. Please rate the extent to which your organization attains each benefit by circling the appropriate number on the associated scale.

	Not Attained				Totally Attained
Benefits from our organization's e-commerce initiatives:					
7. Enhance competitiveness or create strategic advantage.	1	2	3	4	5
8. Enable the organization to catch up with competitors.	1	2	3	4	5
9. Improve internal communication and coordination.	1	2	3	4	5
10. Strengthen strategic planning.	1	2	3	4	5

	Not Attained				Totally Attained
11. Align well with stated organizational goals.	1	2	3	4	5
12. Help establish useful linkages with other organizations.	1	2	3	4	5
13. Enable the organization to respond more quickly to change.	1	2	3	4	5
14. Enhance the credibility and prestige of the organization.	1	2	3	4	5
15. Change the way the organization conducts business.	1	2	3	4	5
16. Improve customer relations.	1	2	3	4	5
17. Enhance the flexibility and responsiveness to customer needs.	1	2	3	4	5
18. Enhance the ability to attract and retain customers.	1	2	3	4	5
19. Provide added value to the organization.	1	2	3	4	5
20. Enable the organization to carry out its work more easily and efficiently.	1	2	3	4	5
21. Help develop close relationships with suppliers/vendors.	1	2	3	4	5
22. Enable electronic transactions with suppliers/vendors.	1	2	3	4	5
23. Improve monitoring of the quality of products and services from suppliers/vendors.	1	2	3	4	5

This section lists a variety of **situations and practices of your organization**. Please rate the extent to which you agree with each of these situations and practices by circling the appropriate number on the associated scale.

	Strongly Disagree				Strongly Agree
24. Our security provisions protect computer equipment, programs, communications, and data from unauthorized access, modification, or destruction.	1	2	3	4	5
25. Our program development and acquisition is performed in accordance with management's general and specific authorization.	1	2	3	4	5
26. Our program modifications have the authorization and approval of management.	1	2	3	4	5
27. Our processing of transactions, files, reports, and other computer records is accurate and complete.	1	2	3	4	5
28. Our source data that is inaccurate or improperly authorized is identified and handled according to prescribed managerial policies.	1	2	3	4	5
29. Our computer data files are accurate, complete, and confidential.	1	2	3	4	5
30. Our top management places a high priority on establishing and maintaining an adequate system of internal control.	1	2	3	4	5
31. Our top management is willing to allocate funds to implement information system audit recommendations.	1	2	3	4	5
32. Top management of our firm is very knowledgeable about IS controls.	1	2	3	4	5

	Strongly Disagree				Strongly Agree
33. IS auditors in our firm participate in information systems development.	1	2	3	4	5
34. IS auditors in our firm participate in the design of internal controls for information systems.	1	2	3	4	5
35. Our top management requires IS audit participation in information systems development.	1	2	3	4	5
36. Adequate time was provided for the completion of the development process for most of our systems in the e-commerce initiatives.	1	2	3	4	5
37. An adequate budget was provided for the development process for most of our systems in the e-commerce initiatives.	1	2	3	4	5
38. Adequate IS personnel were available for the development process for most of our systems in the e-commerce initiatives.	1	2	3	4	5
39. Adequate IS audit staff members were available to participate in the development process for most of our systems in the e-commerce initiatives.	1	2	3	4	5
40. Our customers feel comfortable regarding security and privacy in e-commerce with our organization.	1	2	3	4	5
41. Our customers consider it important to engage in e-commerce.	1	2	3	4	5
42. Our suppliers/vendors have Internet-based systems to engage in e-commerce.	1	2	3	4	5
43. Our suppliers/vendors feel comfortable (regarding security, privacy, etc.) engaging in e-commerce.	1	2	3	4	5
44. Our suppliers/vendors consider it important to engage in e-commerce.	1	2	3	4	5
45. Our organization has an effective understanding of the e-commerce business models.	1	2	3	4	5
46. Our organization has adequate knowledge of the e-commerce marketplace, competitive forces, and strategic awareness of this market.	1	2	3	4	5
47. Our organization is aware of the risks with e-commerce deployment.	1	2	3	4	5
48. Our IS auditors are skilled in designing internal controls.	1	2	3	4	5
49. Our IS auditors are skilled in internal auditing.	1	2	3	4	5
50. Our IS auditors are skilled in systems development.	1	2	3	4	5
51. Our IS auditors are skilled in IS/EDP auditing.	1	2	3	4	5
52. Our IS auditors are encouraged to learn new e-commerce technologies.	1	2	3	4	5
53. Our IS auditors closely follow the trend in current e-commerce technologies.	1	2	3	4	5
54. Our IS auditors understand the e-commerce business environment.	1	2	3	4	5
55. Our IS auditors understand our organization's e-commerce policies and plans.	1	2	3	4	5
56. Our IS auditors have a positive attitude toward the organization's e-commerce initiatives.	1	2	3	4	5
57. Our IS auditors feel that our e-commerce initiatives are valuable to our organization.	1	2	3	4	5

Referring to your organization's **e-commerce initiatives**, please indicate how you would evaluate the technical **complexity** of each of the following elements by circling the appropriate number on the associated scale

	Not Complex				Highly Complex
58. The hardware	1	2	3	4	5
59. The software	1	2	3	4	5
60. The connectivity of the applications	1	2	3	4	5

Comments:

_____

_____

_____

If you have any questions about this survey please contact:

Sandra C. Henderson(334) 844-6421
Department of Management
E-mail: chenderson *a* business.auburn.edu
415 W. Magnolia Avenue
Auburn University, Alabama 36849-5241

Thank you for your participation.

Please return the survey in the pre-paid envelope provided.

APPENDIX C

REMINDER POSTCARD

Reminder: IS Auditor Participation in Developing E-Commerce Systems

A few weeks ago, you should have received a letter and a survey asking you to participate in a survey about your organization's IS auditor participation in developing e-commerce systems. This survey is part of my dissertation research, and your response is very important to the success of this project. If you have not already done so, would you please complete the survey today?

You can access the survey online by going to the following website: http://ecomm.business.auburn.edu/isapec

If you prefer a hard copy of the survey, please e-mail me at the following address and I will send the survey out to you directly. (Please indicate your mailing address in your e-mail).
chenderson@business.auburn.edu

Thank you for your help!

Sandra C. Henderson

APPENDIX D

SURVEY QUESTIONNAIRE

Auburn University
Auburn University, Alabama 36849-5241

Department of Management
415 W. Magnolia Suite 401
Lowder Business Building

Telephone (334) 844-4271

October 30, 2001

Dear Participant:

Thank you for agreeing to participate in my study on IS auditor participation in developing e-commerce systems. The study is being conducted by me, Sandra C. Henderson, a Ph.D. candidate under the supervision of Dr. Thomas E. Marshall, associate professor and Dr. Charles A. Snyder, Woodruff Endowed Professor of Management in the Department of Management at Auburn University. The information you provided will be invaluable in continuing my dissertation research.

I am sending this packet in hopes that you can further assist me by soliciting further participation in your company. In order for me to complete my research, I need a total of three responses from each of my participating companies. The IS Audit Questionnaire should be completed by you and the two additional questionnaires and letters should go to a member of management and a member of the information systems department. I would be most appreciative if you would give these surveys to the appropriate parties and encourage their participation, as well as completing the IS Audit survey. I am enclosing a self-addressed, stamped envelope so that you can return the surveys to me when complete. An additional option is for the participants to complete the survey online at http://ecomm.business.auburn.edu/isapec.

Any information obtained in connection with this study will remain anonymous. Information gathered will be disseminated in a non-identifiable manner in the dissertation of the principal investigator and at least one scholarly journal publication.

If you have any questions, I would be happy to answer them. I can be reached at (817) 272-3520 or (817) 649-5736 or via e-mail at chenderson@business.auburn.edu.

Sincerely,

Sandra C. Henderson

Sandra C. Henderson
Ph.D. Candidate

Auburn University

Auburn University, Alabama 36849-5241

Department of Management
415 W. Magnolia, Suite 401
Lowder Business Building

Telephone (334) 844-4031

INFORMATION SHEET
FOR
IS Auditor Participation in Developing E-Commerce Systems

You are invited to participate in a study of IS auditor participation in developing e-commerce systems to be conducted by Sandra C. Henderson, a Ph.D. candidate under the supervision of Dr. Thomas E. Marshall, associate professor and Dr. Charles A. Snyder, Woodruff Endowed Professor of Management in the Department of Management at Auburn University. You were selected as a possible participant either because of your company's initiative in electronic commerce or because you work in internal or IS auditing, the IS department, or are a member of management.

If you decide to participate, please fill out the attached questionnaire on IS auditor participation in the e-commerce systems development process and the impact of that participation on the success of the system. The questionnaire will take approximately 10-20 minutes to complete. You do not have to answer any questions that you do not wish to answer. The questionnaire may be returned in the enclosed stamped envelope. As an alternative, you may fill out the questionnaire on the Web at http://ecomm.business.auburn.edu/isapec. You may request a copy of the results to be sent to you upon completion of the survey by filling out your name and address on the enclosed postcard and mailing it separately from the questionnaire.

The questionnaire used in this study will potentially be an important aid in helping top management and internal audit managers determine which systems should have IS auditors participation in the development process, which types of IS auditors have more of an impact on the process, and at what level of involvement the most impact is created. There is no expected direct benefit to you as an individual participant.

Any information obtained in connection with this study will remain anonymous. Information gathered will be disseminated in a non-identifiable manner in the dissertation of the principal investigator and at least one scholarly journal publication. You may withdraw from participation at any time; however, after you return the questionnaire you will be unable to withdraw your data since there will be no way to identify individual information.

Your decision whether or not to participate will not jeopardize your future relations with Auburn University or the Auburn University Department of Management.

If you have any questions, the principal investigator, Sandra Henderson will be happy to answer them. She can be reached by telephone at (334) 844-6421 or (229) 888-3743 or via e-mail at chenderson@business.auburn.edu. In addition, you may contact Dr. Thomas Marshall at (334) 844-6509 or marshall@business.auburn.edu or Dr. Charles Snyder at (334) 844-6515 or snyder@business.auburn.edu. For more information regarding your rights as a participant you may contact the Office of Research Programs, Ms. Jeanna Sasser at (334) 844-5966 or sassejb@auburn.edu or Dr. Steven Shapiro at (334) 844-6499 or shapisk@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, THE DATA YOU PROVIDE WILL SERVE AS YOUR AGREEMENT TO DO SO. THIS LETTER IS YOURS TO KEEP.

Sandra C. Henderson — Investigator's Signature
7/16/01 — Date

HUMAN SUBJECTS
OFFICE OF RESEARCH
PROJECT #01-075EX0105
APPROVED 5/31/01 TO 5/31/02

IS Audit Questionnaire

The purpose of this survey is to assess IS auditor participation in the development of e-commerce initiatives within your organization. Please complete all sections by selecting the best response for each question based on your view of the organization. Thank you in advance for your participation.

This section contains questions about the person completing the questionnaire and the organization. Please answer each question in the space provided or check the appropriate box.

What is your current title or position?_____

How many years have your worked in your current position?_____years

How many years have you worked for this organization?_____years

How many years experience do you have in IS auditing?_____years

What is the average number of years IS audit experience of your organization's IS auditors?_____years

What is the average number of years systems development experience of your organization's IS auditors?_____years

What is the average number of years accounting experience of your organization's IS auditors?_____years

What is the number of IS auditors in your organization?_____

What is the number of employees in your organization?_____

How many years and months has your organization been involved in e-commerce?_____years_____months

Which of the following components make up your organization's e-commerce initiatives? (please check all that apply)

- ☐ Internet presence providing information to customers/ vendors/investors
- ☐ Company Intranet
- ☐ Online storefront (e-shop) selling goods and/or services
- ☐ Electronic mall (collection of e-shops)
- ☐ Electronic auction
- ☐ Electronic procurement (seeking suppliers)
- ☐ Virtual community focused on added value of communication between members
- ☐ Electronic Data Interchange (EDI)
- ☐ Value/supply chain integration
- ☐ Search agent
- ☐ Information brokerage
- ☐ Other _____

Please check the primary business activity of your organization (please check only one):

☐ Agriculture	☐ Banking	☐ Business services	☐ Communications	☐ Construction
☐ Education	☐ Finance	☐ Government	☐ Health services	☐ Insurance
☐ Investment	☐ Legal	☐ Manufacturing	☐ Mining	☐ Real estate
☐ Retail	☐ Transportation	☐ Utilities	☐ Wholesale	Other_____

Please indicate the typical degree of **IS auditor participation** in the development of the systems comprising the e-commerce initiatives in your organization by circling the appropriate number on the associated scale. The numbers on the scale range from 1 to 6 as defined below:

1 = ***No* Participation** - unwilling or not invited to participate
2 = ***Symbolic* Participation** - input requested but ignored
3 = **Participation by *Advice*** - advice solicited through interviews or questionnaires
4 = **Participation by *Weak Control*** - have "sign-off" responsibility at a particular stage of development process
5 = **Participation by *Doing*** - development team member or a liaison with the IS group
6 = **Participation by *Strong Control*** - cost of new development came out of your department or your performance evaluation depended on the outcome of the systems development effort

Development Stage of E-Commerce Systems	None	Symbolic	Advice	Weak Control	Doing	Strong Control
Planning stage - feasibility investigation	1	2	3	4	5	6
Analysis stage - determine system requirements and model the system	1	2	3	4	5	6
Design stage - identify outputs, inputs, interfaces, and processes, and design internal and external controls	1	2	3	4	5	6
Immediately before implementation stage	1	2	3	4	5	6
During implementation stage - programs are written, tested, and documented, and the system is installed	1	2	3	4	5	6
Post-implementation stage	1	2	3	4	5	6

This section lists a variety of **situations and practices of your organization**. Please rate the extent to which you agree with each of these situations and practices by circling the appropriate number on the associated scale.

	Strongly Disagree				Strongly Agree
Our security provisions protect computer equipment, programs, communications, and data from unauthorized access, modification, or destruction.	1	2	3	4	5
Our program development and acquisition is performed in accordance with management's general and specific authorization.	1	2	3	4	5
Our program modifications have the authorization and approval of management.	1	2	3	4	5
Our processing of transactions, files, reports, and other computer records is accurate and complete.	1	2	3	4	5
Our source data that is inaccurate or improperly authorized is identified and handled according to prescribed managerial policies.	1	2	3	4	5

	Strongly Disagree				Strongly Agree
Our computer data files are accurate, complete, and confidential.	1	2	3	4	5
Our top management places a high priority on establishing and maintaining an adequate system of internal control.	1	2	3	4	5
Our top management is willing to allocate funds to implement information system audit recommendations.	1	2	3	4	5
Top management of our firm is very knowledgeable about IS controls.	1	2	3	4	5
IS auditors in our firm participate in information systems development.	1	2	3	4	5
IS auditors in our firm participate in the design of internal controls for information systems.	1	2	3	4	5
Our top management requires IS audit participation in information systems development.	1	2	3	4	5
Our IS auditors are skilled in designing internal controls.	1	2	3	4	5
Our IS auditors are skilled in internal auditing.	1	2	3	4	5
Our IS auditors are skilled in systems development.	1	2	3	4	5
Our IS auditors are skilled in IS/EDP auditing.	1	2	3	4	5
Our IS auditors are encouraged to learn new e-commerce technologies.	1	2	3	4	5
Our IS auditors closely follow the trend in current e-commerce technologies.	1	2	3	4	5
Our IS auditors understand the e-commerce business environment.	1	2	3	4	5
Our IS auditors understand our organization's e-commerce policies and plans.	1	2	3	4	5
Our IS auditors have a positive attitude toward the organization's e-commerce initiatives.	1	2	3	4	5
Our IS auditors feel that our e-commerce initiatives are valuable to our organization.	1	2	3	4	5

Comments:

_____

_____

_____

If you have any questions about this survey please contact:

Sandra C. Henderson
Department of Management
415 W. Magnolia Avenue
Auburn University, Alabama 36849-5241

(334) 844-6421
E-mail: chenderson@business.auburn.edu

Thank you for your participation.

Please return the survey in the pre-paid envelope provided.

Management Questionnaire

The purpose of this survey is to assess the success of your organization's e-commerce initiatives. Please complete all sections by selecting the best response for each question based of your view of the organization. Thank you in advance for your participation.

If you have any questions about this survey please contact:

Sandra C. Henderson
Department of Management
415 W. Magnolia Avenue
Auburn University, Alabama 36849-5241

(334) 844-6421
E-mail: chenderson@business.auburn.edu

This section contains questions about the person completing the questionnaire and the organization. Please answer each question in the space provided or check the appropriate box.

What is your current title or position?_____

How many years have your worked in your current position?_____years

How many years have you worked for this organization?_____years

What is the number of employees in your organization?_____

How many years and months has your organization been involved in e-commerce?_____years_____months

Which of the following components make up your organization's e-commerce initiatives? (please check all that apply)

- ☐ Internet presence providing information to customers/ vendors/investors
- ☐ Company Intranet
- ☐ Online storefront (e-shop) selling goods and/or services
- ☐ Electronic mall (collection of e-shops)
- ☐ Electronic auction
- ☐ Electronic procurement (seeking suppliers)
- ☐ Virtual community focused on added value of communication between members
- ☐ Electronic Data Interchange (EDI)
- ☐ Value/supply chain integration
- ☐ Search agent
- ☐ Information brokerage
- ☐ Other _____

Please check the primary business activity of your organization (please check only one):

☐ Agriculture	☐ Banking	☐ Business services	☐ Communications	☐ Construction
☐ Education	☐ Finance	☐ Government	☐ Health services	☐ Insurance
☐ Investment	☐ Legal	☐ Manufacturing	☐ Mining	☐ Real estate
☐ Retail	☐ Transportation	☐ Utilities	☐ Wholesale	Other_____

Please consider the following attributes of your organization's **e-commerce initiatives** and evaluate the **benefits** attained within your organization. Please rate the extent to which your organizations attains each benefit by circling the appropriate number on the associated scale.

	Not Attained				Totally Attained
Benefits from our organization's e-commerce initiatives:					
Enhance competitiveness or create strategic advantage.	1	2	3	4	5
Enable the organization to catch up with competitors.	1	2	3	4	5
Improve internal communication and coordination.	1	2	3	4	5
Strengthen strategic planning.	1	2	3	4	5
Align well with stated organizational goals.	1	2	3	4	5
Help establish useful linkages with other organizations.	1	2	3	4	5
Enable the organization to respond more quickly to change.	1	2	3	4	5
Enhance the credibility and prestige of the organization.	1	2	3	4	5
Change the way the organization conducts business.	1	2	3	4	5
Improve customer relations.	1	2	3	4	5
Enhance the flexibility and responsiveness to customer needs.	1	2	3	4	5
Enhance the ability to attract and retain customers.	1	2	3	4	5
Provide added value to the organization.	1	2	3	4	5
Enable the organization to carry out its work more easily and efficiently.	1	2	3	4	5
Help develop close relationships with suppliers/vendors.	1	2	3	4	5
Enable electronic transactions with suppliers/vendors.	1	2	3	4	5
Improve monitoring of the quality of products and services from suppliers/vendors.	1	2	3	4	5

This section lists a variety of **situations and practices of your organization**. Please rate the extent to which you agree with each of these situations and practices by circling the appropriate number on the associated scale.

	Strongly Disagree				Strongly Agree
Our customers feel comfortable regarding security and privacy in e-commerce with our organization.	1	2	3	4	5
Our customers consider it important to engage in e-commerce.	1	2	3	4	5
Our suppliers/vendors have Internet-based systems to engage in e-commerce.	1	2	3	4	5

	Strongly Disagree				Strongly Agree
Our suppliers/vendors feel comfortable (regarding security, privacy, etc.) engaging in e-commerce.	1	2	3	4	5
Our suppliers/vendors consider it important to engage in e-commerce.	1	2	3	4	5
Our organization has an effective understanding of the e-commerce business models.	1	2	3	4	5
Our organization has adequate knowledge of the e-commerce marketplace, competitive forces, and strategic awareness of this market.	1	2	3	4	5
Our organization is aware of the risks with e-commerce deployment.	1	2	3	4	5

Comments:

_____

_____

_____

Thank you for your participation.

Please return the survey in the pre-paid envelope provided.

IS Department Questionnaire

The purpose of this survey is to assess the complexity and success of e-commerce initiatives within your organization. Please complete all sections by selecting the best response for each question based of your view of the organization. Thank you in advance for your participation.

If you have any questions about this survey please contact:

Sandra C. Henderson
Department of Management
415 W. Magnolia Avenue

Auburn University, Alabama 36849-5241

(334) 844-6421
E-mail: chenderson @ business.auburn.edu

This section contains questions about the person completing the questionnaire and the organization. Please answer each question in the space provided or check the appropriate box.

What is your current title or position?_____

How many years have your worked in your current position?_____years

How many years have you worked for this organization?_____years

How many years experience do you have in systems development?_____years

What is the number of employees in your organization?_____

How many years and months has your organization been involved in e-commerce?_____years_____months

Which of the following components make up your organization's e-commerce initiatives? (please check all that apply)

- ☐ Internet presence providing information to customers/ vendors/investors
- ☐ Virtual community focused on added value of communication between members
- ☐ Company Intranet
- ☐ Electronic Data Interchange (EDI)
- ☐ Online storefront (e-shop) selling goods and/or services
- ☐ Value/supply chain integration
- ☐ Electronic mall (collection of e-shops)
- ☐ Search agent
- ☐ Electronic auction
- ☐ Information brokerage
- ☐ Electronic procurement (seeking suppliers)
- ☐ Other _____

Please check the primary business activity of your organization (please check only one):

☐ Agriculture	☐ Banking	☐ Business services	☐ Communications	☐ Construction
☐ Education	☐ Finance	☐ Government	☐ Health services	☐ Insurance
☐ Investment	☐ Legal	☐ Manufacturing	☐ Mining	☐ Real estate
☐ Retail	☐ Transportation	☐ Utilities	☐ Wholesale	Other_____

To what degree is the development of e-commerce systems outsourced?

☐ Not at All	☐ Some	☐ About Half	☐ Most	☐ Nearly All/All

Referring to your organization's **e-commerce initiatives**, how would your evaluate the technical **complexity** of each of the following elements by circling the appropriate number on the appropriate scale.

	Not Complex				Highly Complex
The hardware	1	2	3	4	5
The software	1	2	3	4	5
The connectivity of the applications	1	2	3	4	5

This section lists a variety of **situations and practices of your organization**. Please rate the extent to which you agree with each of these situations and practices by circling the appropriate number on the associated scale.

	Strongly Disagree				Strongly Agree
Adequate time was provided for the completion of the development process for most of our systems in the e-commerce initiatives.	1	2	3	4	5
An adequate budget was provided for the development process for most of our systems in the e-commerce initiatives.	1	2	3	4	5
Adequate IS personnel were available for the development process for most of our systems in the e-commerce initiatives.	1	2	3	4	5
Adequate IS audit staff members were available to participate in the development process for most of our systems in the e-commerce initiatives.	1	2	3	4	5

Comments:

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Thank you for your participation.

Please return the survey in the pre-paid envelope provided.

GLOSSARY

Acquisition and Implementation. One of the four domains of the COBIT Framework. To realize the IT strategy, IT solutions need to be identified, developed or acquired, as well as implemented and integrated into the business process. In addition, changes in and maintenance of existing systems are covered by this domain to make sure that the life cycle is continued for these systems.

AMOS. A covariance-based structural equation modeling software package published by SmallWarters and marketed by SPSS.

Average Variance Extracted (AVE). The amount of variance that is captured by the construct relative to the amount of variance due to measurement error.

"Brick and Mortar" Stores. A term used to distinguish traditional storefronts from online storefronts.

Business-to-Business (B2B) E-Commerce. The electronic buying and selling of goods and services between two businesses.

Business-to-Consumer (B2C) E-Commerce. The electronic buying and selling of goods in which businesses sell directly to the consumer.

Committee of Sponsoring Organizations of the Treadway Commission (COSO). A committee formed after several significant audit failures in the 1980s for the

purpose of redefining internal control and the criteria for determining the effectiveness of an internal control system.

Composite Reliability. A measure of internal consistency that considers the ratio of non-random variance associated with all measures of a construct to total variance associated with the measures.

Contingency Theory. Often not considered a theory at all because of the lack of the well-developed set of interrelated propositions of theory in the conventional sense. contingency theory may be viewed as an orienting strategy or framework for organizing knowledge in a given area.

Control. Any action taken by management to enhance the likelihood that established objectives and goals will be achieved or exceeded.

Control Activities. Policies and procedures that management establishes to help ensure management directives are carried out. Also called ***control procedures***.

Control Environment. One of the five components of an organization's control structure. The control environment sets the tone for the organization. It influences the consistency of procedures and the general effectiveness of the accounting system and control procedures.

Control Objectives for Information and Related Technology (COBIT). A framework initially released by the Information Systems Audit and Control Foundation (ISACF) in 1996. The COBIT Framework is designed to help meet the multiple needs of management by bridging the gaps between business risks, control needs,

and technical issues. The Framework has 34 Control Objectives within the four domains of Planning and Organization. Acquisition and Implementation. Delivery and Support. and Monitoring.

Control Procedures. Policies and procedures that management establishes to help ensure management directives are carried out. Also called ***control activities***.

Covariance-Based Structural Equation Modeling. A methodology that represents causal process that generate observations on multiple variables. The model is used for explaining the covariation of all the indicators.

Delivery and Support. One of the four domains of the COBIT Framework. This domain is concerned with the actual delivery of required services. which range from traditional operations over security and continuity aspects to training. In order to deliver services. the necessary support processes must be set up. This domain includes the actual processing of data by application systems. often classified under application controls.

Electronic Commerce (e-commerce). The buying and selling of goods and services via electronic means such as the Internet and the World Wide Web.

Electronic Data Interchange (EDI). The movement of information electronically– using a standard format– between a buyer and a seller for the purpose of facilitating a business transaction.

EQS. A structural equation modeling software developed by Bentler (1992), that implements a general mathematical and statistical approach to the analysis of linear structural models.

Independence. The concept that permits internal auditors to render the impartial and unbiased judgements essential to the proper conduct of audits. Internal auditors should be independent of the activities they audit.

Information and Communication. One of the five components of the COSO Integrated Framework. This component involves the identification, capture, and exchange of information in a form and time frame that enables organization personnel to carry out their responsibilities.

Information System (IS). A system that collects, processes, and stores data for the purpose of providing useful information to decision makers.

Information Technology (IT). The combination of computer technology (hardware and software) and telecommunications technology (data, voice, and image networks).

Inner Model (Structural Model). The regression part of the latent structural equation model.

Internal Control. According to COSO, "Internal control is broadly defined as a process, effected by an entity's board of directors, management, and other personnel, designed to provide reasonable assurance regarding the achievement of objectives in the following three categories: effectiveness and efficiency of

operations, reliability of financial reporting, and compliance with applicable laws and regulations."

Internal Auditing. The internal audit function is an individual, group, or department within an organization that acts as a separate higher level of control to determine that the internal control structure is functioning effectively. According to the Institute of Internal Auditors, "internal auditing is an independent appraisal function established within an organization to examine and evaluate the adequacy and effectiveness of the organization's internal control system and its overall quality of performance."

Internal Control– Integrated Framework (the Integrated Framework). The report issued by COSO in 1992. It defines internal control, describes its components, and provides criteria against which control system can be evaluated.

Internet. A global system of interconnected networks which exchange information seamlessly using open, non-proprietary standards and protocols.

IS Auditor Participation. Defined as participation in systems development for the purpose of ensuring security, control, and auditability of a system.

Latent Variables. Variables that represent theoretical constructs (i.e., abstract concepts) that cannot be observed directly and are presumed to underlie particular observed measures.

LISREL. A procedure for the analysis of **LI**near **S**tructural **REL**ations among one or more sets of variables and variates. It examines the covariance structures of the

variables and variates included in the model under construction. LISREL permits both confirmatory factor analysis and the analysis of path models with multiple sets of data in a simultaneous analysis.

Measurement Model. In structural equation modeling, the measurement model relates measures to theoretical variables or factors by generally using confirmatory factor analysis. It contains information about how theoretical variables are operationalized in each study.

Monitoring. One of the five components of the COSO Integrated Framework and one of the four domains of the COBIT Framework. The process of assessing the quality of the internal control structure's performance over time.

Observed Variables. Variables that can be measured (i.e., self-report responses to an attitudinal scale, scores on an achievement test, coded responses to interview questions, etc.). Within structural equation modeling, they serve as indicators of the underlying construct that they are presumed to represent.

Outer Model (Measurement Model). The portion of a structural equation model that relates measures to theoretical variables or factors.

Partial Least Squares (PLS). A structural equation modeling method that combines factor analysis with linear regression, making minimal demands on measurement scales, sample size, and residual distribution. The purpose is to obtain determinate values of latent variable for prediction or theory building.

Planning and Organization. One of the four domains of the COBIT Framework. This domain covers the strategy and tactics, and concerns the identification of the way IT can best contribute to the achievement of the business objectives. Furthermore, the realization of the strategic vision needs to be planned, communicated and managed for different perspectives. Finally, a proper organization as well as technological infrastructure must be put in place.

PLSGraph. A self-contained Graphical User Interface (GUI) based software which created input decks compatible with Lohmoller's PLS program.

Risk Assessment. One of the five components of the COSO Integrated Framework. The organization's process for identifying and analyzing the risks relevant to the achievement of its objectives.

Structural Equation Modeling (SEM). A statistical methodology that takes a hypothesis-testing (i.e., confirmatory) approach to the multivariate analysis of a structural theory bearing on some phenomenon. Typically, this theory represents "causal" processes that generate observations on multiple variables.

Structural Model. The regression part of latent variable structural equation modeling.

Substantive Tests. Tests of details and analytical procedures performed by the auditor to detect material misstatements in the account balance, transaction class, and disclosure components of financial statements.

System of Internal Controls. The rules, policies, and procedures involved in managing an organization's risks and to provide reasonable assurance that specific entity objectives will be achieved.

Systems Development Life Cycle (SDLC). A traditional systems development methodology that consists of several stages: planning, analysis, design, implementation, and maintenance.

User Involvement. A subjective psychological state of the individual and defined as the importance and personal relevance that users attach either to a particular system or the IS in general, depending on the users' focus.

User Participation. The behaviors and activities that target users perform in the development process.

World Wide Web (WWW). A subset of the Internet that connects computers and their contents using a standard interface designed to handle all types of digital information including text, hypermedia, graphics, and sound.