AN INTEGRATED TYPOLOGY OF INFORMATION TECHNOLOGY EFFICIENCY: A TRANSACTION COST APPROACH

By

JENNIFER CRAWFORD LEONARD

Bachelor of Arts
Louisiana Tech University
Ruston, Louisiana
1983

Masters of Business Administration
Northeastern State University
Tahlequah, Oklahoma
1995

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
December, 2003

AN INTEGRATED TYPOLOGY OF INFORMATION

TECHNOLOGY EFFICIENCY:

A TRANSACTION COST

APPROACH

Thesis Approved:

Thesis Advisor

Dean of the Graduate College

ACKNOWLEDGEMENTS

I wish to thank Dr. Robert Dooley, first. He recognized my potential, pushed when I needed pushed, and was ready to catch me when I fell. I could not have completed this dissertation without his unending support, dedication, encouragement, and wisdom. Dr. Dooley has been my champion since I entered the program, and no one has had nor could ask for a better mentor, chair, and friend.

I would like to acknowledge the support and assistance of my other committee members: Dr. Mark Gavin, Dr. Meg Kletke, and Dr. Lee Adkins, all of whom gave me assistance and guidance throughout the process and most of all provided an unwavering belief in this project.

Special recognition goes to Dr. Ken Eastman, who saw me through some tough times, and the late Dr. Wayne Meinhart, who did everything he could to keep me in the program when the going got rough. My thanks is directed to all the professors involved in the Ph.D. program at Oklahoma State University's College of Business for their involvement in such a wonderful educational process.

Finally, to my wonderful husband, Ben, who had absolutely no idea what he was getting into when he married a Ph.D. student. His support, encouragement, and love have been invaluable.

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CHAPTER I

INTRODUCTION

> If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle.
>
> - Sun Tzu, On the Art of War

Knowing and understanding the organization's strengths and weaknesses as well as those of the "enemy" are not limited to armies and generals, for business may be considered a form of war as well – engaged on the economic front rather than a battlefield. Gathering information has been a function of managers since the days of Barnard (1938) because, as suggested by Porter (1979), the information about the environment that is available to an organization affects the efficiency of the strategy it may choose to employ.

The strategy a firm adopts, according to transaction cost economics, depends upon the costs associated with that strategy. In cases where the chosen strategy of the firm does not provide the optimum available reduction of transaction costs, performance suffers. Thus, when the c osts of transacting in the market are high or the market fails transactions will be brought "in-house" and a hierarchical governance mechanism will be used. Conversely, when the costs of transacting in the market are low, the market system will be chosen. However, the strategy of the firm leads to high performance only when the structure that the firm adopts optimizes the transaction costs associated with the chosen strategy (Williamson, 1975). One such structural variable that has begun to receive attention in the last decade is information technology (Davis, 1991; Fiedler, Grover, & Teng, 1996).

Gurbaxani and Whang (1991) have suggested that all transaction costs result in one way or another from lack of information. Thus, information technology (IT), with its ability to increase communication within the firm or between firms (Davis, 1991), increase information availability with respect to internal operations, competitors, buyers or suppliers (Clemons, Reddi, & Row, 1993), and increase coordination and monitoring capabilities (Gurbaxani & Whang, 1991) becomes an important factor with respect to reducing transaction costs.

However, when examining the relationship between IT and transaction cost reductions, one major problem has arisen: the IT literature has numerous classification schemes that deal with portions of IT systems (Ein-Dor & Segev, 1993; Fedorowicz & Konsynski, 1992; Lee & Leifer, 1992; Sabherwal & King, 1995; Sowa and Zachman, 1992), however, a comprehensive, testable classification scheme is notably lacking.

Purpose of the Study

Considering the transaction cost economics' argument that IT may be an important structural variable missing in the strategy – performance relationship and the lack of a classification scheme that may be used to test this argument, the following question presents itself: Can a typology of information systems that is comprehensive, relatively parsimonious, and testable be created?

The purpose of this study, then, is to develop a theory-driven typology of IT efficiency based on transaction cost economics as developed by Williamson (1975) and refined by others (c.f., D'Aveni & Ravenscraft, 1994; Hill & Hoskisson, 1987; Jones &

Hill, 1988 Williamson, 1985), which encompasses a greater number of variables and interactions than can currently be found in the IT literature.

Implications for Theory and Practice

The ultimate purpose of this study is to add to the theoretical and practical knowledge in the fields of both information technology and strategy by developing a typology of information technology that may eventually be used to test and demonstrate the importance of information technology as a structural variable. This study, then, has two primary goals. The first is to provide a classification scheme of efficient IT systems that may be used both in academia to test theory and in practice to enhance the ability of firms to create or maintain an efficient IT system. The second goal is to contribute a more complete empirical examination of the interactions among information technology components.

Theoretical Implications

First and foremost, the development of a new typology of efficient IT systems fills a gap that is present in the IT literature. The typology will provide a new basis for more robust testing of IT system relationships beyond those that are currently available, such as IT investments and single system components, thus providing a deeper understanding of how IT system components interact with each other.

Additionally, most research in the strategy – information technology field consists solely of bivariate relationships (e.g., IT and strategy, IT and performance). Hitt (1999) has lamented the fact that there is a lack of comprehensive interdisciplinary models being researched such as those in which the strategy, information technology, and performance constructs proposed above are examined together. Thus, this research will provide a comprehensive classification scheme for efficient information technology that will allow for more complete and complex interdisciplinary modeling and examinations of the relationships between these three constructs.

Finally, this research will provide support for transaction cost economics, in general, as well as corroboration for the concept that transaction costs may be both internal and externally generated as discussed by Hill and Hoskisson (1987) and Jones and Hill (1988).

The study will be conducted using various cluster analysis techniques on data gathered from surveys of Chief Information Officers[1] (CIO). The sample will contain firms of various sizes and located in numerous industries in order to increase the generalizability of the study.

Practical Implications

In addition to academic contributions, this study will also provide guidance to practitioners in the strategy and IT fields. Information technology (IT) has become a large part of corporate strategic thinking in the last decade (Davis, 1991; Fiedler, Grover, & Teng, 1996), yet IT managers, top management teams, and CEOs have no clear criteria for establishing efficient IT systems.

Thus, from a practitioner's point of view, the typology will provide these managers with a guide for creating the most efficient IT system possible, while considering their own focus on developing internal or external efficiency and the goal

[1] The term CIO is loosely used in this paper to denote the manager of the IT department or the person who is actually responsible for the IT system as a whole, regardless of actual rank or title.

style they use. The detailed checklist of characteristics will allow an organization to determine where changes need to be made in specific areas in order to maximize efficiency. The proposed checklist will also provide guidance for new system development without the high costs of "trial and error" adoption methods. Additionally, the typology and the detailed characteristics of each component will allow managers to determine the best course of action when transitioning from one system type to another in order to maintain and maximize the efficiency of the IT system.

Organization of the Dissertation

The dissertation is organized in five chapters. The first chapter has provided a brief introduction to the strategy and information technology literature and a discussion (albeit abbreviated) of the need for a comprehensive classification scheme of IT system types as well as the theoretical and practical implications of the proposed typology.

Chapter II presents the background and literature review of the transaction cost economics approach needed for the theoretical development of a new typology of efficient IT system types. Models and hypotheses regarding the new IT system typology are included.

Chapter III contains a description of the methodology employed to test the measures of the variables, samples, and other methodological issues.

Finally, Chapter IV provides the details of the cluster analysis and tests of the proposed hypotheses and results of the research, and Chapter V presents the conclusions reached, possible future research, and limitations of the study.

CHAPTER II

LITERATURE REVIEW, THEORY DEVELOPMENT, AND HYPOTHESES PROPOSAL

Introduction

A review of the information technology literature reveals that many different theories are proposed to explain configurations of various components of IT systems. These include such varied themes as Miles and Snow's (1978) organizational taxonomy (Karimi, Gupta, & Somers, 1996), Hambrick and Mason's (1984) upper echelon theory (Jenks & Dooley, 2000), social embeddedness (Chatfield & Yetton, 2000), transaction cost economics (Brynjolfsson et al, 1994), and punctuated equilibrium (Lassila & Brancheau, 1999) to name but a few. To further confound the issue of theory selection, many empirical studies do not propose any theoretical basis for the conclusions made (e.g., Broadbent, Weill, O'Brien & Neo, 1996: Cross & Earl, 1997; Lam & Ching, 1998).

However, there does appear to be a common theme in much of the IT literature: efficiency. Thus, considering that transaction cost economics has efficiency as its underlying theme, efficiency is either directly discussed or implied in much of the IT literature, and as one of the objectives of this section is to consolidate the various major components of IT systems into a cohesive whole under the umbrella of a single theory, I have chosen to use the transaction cost economics arguments proposed by Williamson (1975) as the basis for the typology development.

Literature Review: Transaction Cost Economics

Introduction

Transaction cost economics (TCE) is, at its core, an economic efficiency argument. TCE posits there are costs associated with any transaction that takes place, which are incurred through bounded rationality or opportunistic behavior in association with uncertainty or small numbers exchange (Williamson, 1975). These combinations may be exacerbated by the presence of information impactedness, transaction frequency, and asset specificity (Jones & Hill, 1988; Williamson, 1975).[2] Transaction costs may be market costs (i.e., the costs associated with doing business with trading partners outside the firm) or they may be bureaucracy costs (i.e., those costs associated with the use of a hierarchical form of governance – transacting within the firm) (D'Aveni & Ravenscraft, 1994; Hill & Hoskisson, 1987; Jones & Hill, 1988).

Market costs are associated with contracting, monitoring, and enforcing compliance with contracts that take place with respect to transactions outside of the firm's governance structure as well as search costs associated with finding a trading partner (Williamson, 1985). As originally proposed by Williamson (1975), transaction cost economics makes no specific assumptions about the bureaucracy costs involved with bringing transactions into the firm, however as Jones and Hill (1988) point out transaction costs are not simply a function of the market, but also apply to internal transactions. Bureaucracy costs include monitoring, negotiating, and compliance costs,

[2] It should be noted that opportunistic behavior need not occur – only the possibility that it may occur is required to incur transaction costs (Williamson, 1975). I will use the term *opportunistic behavior* as it is commonly used in the transaction cost economics literature to refer to the possibility that such behavior may exist.

but as transactions take place in-house, no search costs exist. However, these are replaced by coordination costs (Jones & Hill, 1988), which are the costs associated with managing the internal tasks of the organization (Brynjolfsson et al, 1994). The sources of transaction costs are shown in Figure 1 and described in detail below.

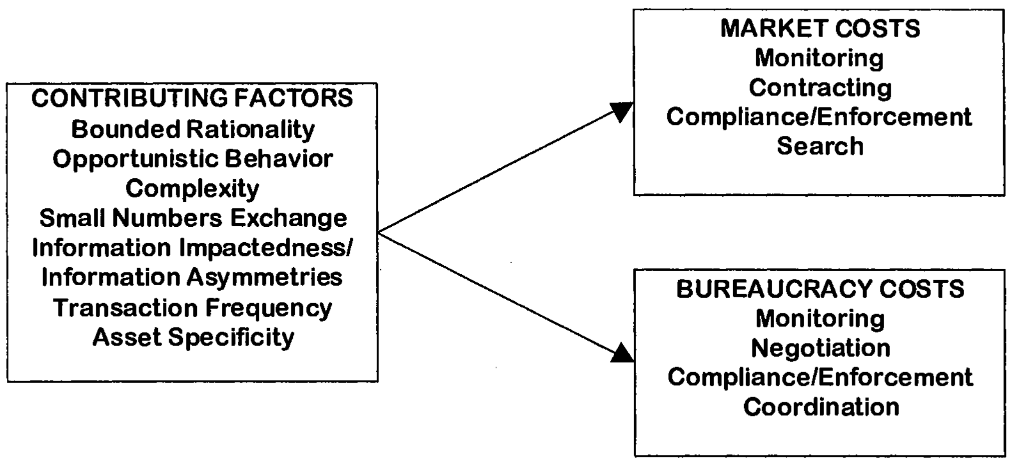

Figure 1: Factors Contributing to Transaction Costs

Market Costs

In essence, market costs are created from the need for searching for a trading partner and contracting, monitoring, and enforcement of compliance with contracts that take place outside of the firm's boundaries. Transaction costs are created when opportunistic behavior exists or bounded rationality is evident in association with complexity or small numbers exchange (Williamson, 1975, 1991). Information impactedness, transaction frequency, or asset specificity increase the costs already present under such conditions (Jones & Hill, 1988; Williamson, 1975, 1991).

Transaction cost economics assumes that information impactedness exists: that information is not equally available to both parties in a transaction because it is not shared (or sharable) or that the costs of obtaining needed information is prohibitively costly (Williamson, 1975). Thus, in situations when information impactedness is combined with complexity or opportunistic behavior, transaction costs increase as the need for monitoring and contracting e scalate. As complexity or opportunistic behavior intensifies and the disparity between partners' information increases, the need for the deficient partner to monitor the behavior of the partner with more complete information in order to protect its own interests also increases (Williamson, 1991). Additionally, contracts must be more complex in order to counteract the effects of the information asymmetry in such situations (Williamson, 1975). In his study of four automobile manufacturers and their suppliers, Dyer (1997) supported the relationship between decreased information impactedness and reduced transaction costs.

An increase in contracting, search, and monitoring costs may also be brought about when transaction frequency is present in conjunction with complexity and bounded rationality (D'Aveni & Ravenscraft, 1994; Williamson, 1975; Williamson and Ouchi, 1981). The less often firms interact, the more the partners must rely on contractual safeguards and extensive monitoring to protect their interests. On the other had, repeated transactions may lead to trust and commitment, which may be used as a reputational safeguard, and thus, the need for complex contracts and monitoring is reduced. Search costs may also be reduced through trust as firms that have had previous interactions become confident in the trading partner's ability to provide the goods or services needed, thereby reducing the search for other suitable partners (Chiles & McMackin, 1996).

Dyer's (1997) automobile manufacturer study supported the notion that when repeated transactions are present transaction costs are lowered as did Gulati's (1995) investigation of 2,400 American, European, and Japanese alliances.

When found in combination with small numbers exchange (i.e., a small number of trading partners), bounded rationality may cause one partner in the exchange to feel it is held hostage by the other due to its inability to find other trading partners (Bensaou & Venkatraman, 1995). This, in turn, may lead to problems with contracting and compliance enforcement. The addition of asset specificity may cause bilateral dependency, thus increasing the costs of contracting, monitoring, and enforcement (Kogut, 1988; Menard, 1986).

In order to reduce market costs, a firm may choose to change to a hierarchy (Williamson, 1985). However, the move from market governance does not indicate that all transaction costs are eliminated; hierarchical governance incurs its own transaction costs. As Jones and Hill (1988) state: "transaction costs do not simply disappear when firms choose hierarchy over the market" (p. 163).

Bureaucracy Costs

Chandler (1988) defined transaction costs as "the cost of transfer of goods or services from one operating unit to another" (p. 475). This definition implies that such costs may be incurred with either market governance (i.e., transacting in the market or outside the firm's boundaries) or hierarchical governance (i.e., transacting within the firm).

The hierarchical governance costs of enforcement, coordination, monitoring, and negotiation are increased by a move to an internal market. Such operating costs are referred to by Williamson (1975) as "bureaucracy costs." These bureaucracy costs are, in essence, transaction costs that are incurred internally within the firm, and may be attributed to the same basic assumptions as traditional transaction costs (Jones & Hill, 1988). While bureaucracy costs do not, obviously, include contracting or search costs, they do include some elements of both: coordination and negotiation.

Internally, the same problems that create market costs create bureaucracy costs. Opportunistic behavior on the part of agents within the firm takes the place of opportunistic behavior on the part of trading partners in the market whenever control is delegated. Thus, the same types of control problems that are experienced in the market are present internally, thereby increasing monitoring costs (Jones, 1987).

Information impactedness, when the information deficiency favors the agent, can also create monitoring and coordination costs (Abrahamson & Park, 1994). Often, these asymmetries exist because the information is costly for principals to obtain or principals simply do not have access to the same information as the agent (Eisenhardt, 1989). As Munter and Kren's (1995) study of *Fortune 500* firms indicate, when information is too costly to obtain, a monitoring system will be employed. Bureaucracy costs are also increased through a higher need for monitoring when the tasks of the agent are not standardized or are complicated. This is supported by Welbourne et al.'s (1995) study of 221 employees in two firms, which indicated that monitoring costs increase with complexity.

When an agent's position is one that is hard to fill because it requires special skills that are not readily available, small numbers exchange and asset specificity may become issues within the hierarchy as they lead to negotiation and enforcement costs (D'Aveni & Ravenscraft, 1994; Welbourne et al., 1995).

As the previous argument shows, the firm itself (as far as transactions between divisions are concerned) may be treated as an internal market with all the costs and benefits associated with market governance.

Literature Review: IT Efficiency

Introduction

In order for a science to gain acceptance and to develop fully, it must contain classification schemes that enhance theory building and make broad categorizations simple (Rich, 1992). The purpose of a science is, after all, to develop laws and theories that allow the explanation, prediction, and understanding of phenomena (Hunt, 1991). Theory, then, is of prime importance to the social scientist. While no classification schemes can be considered theory (Bacharach, 1989), they may serve the purpose of theory development (Glaser & Strauss, 1967), and testing (Bacharach, 1989) especially when such a classification scheme has an *a priori* theory base (Rich, 1992).

Justification for Typology

The social sciences have three major types of classification schemes: frameworks, taxonomies, and typologies. There are fundamental differences among the three, and the characteristics of the three classification schemes are recapped in Table 1 below.

The first difference is in the origin of the scheme. Frameworks are neither theory nor data driven, relying strictly on common sense and linkages observed by the researcher. Taxonomies are data driven; the classification scheme is developed *a posteriori* from empirical procedures that emphasis either similarities or differences between the groups. Typologies are based on *a priori* theory; the classes and members are determined heuristically, before empirical work is done (Warriner, 1984).

The other major differences among the three are generalizability and boundaries. In order to be generalizable, a classification scheme should have as few boundaries as is feasible, while maintaining parsimony and simplicity. Frameworks have the most restrictive boundaries and the lowest generalizability among the three classification types. Taxonomies developed from empirical evidence are generally more restrictive (and therefore less generalizable) than typologies, which are generally broader in scope (Bacharach, 1989). As typologies are theory driven and more generalizable than frameworks and taxonomies, they provide a greater basis for theoretical testing and hypothesis development than the other two (Rich, 1992).

The groupings that result from typology development may be either monothetic (i.e., large numbers of groups in which members share all attributes) or polythetic (i.e., smaller number of groups in which members share many, but not all characteristics). Typologies that create polythetic groupings require that members of the resultant groups contain as many of the characteristics of the group as possible, that the members have overlapping characteristics with each other, and that no member contain all the characteristics assigned to the group (McKelvey, 1978). Furthermore, polythetic typologies do not rank groups by desirability of characteristics. There is no hierarchical basis for comparison as to which group is "better" than any other (Rich, 1992). Polythetic typologies, therefore, provide "ideal types" in which members are comparable within groups, but not across groups, and groups are not comparable to each other. Thus, a polythetic typology provides a broad classification scheme that has an *a prior* theoretic basis, and provides the grounds for building and testing theory, which in turn enhances the understanding, prediction, and explanation of phenomena in the field.

Classification Type	Basis	Generalizability	Boundaries
Framework	Common Sense – Observation	Low	Very Restrictive
Taxonomy	*a posteriori* – Empirical	Medium	Restrictive
Typology	*a priori* – Theoretical	High	Broad – limited only by researcher

Table 1: Types of Classification Schemes

The field of information technology has reached the point where classification schemes abound (e.g., Ein-Dor & Segev, 1993; Lee & Leifer, 1992; Sabherwal & King, 1995), yet few of these are either integrated or theory driven. Thus, in order to advance the field of information technology, it is time for development of a typology of IT systems that is both integrated across components and, by definition, is driven by theory, rather than derived from strictly empirical evidence or researcher observed linkages. It is the development of such a polythetic typology that is the main purpose of this section.

Two notable exceptions to the integration issue are Fedorowicz and Konsynski's (1992) taxonomy[3] and Zachman's (1987) and Sowa and Zachman's (1992) ISA framework. While Fedorowicz and Konsynski (1992) attempt to provide a broad taxonomy of system sophistication, their framework has overlapping categories, thus

[3] Although Fedorowicz & Konsynski (1992) use the term "taxonomy," according to the definitions provided earlier "framework" might be a better categorization as no empirical evidence is provided.

making it difficult to classify organizational-level IT systems, though a single application may be placed into a category quite easily. Sowa and Zachman's (1992) classification has the same problem; it was created to specifically aid in the development and design of a particular application, and it has much merit as a framework at the individual application level. The difference between these two classification schemes is that the expanded Zachman ISA Framework (Sowa & Zachman, 1992; Zachman, 1987), with minor modification and generalization, may be applied to an organizational-level typology of efficient IT systems, whereas the overlapping categorization of the Fedorowicz and Konsynski (1992) framework makes this extremely difficult.

In 1987, Zachman (1987) created the basic ISA framework for IT systems analysis and design. Considered a seminal article (Lewis, 1998) on information systems architecture, the Zachman ISA Framework is widely regarded as the basic building block of IT design (Aiken & Girling, 1998; Ho, 1996; Karimi, 1990). Although several authors have attempted to provide alternative approaches to the Zachman ISA Framework (Bytheway, 1996; Hofman & Rockart, 1994; Lewis, 1998), the usefulness and appropriateness of the framework has withstood the test of time (Mowbray, 1999; Wladawsky-Berger, 1999). In the expanded framework (Sowa and Zachman, 1992), a six by five classification of systems architecture was proposed, which increased the number of components from three to six, thus providing a more specific level of detail.

Considering the usefulness and acceptability of the Zachman ISA Framework, and its subsequent expansion, the typology proposed in this paper finds its origins in that seminal work.

Components of the Efficient System

The expanded framework described by Sowa and Zachman (1992) consists of six broad IT components: function, networks, people, motivation, data, and time. Following are brief descriptions of the new typology components, which are based loosely on the definitions provided by the Zachman ISA Framework. Additional detailed information on their relevance to efficiency is discussed later in the section.

1. Function: The function component is essentially the operating software and the applications used to process data thereby turning them into usable information.
2. Networks: The network element of the framework concerns the location of data and how they can be stored, accessed, and distributed. In short, the network component is concerned with the system's hardware. Due to the confusion that may result between the broader term *hardware* and the more narrow and common definition of *networks*, the term hardware will be used in this paper.
3. People: While Sowa and Zachman (1992) envisioned the people factor of the schema as the users of the system, it is the designers, builders, programmers and managers of the IT system who ultimately determine the overall workings of the IT system (Sawyer & Guinan, 1998; Schenk, Vitalari, & Davis, 1998). Sowa and Zachman (1992) did consider these specialized technical people in their framework however, describing them as "perspectives." It is these IT staff members (rather than the users) to which the people component of the proposed IT typology will refer.
4. Motivation: The motivation portion of the framework addresses why the system exists: the use of the data and resultant information to accomplish the organization's goals and strategies.

5. Data: The facts about people, places, or things with which the firm interacts make up the data portion of the framework. The data component is the basic building block of all information systems.
6. Time: The time element consists of the events that trigger the processing, retrieval, or storage of data.

For the purposes of this typology, the data and time components will not be considered. First, these elements are application specific – it can safely be assumed that any information system, manual or automated, will contain data relevant to its firm and that the gathering and use of such data will be triggered by some application specific event (e.g., sale, material receipt, production) as the time element suggests. In addition to being application specific, the time and data components are generalized at a higher level – they are contained in all IT systems, from the most basic to the most sophisticated, with little variation (Fedorowicz & Konsynski, 1992), thus making their inclusion in this typology redundant.

Sowa and Zachman (1992) laid out several "rules" in the creation of their framework, two of which are particularly pertinent to the development of the typology of IT efficiency proposed here. First, each of the entities is unique. There are no overlapping constructs or abstractions among them. Second, the components cannot be ranked – no component is more or less important that any other. These two rules, which are also an integral part of typology development of any kind, have been strictly adhered to in this typology development process as well.

Function

The function component is essentially comprised of the software and applications that are employed in the IT system. This element of the IT system includes not only topics directly related to application development such as data transparency, flexibility, application functionality (Byrd & Turner, 2000), and application standards (Cross & Earl, 1997), but also management issues involved in application choice. Whether the firm should use off-the-shelf software, develop applications in-house, or some cross between the two (Butler, 1999; Grupe & Symonds, 1992), the selection of an operating platform (Taudes, 2000), planning for processing requirements for different user types (Rajkumar & Dawley, 1996), dissemination of data, database formats (Levitin & Redman, 1998; Wang, Lee, Pipino, & Strong, 1998), and organizational adoption issues (Lassila & Brancheau, 1999) are all part of the management portion of the function element.

As can be seen from the list above, the function of the IT system is not simply a matter of selecting an operating system and database management package; the firm must be aware how these issues relate to each other. For example, the selection of the operating system affects the application standards that may be applied (Venkatraman, 1997), the ability to disseminate information (Gallaugher & Ramanathan, 1996), and whether proprietary software development is optional or required (Taudes, 2000).

Additionally, it must be remembered that function is not a stand-alone element of the IT system; the interaction of all four components is crucial to gaining the efficiency the system needs. Information dissemination needs, for example, may influence the choice of processing structure (Fiedler et al, 1996), the type of tech support personnel the firm should employ (Nelson, Nadkarni, Narayanan & Ghods, 2000) and the ability to use virtual teams (Dennis, Pootheri, Natarajan, 1998).

Hardware

The hardware component of the IT system is primarily comprised of the hardware and networking that the system employs. As with function, this element has both technical and managerial portions. Technical items include such topics as processing structure (Fiedler et al, 1996; Scherr, 1999), interorganizational system compatibility (Senn, 2000), network design (Balusek & Sircar, 1998), flexibility (Duncan, 1995), portability (Weill, 1999), and distribution of computing functions (Miller, 1997). Management issues include appropriate choices of the Internet, intranets, and extranets (Townsend, DeMarie & Hendrickson, 1998), choice of infrastructure standards (Broadbent & Weill, 1997; Keen, 1991), selection of data storage areas, data warehouse equipment (Zaino, 2000), and functional integration (Tan, 1995).

The hardware element must be examined from an internal interaction (i.e., interactions within the hardware element) point of view, as well as consideration of the interplay of the hardware function with the other three components of the ISA framework. For example, the selection of the network design may affect both portability (Weill, 1999) and the ability to use intranets and extranets (Townsend et al., 1998). In the broader sense, the choice of intranets, extranets, and the Internet may be affected by and affect the skills provided by the IT staff (Kay, 1996), the operating platform chosen (Chan & Davis, 2000), and strategic uses the firm wishes to have available (Venkatraman & Henderson, 1998).

People

The Chief Information Officer, programmers, analysts, system and data base operators and administrators, tech support personnel, and those that provide special technical services make up the people component of the IT system. The people element embraces the pure technology side of IT employees including technical skills (e.g., programming, analysis, equipment operation), knowledge, and education (Bharadwaj, 2000; Edberg & Bowman, 1996; Leitheiser, 1992), as well as management issues such as the IT employees' physical locations (Bergeron, & Rivard, 1990), management skills (Bharadwaj, 2000), reporting hierarchies (Brown, 1999), outsourcing options (Slaughter & Ang, 1996) and role and position within the firm (Karimi et al, 1996; Keen, 1991).

As with the other components of the IT system, people must be viewed with an eye to internal interaction as well as to interactions with the function, hardware, and motivation elements. For example, the position of the CIO affects not only the determination of what types of IT skills employees will have (Cross & Earl, 1997; Grover, Jeong, Kettinger & Lee, 1993) and to whom they will report (Brown, 1999), but also impacts the use of information technology in the firm (Jenks & Dooley, 2000), the type of applications that are appropriate (Grover et al, 1993), and the hardware that is chosen (Applegate & Elan, 1992).

Motivation

Motivation, or the use of the IT system, is the final component of the IT system. Motivation includes strategic uses such as environmental monitoring (Jenks & Dooley, 2000) and business-to-business integration (Iacovou & Benbasat, 1995; Radding, 2000), as well as communication (Chan & Davis, 2000; Dennis & Tyran, 1997), decision support (Chen, 1995) and knowledge management (Hackbarth & Grover, 1999). These three broad areas encompass the major uses of IT systems, although they all have sub-levels. For example, communication includes group communication (Dennis et al., 1998; Nunamaker & Briggs, 1996), person-to-person or person-to-group communication (e.g., e-mail (Barua, Ravindran & Whinston, 1997), or business-to-business communication (Townsend et al., 1998), while knowledge management and decision support subsumes the areas of expert systems (Jenks & Wilson, 1999), artificial intelligence (Qureshi, Shim & Siegel, 1998), executive information systems (Lam & Ching, 1998), and group decision support systems (Townsend et al., 1998).

As is the case with the other three elements of the IT system, motivation interacts within itself. Communication affects the ability to use group decision support systems (Townsend et al., 1998), for example. The interactions among the other three components exist as well. The use of a group communication system is affected by and affects the types of skills needed by IT personnel (Edberg & Bowman, 1996), the type of hardware infrastructure that is chosen (Bidgoli, 1999), and the applications that are needed to support such a system (Townsend et al., 1998).

Interrelationships

The four components of the IT system are not stand-alone units. The brief examples given above indicate there is mutuality between and within the elements of the IT system. The proposed relationships, commonly referred to as the system architecture, are shown in Figure 2 below (Broadbent & Weill, 1997; Feeny & Willcocks, 1998; Keen, 1991).

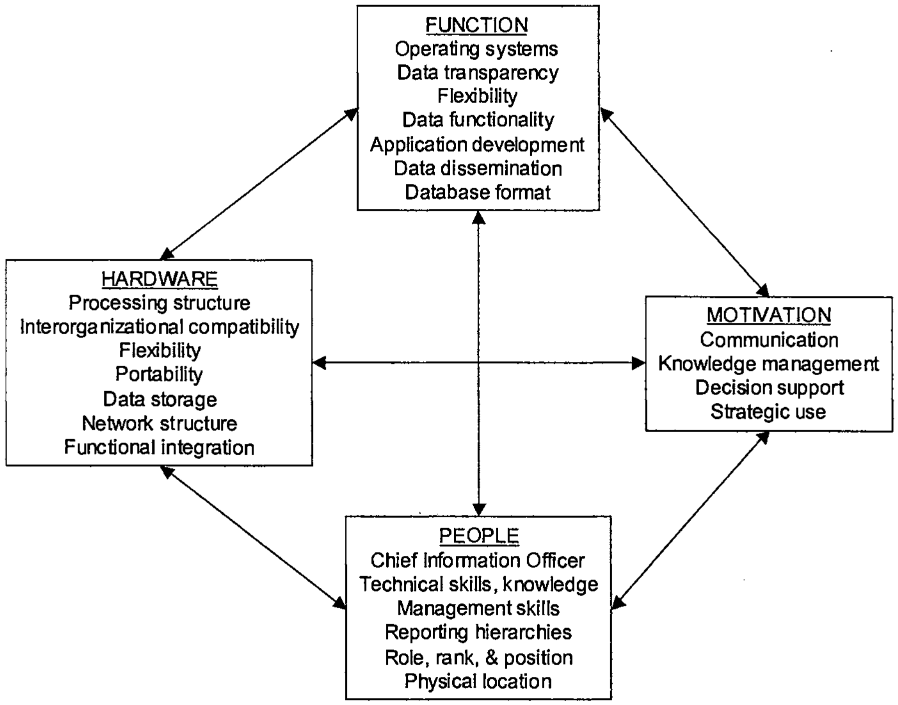

Figure 2: Relationships Between and Among IT System Components

It must be emphasized that no single element of the IT framework either enhances or hinders the efficiency of the IT system. Rather, it is the mutual influences of the four elements that determine system efficiency. Therefore, knowing that the elements work together is not sufficient for an efficient system; the fit between the various components of the IT system must be complementary in order for efficiency to be achieved (Keen, 1991).

An IT system that is designed with functional applications and is not required to share data within the organization may be well suited to having a CIO that has a high level of technical skills and little business knowledge (Karimi et al, 1996), for example, while those firms that expect to employ the IT system for strategic uses such as environmental monitoring are more efficiently handled by a CIO that is a member of the top management team (Jenks & Dooley, 2000). When the interactions between the components of the IT systems do not work together, efficiency suffers and inconveniences, operational gridlocks, and deficiencies may be the result (Grupe & Symonds, 1992; Jain, Ramamurthy, Ryu, & Yasai-Ardekani, 1998).

Theory and Hypotheses Development

Typology Development

Transaction cost economics states that firms choose to transact either in-house or in the market; selecting whichever strategy is most efficient.[4] A firm that decides to transact in-house will place emphasis on internal efficiency and reduction of bureaucracy costs. Accordingly, if markets are used external efficiency and a reduction of transaction or market costs becomes paramount. Additionally, in order for the chosen strategy to be effective, and performance to increase, the structure must be compatible with the strategy (Williamson, 1975). Information systems (i.e., the structure), like strategies, focus on either the internal aspects of the firm or the external market forces (Dennis et al, 1998; Fiedler et al, 1996; Keen, 1991; Senn, 2000). Therefore, the first delineation of efficient IT systems is based on internal or external focus.

While transaction cost economics has been used extensively to explain strategic choice, the effects of the individual decision maker have largely been ignored (Ghoshal & Moran, 1996; Larson, 1992; Podolny, 1994; Tyler & Steensma, 1995). Williamson (1985, 1996) and others (Arthur & McCollum, 1998; Dickson & Weaver, 1997) have acknowledged that behavioral aspects exist and do have an impact on transaction costs, yet the specific behavioral mechanisms were not described beyond bounded rationality and opportunistic behavior. Research in transaction cost economics has started to fill this void. For example, Gulati (1995) and Chiles and McMackin (1996) discussed trust between trading partners and its impact on reducing the need for complex contracting; Dickson and Weaver (1997) studied the relationship between managers' entrepreneurial and individualism/collectivism orientations and alliances; and Ring and van de Ven (1992) explored interorganizational relationships and transaction cost reductions.

Simon (1976) has specifically addressed the issue of decision choice with respect to bounded rationality. He states that individuals cannot possibly have all information about potential outcomes; therefore organizations create goals in order to give decision-makers a reference on which to base choices. Thus, decision makers use a sort of "cause-effect" rationale for choosing a specific plan or course of action that revolves around the goals set (Cyert & March, 1963). These goals, set by the organization, may be operational or non-operational. Operational goals are those that have a clear cause-effect in the mind of the decision maker, are quantifiable, and generally short-term in nature, while non-operational goals are loftier, esoteric, and long-term (Cyert & March, 1963; March & Simon, 1993; McGrath, 2001; Simon, 1976). The distinction between operational and non-operational focus is also important from an IT point of view as it strongly influences the system architecture and infrastructure (Hay & Munoz, 1997; Truman, 2000).

IT systems that have an operational focus, as described above, are generally used to automate routine tasks, cut administrative costs, handle procedural functions, and to

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[4] Efficiency being defined as that which provides the lower transaction costs (Williamson, 1975).

maximize resource usage – essentially to increase the effectiveness of the logistics of the business. Non-operationally oriented systems, on the other hand, are used to assist decision-making, handle processes (rather than functions), and support long-range planning and trend setting. Thus, the second delineation of IT systems I will use will be operational versus non-operational focus.

Bounded by internal versus external focus and operational versus non-operational orientation, the resulting 2x2 matrix indicates that four efficient IT systems are possible. These four systems will be referred to throughout the remaining portions of the paper as *traditional*, *executive*, *outreach*, and *visionary* as indicated in Figure 3 below. These are arch-types and it is reiterated that they are ideal system types and are neither hierarchical in nature nor is one system inherently more efficient than another without examining the context in which the system is deployed.

	INTERNAL	EXTERNAL
OPERATIONAL	**TRADITIONAL**	**OUTREACH**
NON-OPERATIONAL	**EXECUTIVE**	**VISIONARY**

Figure 3: Classification of Efficient IT Systems

In the section following, each system type's goals, specific characteristics, and the ability of its attributes to reduce transaction costs will be discussed.

Traditional

The *traditional* IT system, as indicated in Figure 3 above, has an internal-operational focus. This system concerns itself mainly with the details of operations within the firm such as cutting administrative costs, automating routine tasks and functions, and maximizing internal resources. In other words, the *traditional* system's main goal is to lower bureaucracy costs associated with transaction processing.

Focus. Referred to as "back-office" (Henderson & Venkatraman, 1999) or "support" systems (Fedorowicz & Konsynski, 1992; Karimi et al, 1996), *traditional* systems provide no support to the business strategy process (Broadbent & Weill, 1997) and are used primarily for existing transaction automation (Tan, 1995). Specifically, the *traditional* system concentrates on reducing internal monitoring and coordination costs.

Monitoring is a source of bureaucracy costs (Eisenhardt, 1989). As Gurbaxani and Whang (1991) point out, the accessibility of inexpensive monitoring is critical to reducing bureaucracy costs: "Information systems contribute to this end by providing an effective tool to monitor agents' actions directly and by keeping track of the performance records of an agent or a functional unit in a firm" (Pg. 67).

Coordination costs are also reduced using a *traditional* IT system by providing information to management regarding the various operations of the organization and providing standardized reports at the transaction level as well as the department level (Gurbaxani & Whang, 1991). The *traditional* IT system reduces the costs of monitoring and coordination by providing information that may have been too costly to compile otherwise (Mitra & Chaya, 1996; Munter & Kren, 1995), and with speed and accuracy that has never before been available (Fielder et al, 1996). *Traditional* IT systems use neither "information economies of scale" (Gurbaxani & Whang, 1991) nor the synergistic effects of IT integration in order to reduce bureaucracy costs (Broadbent & Weill, 1997). Rather, efficiency is gained through task economies of scale and specialization (Broadbent & Weill, 1997; Broadbent, Weill, & St. Clair, 1999; Broadbent et al, 1996, Tan, 1995). Monitoring, coordination, negotiation, and enforcement costs associated with functional specialization and task complexity can be reduced through the use of the *traditional* IT system by allowing information at the transaction level to be analyzed and quantified, thus reducing information impactedness, asset specificity, and performance ambiguity (D'Aveni & Ravenscraft, 1994).

Function and Hardware. As the *traditional* system has an internal-operational focus, hardware and applications are chosen not for their connectivity, transparency, or portability, but rather for their ability to streamline functional tasks (Byrd & Turner, 2000; Radding, 2000). The choice of applications is often based on user demands (Tan, 1995) within limited technical and monetary guidelines established by the CIO (Cross & Earl, 1997; Tan, 1995; Venkatraman, 1997). Additionally, as applications are primarily chosen by the users, integration is often limited to the functional level (Radding, 2000). As Goodhue, Wybo and Kirsch (1992) suggest, uncertainty caused by task specialization may be reduced through lower levels of firm-wide integration because "mandatory data integration might reduce the flexibility of an individual subunit to redesign its information systems to address its unique needs. Here a high level of data integration could be undesirable" (Pg. 298). However, whenever possible, the CIO will adopt business level connectivity (Cross & Earl, 1997), thus allowing for generic document sharing, though this is normally limited to general use applications such as word processing and spreadsheets (Bergeron & Rivard, 1990) as functional efficiency requires nothing more.

Motivation. Knowledge management issues are also related to the *traditional* IT system's limited data sharing capabilities (Chen & Frolick, 2000). As one of knowledge management's main premises is that the components of the IT system work together in order to capture, process, and analyze organizational memory (Hackbarth & Grover, 1999), and considering the limited application integration in a *traditional* IT system, it is obvious that any knowledge management system in use can not be intricate. The data manipulation system is low in both technological and knowledge complexity. Mainly developed by the end-user, based on a single information domain, and relying on information that is readily available, knowledge management in a *traditional* system does not require sophisticated programming skills and is often based on stand-alone PCs (Meyer & Curley, 1991). Such knowledge management systems are not designed for data driven decision support and, as they are not strategic in nature (Lam & Ching, 1998), a *traditional* IT system is limited to different-time-different-place, communication based decision support functions (Alavi, 1991).

Internal communication between departments is high in a *traditional* IT system, reducing coordination costs associated with task specialization (D'Aveni & Ravenscraft, 1994). However communication outside of the organization is limited or non-existent as reducing bureaucracy costs is an internal, rather than external function (Jones & Hill, 1988). Keen (1991) has suggested that one of the major benefits of IT is to increase simple and quick communication. Electronic communication, unlike personal communication, allows messages to stay in memory (Raisinghani, Ramarapu & Simkin,

1998) permitting the user to reference saved information, thus reducing uncertainty and increasing efficiency (Barua et al, 1997).

Keen (1991) and Duncan (1995) have described networking capabilities in the terms of "range" (the extent to which data, communications, and applications can be shared) and "reach" (the locations with which the system can interact). A *traditional* IT system is ranked low on both conditions; range may be confined to standard messages or access to function-level shared data, and reach extends only to a single location (Keen, 1991). Thus, networking requirements in *traditional* IT systems are limited as they are used primarily for interfirm communication. Fiedler et al (1996) describe this hardware combination as "centralized" – one in which processing is completed by stand alone PCs or, in the case of a network presence, by a server, and sharing of data is restricted to the functional level.

People. Broadbent and Weill (1997) have identified five core services that should be provided by I T personnel: managing the organization's network services, managing organizational messaging services, recommending organizational wide standards, establishing security and disaster planning, and providing advice and support at the organizational level. However, as the *traditional* system is not complex, nor strategic in nature, these services are a minimal part of the IT department's duties. Assisting users with data base queries, affording software operations support (Nelson et al, 2000), maintaining multiple platforms, and providing some limited system development and customization (Cross & Earl, 1997) are the main functions of the IT department.

The role of the CIO is also one of support only (Karimi et al, 1996). While expected to be heavily involved in setting technical infrastructure standards within the organization (Cross & Earl, 1997), the CIO is not required to provide business advice (Karimi et al, 1996). Based on Lederer and Mendelow's (1990) managerial roles in IT, Grover et al (1993) have suggested that the two roles most important for a CIO in a *traditional* system are those of *leader* and *resource allocator*. The *leader* role consists of those things one would expect of any supervisor: management, employment, instruction, and motivation of the IT personnel. Karimi et al (1996) have agreed with this position stating, "When IT served a strictly supportive function in firms, it was all right for the IT leader to be a technical expert and competent manager" (Pg. 68). The second role, *resource allocator*, involves the allocation of personnel, information, and economic assets and is in agreement with the cost-center perspective suggested by Venkatraman (1997). As a *traditional* system plays only an operational role in the organization, there is no need for the CIO to be strategically involved (Cash, McFarlan, McKenney, & Applegate, 1992; Earl & Feeny, 1994), and relatively low managerial rank is sufficient for the CIO to accomplish the associated managerial duties (Karimi et al, 1996).

Recap. What emerges from the above discussion is the conception of an IT system containing a combination of stand-alone functional systems; few networking capabilities (Fiedler et al, 1996); limited decision (Lam & Ching, 1998) and knowledge management support (Chen & Frolick, 2000); that is tasked to provide functional efficiency (Venkatraman, 1997). Support from the IT department is minimal (Nelson et al, 2000) and the role of the CIO is primarily one of supervision and technical expertise (Karimi et al, 1996). Thus, a *traditional* IT system (i.e., one that has an internal-operational focus) combines function, hardware, people, and motivation to provide a reduction in bureaucracy costs. This is accomplished by lowering monitoring and coordination costs through the creation of functional efficiency and transaction automation. The most efficient combination of components for a *traditional* system is recapped in Table 2 below.

Component	Characteristics	Specific Attributes
Focus and Orientation		Bureaucracy costs Operational efficiency
Motivation	Communication focus	Internal – high External – low
	Knowledge management	Low knowledge – low technology
	Decision Support	Different time – different place
Hardware	Configuration	Centralized
	Range and reach	Range – low Reach – low
Function	Standardization	Business level
People	Infrastructure services	Little or no services
	CIO involvement	Support only
	CIO leadership roles *Leader* *Technology monitor* *Environmental monitor* *Liaison* *Spokesman* *Resource allocator* *Entrepreneur*	 Low Low Low Low Low High Low
	CIO rank	Line manager

Table 2: Characteristics of the *Traditional* IT System

Executive

The *executive* IT system, as indicated in Figure 3 above, has an internal-non-operational focus. The *executive* IT system's priority is to lower monitoring and coordination costs: those bureaucracy costs associated with planning and decision-making.

Focus. The main goals of the *executive* IT system are to provide information regarding all levels of the organization to upper management and to assist with managerial decision-making in order to facilitate organizational planning. The *executive*

IT system is considered efficient if it can accomplish these goals. The *executive* IT system reduces bureaucracy costs through information and resource sharing (Broadbent & Weill, 1997; Goodhue, Quillard, & Rockart, 1988) thereby reducing information impactedness (Daft & L engel, 1986). Business processes, rather than functions are the focus of the *executive* system (Tan, 1995). The result is lowered information impactedness and bounded rationality because information is shared across the organization (Goodhue et al, 1992) and personnel with different backgrounds bring varied knowledge and experience bases to the IT development process (Hambrick & Mason, 1984).

Non-operational bureaucracy costs are the result of information impactedness, bounded rationality, and uncertainty (Baysinger & Hoskisson, 1989; Vandenbosch & Huff, 1997). Information impactedness and bounded rationality create monitoring costs because the manager's ability to assemble, organize, and understand information about divisional performance is limited (Baysinger & Hoskisson, 1989). As the interaction between task uncertainty and information impactedness becomes more pronounced coordination costs increase (D'Aveni & Ravenscraft, 1994). As the need for information increases the interaction of performance ambiguity and task uncertainty requires more complex internal governance structures (Jones, 1987). Thus, the combination of uncertainty, information impactedness, and coordination create costs associated with strategic decision-making and planning; if the manager does not have the information to make decisions, or the ability to coordinate internal divisions, planning and decision-making become difficult.

IT provides efficiency by reducing the costs of monitoring and coordination (Brynjolfsson, et al., 1994). Coordination costs are reduced because information technology lowers the cost of information sharing and communication and provides faster processing speeds, less expensive information gathering, and improved tools for analysis and management decision-making (Fielder et al, 1996; Gurbaxani & Whang, 1991). Coordination cost reductions may be accomplished though increased electronic communication, the handling of complex information systems, the use of sophisticated production scheduling techniques, and increased and complex resource sharing (Fielder et al, 1996; Gurbaxani & Whang, 1991; Jones & Hill, 1988). The ability to view information at individual levels as well as departmental or divisional levels, data and application sharing, and the use of other monitoring tools such as hand-held computers, optical scanners, and electronic communication reduces the costs associated with internal monitoring as well (Fielder et al, 1996; Gurbaxani & Whang, 1991).

Function and Hardware. In an *executive* IT system, a process approach is used, rather than a focus on functional automation (Tan, 1995). Users are extensively trained in the use of the system as well as work processes affording them a high degree of understanding of both, and experimentation is not only encouraged but also expected (Lassila & Brancheau, 1999). Thus, the *executive* system uses superior information processing abilities to create "informational economies of scale" (Gurbaxani & Whang, 1991), and perpetuates the reduction in bureaucracy costs by reducing information impactedness (D'Aveni & Ravenscraft, 1994). A centralized processing system with high intrafirm interaction capabilities and a high level of application and data sharing is needed in the *executive* IT system, as it requires complex intrafirm communication and integration of data. "Centralized Cooperative" is the nomenclature Fiedler et al (1996) have given this combination of features, which provides moderate range and low to moderate reach (Keen, 1991).

Knowing what information is available, who needs it, how is can be accessed and used is an essential determinant in the effective use of IT systems (Hackbarth & Grover, 1999). Many times information that is too costly to gather manually is generated automatically through normal operations processing and data sharing (Clemons and Row, 1992). Therefore, whenever possible the CIO will adopt business level standards (Cross & Earl, 1997), thus allowing for the maximum internal integration possible.

Motivation. Monitoring costs increase when there is task complexity (Welbourne, Balkin, & Gomez-Mejia, 1995). By allowing messages to be stored in memory, electronic communication provides access to information previously received. Thus, complexity is reduced as users may effortlessly and repeatedly refer to information that may be complicated. This is not the case with face-to-face communication (Raisinghani et al, 1998). Communication within the firm reduces information asymmetry and uncertainty between departments, managers, and employees by providing fast and easy access to disparate information (Fielder et al, 1996).

Information asymmetries are reduced through data sharing as well (Galbraith, 1973). Data integration allows for all levels of the organization to have a common information base (Huber 1982) thereby reducing ambiguity and confusion. Galbraith (1973) has stated that uncertainty is another reason data need to be integrated. Integration of data provides reduced uncertainty as Goodhue et al (1992) have so aptly stated:

> Where uncertainty comes mainly from interdependence between subunits (for example, when the two manufacturing subunits must deal with the

> procurement unit to purchase material), data integration would be highly desirable because it provides a standardized, formalized language shared by all subunits and facilitates communication between the interdependent subunits.

Task uncertainty and ambiguity and information asymmetries increase risk; therefore the resultant reduction in risk is an additional benefit of integrated data (Cross & Earl, 1997). Increasing range and reach allows for more complete communication – reaching more people and providing more information (Keen, 1991). As the above discussion indicates, communication within the firm must be high in an *executive* IT system. Outside of the organization, however, data sharing and communication are restricted; as reducing bureaucracy costs is the function of an *executive* system, there is an internal focus, rather than an external one (Jones & Hill, 1988).

Bounded rationality is an important contributor to bureaucracy costs associated with decision-making (Williamson, 1991). "Information technology can directly affect the computational and communication abilities of a decision-maker, thus shifting the limits of rationality" (Bakos & Treacy, 1986:109). This occurs because additional information is available to the decision-maker, thus allowing him or her to increase the knowledge base upon which decisions are made (Williamson, 1991). Therefore, knowledge management that allows the free flow of information and data increases efficiency and effectiveness of decision-making (Hackbarth & Grover, 1999).

Information technology reduces information asymmetries and bounded rationality of group decision-making as well (Bakos & Treacy, 1986). Members of a group can provide more information and differing perspectives than are available to a single individual (Hambrick & Mason, 1984). In support, Turrof and Hiltz (1993), in their five case studies, found that the use of distributed group support systems improved the quality of the decisions, sped the processes, and increased the amount of information available to the decision-makers.

Assuring that managers who need information receive it promptly and accurately is a main goal of the *executive* IT system. Thus, the *executive* IT system enhances decision-making quality and quantity (Fedorowicz and Konsynski, 1996). Complex decision support, executive information systems, and knowledge management systems will be employed by the *executive* IT system because the decisions that must be made at the strategic level are neither straight-forward nor simple (Chen & Frolick, 2000; Lam & Ching, 1998). Meyer and Curley (1991) have very succinctly defined the knowledge management portion of an *executive* IT system by saying they

> incorporate "deep" knowledge, i.e., elaborate reasoning in specialized fields. In addition, these systems often span multiple complex domains and resolve uncertainty in the information inputs used by the expert system in its reasoning process to make decisions. While containing a high degree of knowledge intensity, these systems are nonetheless technologically uncomplex and tend to operate on single hardware platforms utilizing small databases. (Pg. 457)

Group support in an *executive* IT system is provided in a manner that allows for any combination of different-time-different-place (e.g., e-mail, voice mail), different-time-same-place (e.g., team or project rooms with access to databases and bulletin boards), and same-time-same-place (e.g., decision rooms equipped with networked workstations and the ability to display common information) interactions (Alavi, 1991).

<u>People.</u> The role of the CIO in an *executive* system is one with emphasis on decision-making with some technical support (Karimi et al, 1996). The CIO is expected to keep abreast of current technology available to both meet the organization's strategic

goals or to enhance them (Grover et al, 1993) and to be able to provide visionary business and strategic support (Karimi et al, 1996). Grover et al. (1993), based on Lederer and Mendelow's (1990) discussion of IT management roles, have suggested that the CIO of an *executive* IT system be strong in the *technical monitor* role and moderately involved in the roles of *spokesman*, *environmental monitor*, *liaison*, and *entrepreneur*. This combination of managerial roles indicates the CIO is someone who must keep abreast of technological innovation, can provide information across departmental boundaries, can communicate the business needs of the firm with IT suppliers and vendors, and can foresee the impact of IT on the firm's industry. It is important for the CIO to be strategically involved, given the nature of an *executive* IT system (Jenks & Dooley, 2000); however, Karimi et al (1996) have suggested that upper manager rank without inclusion on the top management team is sufficient, given the other roles the CIO plays in the organization.

The IT department works closely with the divisions and their requirements (Scheier, 1996), therefore, the IT department, and the CIO in particular, is expected to provide strategic advice (Karimi et al, 1996). Broadbent and Weill (1997) have suggested a list of five core and eighteen additional services that may be provided by the IT department. The core services are providing advice and support at the organizational level, recommending organizational wide standards, establishing security and disaster planning, managing the organization's network services, and managing organizational messaging services. Optional items include such services as identifying and testing new technologies for business purposes, performing IT project management, providing technology education services, and enforcing IT architecture and standards. They found, in their study of twenty-seven firms, the average number of services offered in an *executive* IT system to be thirteen (from the list of twenty-three possibilities), although the actual services provided varied among the firms. The discussion above allows a picture of an internally focused, strategically oriented IT department to emerge.

Recap. Per the discussion above, an *executive* IT system (i.e., one that has an internal-non-operational focus) combines function, hardware, people, and motivation to provide a reduction in the costs of monitoring, coordination, negotiation, and enforcement. Increases in decision-making and planning capabilities are achieved through reductions in information asymmetries, bounded rationality, and task uncertainty. A recap of components for an *executive* system may be found in Table 3 below.

Component	Characteristics	SPECIFIC ATTRIBUTES
Focus and Orientation		Bureaucracy costs Non-operational efficiency
Motivation	Communication focus	Internal – high External – low
	Knowledge management	High knowledge – low technology
	Decision Support	Different time – different place; Same time – same place; Different time – same place
Hardware	Configuration	Centralized cooperative
	Range and reach	Range – moderate Reach – low to moderate
Function	Standardization	Business level
People	Infrastructure services	Low number of services
	CIO involvement	Decision making with support; moderate strategic involvement
	CIO leadership roles *Leader* *Technology monitor* *Environmental monitor* *Liaison* *Spokesman* *Resource allocator* *Entrepreneur*	 Low High Moderate Moderate Moderate Low Moderate
	CIO rank	Upper manager

Table 3: Characteristics of the *Executive* IT System

Outreach

As indicated by Figure 3 above, the *outreach* IT system focuses on the external-operational elements. The *outreach* IT system concentrates on reducing the market costs associated with transaction processing: primarily monitoring and compliance.

Focus. The *outreach* IT system's goal is to decrease uncertainty and information impactedness between the organization and its trading partners and to increase, when possible, the number of transactions between the contracting parties in order to reduce market costs. The ability to leverage current resources and capabilities externally (Venkatraman, 1997) and to support current strategies (Broadbent & Weill, 1997) while reducing market costs is of prime importance (Malone, Yates, and Benjamin, 1987).

Opportunistic behavior, uncertainty, and complexity, in combination with information impactedness create monitoring costs in the market (Williamson, 1975). Transaction frequency, in conjunction with uncertainty and bounded rationality or information impactedness can be another source of market costs by increasing the amount of monitoring that may be required (D'Aveni & Ravenscraft, 1994; Williamson, 1975; Williamson and Ouchi, 1981). When transaction frequency is low or complex, and is combined with the possibility of opportunistic behavior, market costs are increased because one partner does not know how the other will act, therefore monitoring and enforcement costs must be built into contracts (Jones, 1987). This, in turn, leads to costs associated with negotiation and compliance enforcement.

Function and Hardware. The *outreach* IT system accomplishes its goals by increasing information flows between contracting parties, both through communication and data and application sharing (Clemons et al, 1993). The need to integrate with trading partners makes the use of industry-level standards for selection of hardware and software essential in an *outreach* system (Cross & Earl, 1997).

As market costs must be reduced through collaboration with important trading partners (Venkatraman, 1997), an *outreach* system requires moderate levels of reach and range (Keen, 1991): the ability to reach customers and suppliers with the same IT base as the organization and the ability to process independent transactions. Thus, the combination of processing, data and application sharing, and communication abilities that best match this system's needs is a combination of types as identified by Fiedler et al. (1996). The *outreach* system is decentralized internally, but cooperative decentralized externally. In other words, the internal system has decentralized processing and low levels of intrafirm communications and data sharing, while the interorganizational system is decentralized with high levels of communications and data sharing. This is in agreement with the operational nature of the system (decentralized internally) and the external nature of the system (cooperative decentralized). This combination allows for functional task specialization both internally and externally, while focusing on the reduction of market costs of information impactedness and bounded rationality, the main goals of the *outreach* system.

Motivation. The use of an *outreach* system increases data sharing and reduces information impactedness and uncertainty while increasing transaction frequency, thereby reducing the related market costs of monitoring and compliance (D'Aveni & Ravenscraft, 1994; Truman, 2000). Keen (1991) has suggested that the biggest gains to be made from IT are through managing documents electronically and fast, clear, and natural communications. Thus, there will be high communication and data sharing with market partners in an *outreach* system.

As efficiency, in an internal sense, is gained though task specialization and task economies of scale (Broadbent & Weill, 1997; Broadbent et al, 1999; Broadbent et al, 1996: Tan, 1995) and the focus of the *outreach* IT system is primarily reduction of market costs, internal communication and data sharing in an *outreach* system will be low to moderate.

Neither knowledge management nor decision support, both being non-operational in nature, is strongly supported in an *outreach* IT system as the system has an operational focus. However, *outreach* systems do support interfirm communications among groups with such technology as decision rooms, distribution lists, bulletin boards, chat sites, computer-conferencing, project rooms, video conferencing, email, and voice mail (Alavi, 1991; Barua et al, 1997; Raisinghani et al, 1998). Stretching communication across time and distance can be expensive (Keen, 1991), and the use of such technology allows groups to communicate and share data in any combination of time and place (i.e., same-time-same-place, same-time-different-place, different-time-different-place, different-time-same-place) in order to become efficient (Alavi, 1991). Additionally, these technologies make communications between and among group members nearly as simple and cost effective as communicating with only one person or face-to-face (Raisinghani et al, 1998). Thus, in order to reduce information impactedness and bounded rationality (Bakos & Treacy, 1986), interfirm group support is a component of an *outreach* IT system.

Knowledge management in an *outreach* system is limited, as it is considered a non-operational function. However, because of the external nature of the *outreach* system, some knowledge management system may be in place. Meyer & Curley (1991) have recognized a low-knowledge-high-technology type of knowledge management system that most closely matches the needs of the *outreach* system: low in knowledge requirements (i.e., readily available information and data based on a single information domain), but high in technical complexity (due to the interfirm nature of the data sharing). Highly complex knowledge, such as would be needed for advanced decision support, is not required as this knowledge management system is used primarily to communicate with trading partners and the *outreach* system does not strongly support non-operational uses.

People. The IT department in an *outreach* system will provide the five core services identified by Broadbent & Weill (1997): managing communication network services, managing messaging services, recommending IT architecture standards, establishing security, disaster planning, and business recovery services, and providing technology advice and support services as these are required to maintain and upkeep the *outreach* system. They also found, in their study of twenty-seven firms, that IT personnel provide an average of sixteen services (from a possible twenty-three) such as negotiating and managing suppliers and outsourcers, managing functional level-specific applications, and managing on-line and/or EDI linkages. These service requirements are in agreement with the external complexity of the *outreach* system though the actual services provided will vary from firm to firm.

The CIO is expected to provide heavy technical support and a moderate level of business advice (Karimi et al, 1996). The roles of the CIO regarding Grover et al.'s (1993) classification are varied and complex. With the exception of the supervision component, the CIO is expected to play a strong *leadership* role, but a low *resource allocator* role. As the CIO is expected to provide technical support and assistance, the role of *technical monitor* is strong – the CIO must stay alert to changes in technology and their possible business uses in the firm. Additionally, as some business support is also a part of the CIO's duties, the roles of *liaison* and *environmental monitor* will be moderate: it is important for the CIO to keep abreast of the external environment with respect to industry changes and to be able to communicate with trading partners. Finally, as the *outreach* system is seen as operational in nature, the roles of *spokesman* and *entrepreneur* will be low. The CIO is expected to provide neither strategic advice nor to champion the cause of a particular IT system – this is the job of the department manager (Brown, 1999; Nelson, et al, 2000). As the CIO is not strategically involved, it is not essential that he or she be part of the top management team and Karimi et al. (1996) have suggested that a middle management rank is sufficient for the performance of the duties discussed above.

Recap. In recap, the goals of the *outreach* IT system are to reduce market costs associated with transaction frequency, information impactedness, and bounded rationality Table 4 below shows a recap of the function, motivation, hardware, and people components that create the *outreach* IT system.

Component	Characteristics	SPECIFIC ATTRIBUTES
Focus and Orientation		Market costs Operational efficiency
Motivation	Communication focus	Internal – low External – high
	Knowledge management	Low knowledge – high technology
	Decision Support	Different time – different place; Same time – same place; Different time – same place; Same time – different place
Hardware	Configuration	Decentralized/ Decentralized cooperative
	Range and reach	Range – moderate Reach – moderate
Function	Standardization	Industry level
People	Infrastructure services	Moderate number of services
	CIO involvement	Support with influence; no strategic involvement
	CIO leadership roles *Leader* *Technology monitor* *Environmental monitor* *Liaison* *Spokesman* *Resource allocator* *Entrepreneur*	 High High Moderate Moderate Low Low Low
	CIO rank	Middle manager

Table 4: Characteristics of the *Outreach* IT System

Visionary

The *visionary* IT system has an external-non-operational focus as shown in Figure 3 above. Reducing the market costs associated with planning and decision-making with trading partners is goal of the *visionary* system.

Focus. Planning and decision-making based market costs are associated with monitoring, enforcement, negotiation, and search costs (Williamson, 1975). These costs, in turn, are caused by bounded rationality, information impactedness, and uncertainty, in combination with small numbers exchange, transaction frequency, the possibility of opportunistic behavior, and asset specificity (Baysinger & Hoskisson, 1989; D'Aveni & Ravenscraft, 1994; Jones, 1987; Vandenbosch & Huff, 1997).

When bounded rationality, or the inability to have perfect information, is coupled with small numbers exchange (a limited number of possible trading partners) it is possible for one partner to feel it is held "hostage" by the other due to its inability to find other trading partners (Bensaou & Venkatraman, 1995). This, in turn, may lead to problems with negotiation and compliance enforcement. Adding asset specificity (the extent to which assets can be used in other transactions with other firms) into the equation may cause what Menard (1986, p. 286) calls "bilateral dependency," where the costs of switching trading partners becomes very high for both partners and thus the costs of negotiating, monitoring, and enforcement may well increase.

Transaction frequency, in conjunction with uncertainty, bounded rationality or information impactedness can also cause transaction costs by increasing the amount of monitoring that may be required (D'Aveni & Ravenscraft, 1994; Williamson, 1975; Williamson and Ouchi, 1981) as infrequent transactions keep a firm from acquiring information about subsequent transaction performance (Jones, 1987).

Bounded rationality, opportunistic behavior, and asset specificity are associated with market costs that result from searching for trading partners (Bakos, 1991; Clemons and Row, 1992; Gurbaxani and Whang, 1991). These costs arise because the organization can not know everything it needs to know about possible trading partners and their subsequent behavior (Williamson, 1975).

The *visionary* system reduces information impactedness by lowering the costs of sharing communications and information between firms (Fielder et al, 1996). Faster processing speeds and communication links reduce the amount of time between the event and the time information is available, thus reducing information impactedness and uncertainty (Keen, 1991). Bounded rationality and uncertainty are both reduced through the *visionary* system's use of sophisticated analysis and decision-making tools as well as information gathering that is less expensive than other methods (Fielder et al, 1996; Gurbaxani & Whang, 1991). The goal, then, of the *visionary* IT system is to reduce the market costs of searching, monitoring, enforcing, and negotiation by reducing information impactedness, bounded rationality, and uncertainty. When these goals are met, the *visionary* system is considered efficient.

Function and Hardware. The more information that is shared, the lower the market costs associated with information impactedness. Therefore, external communication and data sharing in the *visionary* system are of prime importance. In order to increase communication and data sharing, the range and reach of the *visionary* system must both be high to very high. The range of the system, in order to obtain the most data sharing and communication possible, must be able to handle "independent" transactions at the minimum, and preferably "multiple cross-linked transactions." The information gathered from such transactions must be available to "customers and suppliers regardless of IT base," although having access to "anyone, anywhere" is the ultimate goal (Keen, 1991).

As information is exchanged freely with trading partners on an Internet-based system, industry-level application and operating system standards must be adopted (Cross & Earl, 1997). Highly standardized applications, operating system platforms, and hardware platforms are the norm (Lam & Ching, 1998; Radding, 2000). The extensive decision making and knowledge management required to support a non-operational system fit well with Fiedler et al.'s (1996) description of a decentralized cooperative configuration; one in which data sharing and communication are far-reaching.

Motivation. Decision support and knowledge management are highly supported in a *visionary* IT system. This system type must include the ability to capture information from sources external to the organization as well as the ability to create new knowledge from novel interpretations of both existing knowledge and new data (Hackbarth & Grover, 1999). By providing increased access to information, sophisticated analysis tools, the ability to draw on multiple experts, and interaction that allows for communication and decision support that is not required to take place in a face-to-face setting (Chen, 1995; Gurbaxani & Whang, 1991), the *visionary* system reduces uncertainty, bounded rationality, and information impactedness (Bakos & Treacy, 1986; Hackbarth & Grover, 1999).

Decision support services may be used at all levels of the organization, but are mostly used for strategic planning purposes (Venkatraman & Henderson, 1998). Executive decision support systems, which include communication, organization, access, and analysis tool components (Chen, 1995), offer timely and convenient access to data from all levels of the organization as well as information from trading partners and other external sources (van den Hoven, 1995). Because information is readily and cheaply available, managers may quickly suffer from information overload, thus access to information is not enough; analysis tools play a large part in efficient executive information systems (Chen, 1995; Lam & Ching, 1998). Access to and ability to process external information quickly through a user-friendly interface allow managers to reduce uncertainty in a volatile environment (Bakos & Treacy, 1986; Chen, 1995).

Decisions and communications are maintained in computer memory, thus aiding in future decisions or continued deliberation of current decisions (Raisinghani et al., 1998). Additionally, as managers are traditionally very busy, this memory allows a manager to continue a task after interruption with a minimum of restart time (Dennis & Tyran, 1997). Together these features provide for reduced uncertainty and information impactedness.

The use of IT has allowed for new and specialized interorganizational group support systems to be put in place (Dennis et al., 1998) which boast sophisticated decision support applications (Turrof & Hiltz, 1993). Group support systems allow for a larger number of participants than do traditional face-to-face meetings (Raisinghani et al., 1998), resulting in a wider range of expertise and knowledge bases (Hambrick & Mason, 1984; Nunamaker & Briggs, 1996) and interorganizational information sharing (Gurbaxani & Whang, 1991). Anonymity is often built into group support systems, thus permitting participants to provide information that might not otherwise be made available to the group due to politics, position, or personality (Dennis & Tyran, 1997; Nunamaker & Briggs, 1996). This also allows for wider diversity in the expertise upon which the group has to draw (Hambrick & Mason, 1984; Nunamaker & Briggs, 1996). The use of a group support system, then, reduces bounded rationality and information impactedness.

Decision support systems of any type must include the ability to capture information from sources external to the organization as well as ability to create new knowledge from innovative interpretations of both current knowledge and new data (Hackbarth & Grover, 1999). It is the ability to use additional external information that may not have been previously available that reduces bounded rationality (Gurbaxani &

Whang, 1991). Furthermore, interorganizationally integrated information will allow for better decision-making, as information impactedness is reduced (Goodhue & Wybo, 1992).

The above discussion leads to the conclusion that decision support systems in a *visionary* IT system must be able to assist with decisions to be made in any combination of time and place: same-time-same-place, same-time-different-place, different-time-same-place, and different-time-different-place interaction (Alavi, 1991).

Artificial intelligence and expert systems, which have recently become sophisticated enough to assist with decisions that had only been in the purview of human reasoning, can be a strong asset with respect to strategic planning and decision-making as these are neither straightforward nor simple (Gurbaxani & Whang, 1991; Hitt & Brynjolfsson, 1997). Expert systems rely on programmed sets of "if-then" statements that do not change over time unless specifically reprogrammed (Quershi, Shim, & Siegel, 1998). Thus, one of the biggest advantages of the use of an expert system is consistency (Jenks & Wilson, 1999), which, in turn, reduces uncertainty.

Additionally, knowledge management systems that are interorganizational in nature allow for the firms involved to take advantage of synergies between the organizations and may allow a firm to either gain bargaining power over trading partners, or at a minimum, reduce the threat that trading partners may gain power over it (Bakos & Treacy, 1986). Knowledge management, through data mining, allows managers' access to information that may have been hitherto unwanted, unneeded, or unavailable. This data access, in turn, gives managers the ability to draw on data stores for unique opportunities that previously went undetected (Lam & Ching, 1998).

Knowledge management systems permit cost-effect access and analysis of internal and external information thereby reducing market costs related to contracting, since they reduce uncertainty and information impactedness through data and application sharing and mutual monitoring (Gurbaxani & Whang, 1991). Archived information, maintained by knowledge management systems, is readily accessible, and may provide insight into prior decisions thereby making contract negotiations more efficient (Hackbarth & Grover, 1999).

Knowledge management systems subsumed under the *visionary* IT system are considered to be high-knowledge-high-technology requiring "deep" knowledge provided by experts across the organizations and highly evolved decision-making processes as well as technically advanced programming and user interfaces (Meyer & Curley, 1991).

People. As can be seen from the description of the *visionary* IT system thus far, IT personnel are expected to be able to support users technically, as well provide business and strategic support. Broadbent et al.'s (1999) study identified core and optional services that could be provided by the IT department. The enabling types, as discussed above, had extensive services, with an average of twenty services of the twenty-three possibilities, although the actual selection of services provided varied among firms.

The managerial roles the CIO plays in a *visionary* system are, by definition, strategic in nature. Grover et al. (1993) have modified Lederer and Mendelow's (1990) managerial roles and identified seven which are particularly pertinent to CIOs. Of these seven, the CIO of a *visionary* system embraces five of these roles with a high degree of involvement. The first of these are the roles of *spokesman* and *liaison* in which the CIO is expected to interact with other departments and organizations and to promote the importance of and non-operational uses of IT to the top management team. Another role the CIO must play is that of *technology monitor*. As discussed briefly above, technology is rapidly changing, and the CIO must be abreast of these changes, as well as their possible applications within the organization. As an *environmental monitor*, the CIO is expected to know what changes are happening within the industry and how IT can best be employed to gain or maintain a competitive advantage. Finally, the CIO acts as an *entrepreneur*, finding new ways of applying IT to current strategy, changing strategy through the use of IT, and exploiting IT to the advantage of the organization. The CIO, expected to provide business advice and planning, must have a strong business orientation, rather than purely technical expertise (Karimi et al., 1996). Thus, the CIO plays a strong strategic role in the *visionary* system, and it has been suggested by Jenks and Dooley (1999) and Karimi et al (1996) that in order to be most efficient the CIO must be a member of the top management team.

Recap. The goals of the *visionary* IT system are to reduce market costs associated with uncertainty, information impactedness, and bounded rationality. Table 5 below shows the combination of function, motivation, hardware, and people needed to accomplish the goals of the *visionary* IT system.

Component	Characteristics	SPECIFIC ATTRIBUTES
Focus and Orientation		Market Costs Non-operational efficiency
Motivation	Communication focus	Internal – low External – high
	Knowledge management	High knowledge – high technology
	Decision Support	Different time – different place; Same time – same place; Different time – same place; Same time – different place
Hardware	Configuration	Decentralized
	Range and reach	Range – high Reach – high
Function	Standardization	Industry level
People	Infrastructure services	High number of services
	CIO involvement	High strategic involvement
	CIO leadership roles *Leader* *Technology monitor* *Environmental monitor* *Liaison* *Spokesman* *Resource allocator* *Entrepreneur*	 Low High High High High Low High
	CIO rank	Top Management Team

Table 5: Characteristics of the *Visionary* IT System

Table 6 below recaps and contrasts the characteristics and specific attributes for the four components of the four proposed system types.

Component	Characteristics	Traditional	Executive	Outreach	Visionary
Focus and Orientation		Bureaucracy costs Operational efficiency	Bureaucracy costs Non-operational efficiency	Market costs Operational efficiency	Market Costs Non-operational efficiency
Motivation	Communication focus	Internal – high External – low	Internal – high External – low	Internal – low External – high	Internal – low External – high
	Knowledge management	Low knowledge – low technology	High knowledge – low technology	Low knowledge – high technology	High knowledge – high technology
	Decision Support	Different time – different place	Different time – different place; Same time – same place; Different time – same place	Different time – different place; Same time – same place; Different time – same place; Same time – different place	Different time – different place; Same time – same place; Different time – same place; Same time – different place
Hardware	Configuration	Centralized	Centralized cooperative	Decentralized/ Decentralized cooperative	Decentralized
	Range and reach	Range – low Reach – low	Range – moderate Reach – low to moderate	Range – moderate Reach – moderate	Range – high Reach – high
Function	Standardization	Business level	Business level	Industry level	Industry level
People	Infrastructure services	Little or no services	Low number of services	Moderate number of services	High number of services
	CIO involvement	Support only	Decision making with support; moderate strategic involvement	Support with influence; no strategic involvement	High strategic involvement
	CIO leadership roles *Leader* *Technology monitor* *Environmental monitor* *Liaison* *Spokesman* *Resource allocator* *Entrepreneur*	 Low Low Low Low Low High Low	 Low High Moderate Moderate Moderate Low Moderate	 High High Moderate Moderate Low Low Low	 Low High High High High Low High
	CIO rank	Line manager	Upper manager	Middle manager	Top Management Team

Table 6: Comparison of Efficient IT System Characteristics

Hypotheses Proposal

As discussed in the previous sections, it is the combination of the four components of an IT system (i.e., function, hardware, people, and motivation) that creates an efficient IT system. These systems will emphasize either operational or non-operational efficiency and work toward reducing either market (external) or bureaucracy (internal) transaction costs. The four combinations possible from these elements are internal-operational (*traditional*), internal- non-operational (*executive*), external-operational (*outreach*), and external-non-operational (*visionary*). Each of these systems has a unique combination of components in order to create efficiency considering the goals of the system. Therefore, the following general hypotheses are presented as specified in Table 6:

> *Hypothesis 1: There will be a significant difference between the combination of IT system components (hardware, function, motivation, and people) between* traditional *IT systems and other IT system types.*
>
> *Hypothesis 2: There will be a significant difference between the combination of IT system components (hardware, function, motivation, and people) between* executive *IT systems and other IT system types.*
>
> *Hypothesis 3: There will be a significant difference between the combination of IT system components (hardware, function, motivation, and people) between* outreach *IT systems and other IT system types.*
>
> *Hypothesis 4: There will be a significant difference between the combination of IT system components (hardware, function, motivation, and people) between* visionary *IT systems and other IT system types.*

Recap

The interaction of the components of an IT system is complicated. Not only must the interactions between the components be examined, but the interplay within the components is also important. However, the use of transaction cost economics to drive the development of the typology provides straight-forward guidelines and by concentrating on internal or external focus and operational or non-operational orientation of the organization and its IT system, the combination of people, hardware, function, and motivation needed to create an optimally efficient system may be determined relatively simply as indicated in Table 6 and reflected in the hypotheses presented.

CHAPTER III

METHODS

Data Collection

Sample

The sample was selected from the ReferenceUSA business database. ReferenceUSA was created, and is maintained, by infoUSA and contains data from more than 12 million businesses in the U.S. Data that was not gathered from ReferenceUSA was collected from surveys.

In order to increase generalizability, the sample was not limited by industry or ownership. However, as size of the organization may play a role in the ability of the firm to invest in information technology, as described in detail below, firm size was limited to those organizations with 50 or more employees. This allowed for a sample that included those firms most likely to have IT systems, without unduly limiting the number of smaller firms. Due to the large number of smaller firms and small number of large firms and, as cluster analysis is highly dependent upon the representativeness of the sample (Hair et al, 1995), the sample was stratified by size. The sample was taken in the same proportions as the original list, in order to ensure that a truly representative sample was chosen and to increase the statistical efficiency of the estimates (Pedhazur & Schmelkin, 1991).

Finally, firms were limited to the Pacific Northwest region of the U.S. including Idaho, Washington, and Oregon.

With these limitations, the final population from which the sample was drawn included 12,318 organizations from various industries, with 50 to in excess of 10,000 employees, with private, public, and government ownership, and both profit and non-profit sectors. The respondents were the CIO[5] from each firm. The names and addresses of the CIOs were gathered from the ReferenceUSA database whenever possible. In those cases where no CIO was listed, the request was sent to the organization's listed point-of-contact, who was asked to forward the survey to his or her CIO.

While previous studies have shown a return rate of between 17 and 25 percent for CIO respondents (Karimi, Bhattacherjee, Gupta, & Somers, 2000; Ravichandran & Rai, 2000; Ravichandran, 2000; Torkzadeh & Xia, 1992), Pinsonneault and Kraemer (1993) have suggested that a large number of surveys targeted at IS managers have a low response rate and more than two-thirds of published findings had responses of less than 150. Therefore, a conservative response rate of 10 percent was estimated considering the length of the survey. The actual number of surveys to be sent was calculated using the estimated 10 percent response rate in order to provide a sufficient sample size for the analysis techniques used and to ensure that enough power was present to test the hypotheses. Thus, a random sample of 1,500 firms was selected from ReferenceUSA, resulting in an expected return of at least 150 usable responses.

After accounting for duplicate firms, 1,491 surveys were sent. Of these, 168 were returned for a total response rate of 11.27%. Of those 168, 18 responses, or 10.71%, were returned unusable. The primary reasons stated for not participating were that the firm did not have an IT department; the firm felt it was too small to participate; or the address was

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[5] As noted earlier, the term CIO is loosely used in this paper to denote the manager of the IT department or the person who is actually responsible for the IT system as a whole, regardless of actual rank or title.

no longer valid. The final number of useable responses was 150, or 10.06% of the total sent. While this response rate is well below the 20% recommended for organizational surveys (Grover, 2000; Yu & Cooper, 1983), the length of the survey may have been a deterrent to a high response rate as the above referenced surveys were all relatively short[6] and was not unexpected.

Respondents had an option of filling out the survey either in hard-copy or on-line format. Of the useable responses, 112 (74.67%) were submitted in hard-copy and 38 (25.33%) were submitted on-line. Response type bias was analyzed by comparing on-line and hard-copy respondents on the firms' leadership roles, reach, and internal communication. No significant differences were found between the two groups on leadership roles (F-value = 492, p>.05), reach (F-value = 1.129, p>.05), or internal communication abilities (F-value = .091, p>.05).

Non-response bias was also analyzed by comparing respondent and non-respondent firms' estimated sales, credit score, and ownership type. No significant differences were found between the two groups on sales (F-value = 2.346, p>.05), credit scores (F-value = 2.092, p>.05), and industry membership (F-value = 3.512, p>.05).

Survey

The survey, which consists of 125 items representing four components and eighteen variables, was sent to the CIO[7] of the 1,491 firms. The survey questions may be found in Appendix A. A pretest survey was conducted both in hard-copy and on-line.

[6] Number of items ranged from 14 to 55 on previous surveys.

[7] Or the organization's listed point-of-contact, as described above.

Changes to the survey layout and instructions were made according to the feedback received from the participants.

An on-line version of the survey was also created and was available to all potential participants of the study. A unique password and user ID were furnished to each organization so that participants would not be able to inadvertently enter their data into an incorrect record set, as well as to deny a participant access to any other firm's information, thereby providing confidentiality to the firms that participated on-line. The on-line version was designed to look as much like the paper version as possible, with formatting, instructions, and question placement in the same positions as on the original, thus reducing any bias between those that use the paper survey and those who participate on-line. A print-out of the on-line survey may be found in Appendix B.

The survey packet included a hard-copy survey and a letter that explained the request, gave instructions for the recipient to fill out the survey, guaranteed his or her confidentiality, and gave the option to complete the survey on-line. A prepaid envelope was included in the survey packet. Three weeks after the first survey was sent, non-respondents were sent a postcard reminding them to fill out the survey either on-line or in hard copy.

ReferenceUSA

Financial and general firm data for each organization was gathered using infoUSA's ReferenceUSA database. Information contained in the ReferenceUSA database is gathered from phone directories, 10K and other SEC filings, government data at various levels, and trade magazines. The data is verified and updated at least annually through direct organizational contact.

Components, Variables, and Measures

For purposes of this research, several new measures were created based on previous research. The following section discusses the analysis methods that were used in the study in order to test the measures. The first step in the analysis is to determine the reliability, validity, and unidimensionality of the measures of the components. The second step is to test the hypotheses proposed with cluster analysis and MANOVA. The results of the cluster analysis are reported in Chapter IV

Psychometric Properties of the Scales

General Data

Normality was assessed, and as one would expect, the responses did not fall in a normal distribution pattern. However, when the responses were grouped by cluster membership, the distribution appeared normal, with a preponderance of the skewness and kurtosis statistics close to the 0 level and Kolmogorov-Smirnov test results being primarily non-significant. The homoscedasticity plots and linearity reflect the same type of results: variables are normal once they are grouped by cluster membership.

Reliability & Validity

In order to ensure the appropriateness of the measures used to represent a construct, various methods of evaluation are employed. Theoretically, internal and external validity, internal consistency of operationalization, convergent, discriminant, and nomological validity, and theoretical meaningfulness should be assessed (Bagozzi, 1980; Sethi & King, 1994.). However, from an operational standpoint, reliability, discriminant validity, and convergent validity are considered sufficient (Sethi & King, 1994; Venkatraman, 1989). Thus, the latter three were evaluated in this study.

Convergent validity and unidimensionality indicate that there is only one fundamental construct associated with a set of measures (Anderson, Gerbing, & Hunter, 1987). When items that measure the same construct are highly correlated with each other, convergent validity is assumed. In this study the tests performed are used solely to assess the convergent validity of the items to the construct and not the convergent validity of the scales themselves.

To start, a visual inspection of inter-item correlation was performed. Additionally, both convergent and discriminant validity can be assessed using CFA. Factor loadings should be above the .6 level (Nunnally, 1967), the RMSEA should be at or below .08, and the comparative fit index should be at or above .9 (Hair et al., 1995). Additionally, the adjusted χ^2 should not be significant at $p<=.05$ (Hair et al, 1995). Fornell & Larker (1981) have suggested two additional, more robust tests of fit: composite reliability (P_η) and average variance extracted ($P_{vc(\eta)}$), especially when degrees of freedom is very low. While P_η should be above a minimum level of .50, $P_{vc(\eta)}$ should be at or above a .60 level, indicating that the model is capturing more variance than error, to be acceptable. Finally, reliability will be assessed using Chronbach's alpha, which should be at or above the .60 level as suggested by Nunnally (1967) for early stages of basic research.

The results of the psychometric properties as discussed above may be found in Appendix C, in the tables associated with each of the four components. The CFAs were performed using structured equation modeling and fully standardized results are reported. EFAs were conducted using principal axis factoring with Varimax rotation.

Cluster Variables

Motivation

The motivation component of IT efficiency encompasses the uses of the IT system, which is comprised of variables that evince the communication ability of the system and the use of knowledge management tools. As previously discussed, these variables are significant elements in determining the efficiency of the IT system.

Motivation was created using four variables: internal and external communication, knowledge management – knowledge and knowledge management - technical. Originally, these variables were projected to be decision support, communication focus, and knowledge management – knowledge and knowledge management – technical. All measures were obtained by surveying the CIO.

As a result of the CFA and examination of Chronbach's alpha, communication focus was separated into internal and external focus and decision support was dropped.

All of these are new measures based on theory and, thus, no reliability coefficients were available, and no comparison to previous studies is possible. The results of the psychometric tests are shown in Appendix C, Table 2 through Appendix C, Table 10.

As a result of the CFA, several changes were made to the proposed measures. Although all of the original scales were retained, communication focus was separated into two separate variables: internal and external. The choice to use internal and external as opposed to data sharing and general communication (e.g., email) was based on slightly higher factor loadings and variance explained[8] as well as the theoretical support for a difference between internal and external focus as discussed in Chapter II.

Decision support. The ability of groups to be able to communicate across time and distance is an indicator of IT system efficiency as discussed in Chapter II. Alavi (1991) has suggested that there are four possible combinations of group communications: same-time-same-place, same-time-different-place, different-time-same-place, and different-time-different-place. Different efficient IT system types allow for different group communication abilities. The measure of the group communication is based upon Alavi's (1991) discussion and is designed as a four-item (as listed above) seven-point ("strongly disagree" = 1; "strongly agree" = 7) Likert-type scale. As the original measure was theoretical, no reliability measure was available. Decision making, based on very low factor loadings (below .4) and unacceptable reliability coefficients (.24), was dropped totally from the model.

Communication focus. Network communications, or the use of intranets, extranets, and the Internet, are an indicator of internal or external focus of the IT system as argued previously. The measure of this variable consists of four items on a seven-point Likert-type scale ranging from 1 ("strongly disagree") to 7 ("strongly agree") and is based upon the discussions of networking by Chan and Davis (2000) and Dunn and Varano (1999). As these measures are based only on discussion, and not actual surveys, no reliability factor was available.

The measure used for the internal communication variable was created specifically for this study. A confirmatory factory analysis could not be performed as the

[8] All factor loadings were .85, while variance explained was approximately 76% for the internal - external split, as opposed to approximately 73% for the data sharing – general communication split.

required degrees of freedom were not present. However, as a weaker alternative, an exploratory factor analysis was completed for the measures. The resultant factor loadings were both above the .6 level and only one factor emerged. The reliability coefficient of .67 is acceptable. While these results indicate there is weak support for convergent validity and unidimensionality, reliability is present.

External communication was also measured using new items created for this research. Chronbach's alpha of .69 is above the recommended minimum of .6. As the required degrees of freedom were not present, a CFA could not be performed. The EFA results, although not as strong as those of the CFA, show that only one factor was present and the loadings were above the .6 recommended level.

This analysis indicates that reliability is present, and that some, albeit weak, support for convergent validity and unidimensionality is present.

Knowledge management – knowledge and technology. The use of expert systems is an indicator of strategic and tactical focus. Specifically the knowledge domain and technological complexity of such expert systems indicates the strategic and tactical uses the expert system can support as argued in earlier chapters. The measures of the knowledge component originally consisted of seven statements and the technology component of eight statements, all with categorical responses (ranging from three to six available choices) adopted from those proposed by Meyer and Curley (1991). The items explore the knowledge complexity in terms of knowledge domain usage (for example, "Which of the following best describes your expert system domain usage? We use only a single domain; We use two domains in conjunction with each other; We use three or more domains in conjunction with each other."), depth and changes in expert knowledge, and output types and availability. Technology complexity is addressed through items exploring number and types of hardware and operating system platforms used in the expert system, multimedia capabilities, networking and data source capabilities, number of users, and integration. These variables, while categorical, are ordinal with each possible response encompassing the one before it. A categorical scheme was used solely for respondent clarity purposes; therefore, the coding of these variables will be treated as if they were interval responses. As the original measure was theoretical, no reliability measure was available.

The scales for both the knowledge and technical variables were created for this study. As not all organizations use knowledge management, the number of respondents to both of these scales was low (n=58 and n=49, respectively for knowledge and technical complexity). The CFA resulted in changes being made to the scales of both knowledge management - knowledge and - technical. The knowledge management - knowledge items were reduced from seven to four by removing those with the lowest factor loadings (below .40), decreasing the χ^2 from 10.59 (df = 14, p = .28) to .04, while leaving the RMSEA and CFI unchanged at .00 and 1, respectively. Five measures were dropped from the knowledge management – technical variable, also based on lowest factor scores (below .5), decreasing χ^2 from 31.16 (df = 20, p = .95) to 0, RMSEA from .096 to 0, and increasing CFI from .87 to 1.

While, the CFA for knowledge resulted in acceptable alpha, χ^2, RMSEA, and CFI levels, two additional, more robust assessments of psychometric performance, composite reliability (P_η) and average variance extracted ($P_{vc(\eta)}$) were conducted. These analyses indicate that reliability, unidimensionality, and convergent validity are present. However, the two items with low (.44) or borderline (.57) factor loadings and the low average variance extracted (.35 - .43) indicate the items may be questionable, although they are highly correlated with each other.

It should be noted here that fit tests performed often resulted in acceptable scores; however this is primarily due to the small degrees of freedom.

Overall Fit. Discriminant validity was assessed using EFA, as the CFA model would not converge. While this is not the preferred method, it will give some support to the model.

The EFA indicates that three factors, rather than the four predicted, are present. However, as can be seen in Appendix C, Table 11, all of the factors for communication loaded onto one factor. When a CFA was preformed using all four factors, the loadings were all above the .6 level for one factor, but the fit indices ($\chi^2 = 22.7$, $df = 2$, $p = 0.00$, RMSEA = .265, and CFI = .84) suggested that there was a better model. As indicated, the two-factor model could not be run using CFA as there were not enough degrees of freedom, but the EFA supported a two factor model (see Appendix C, Table 11). While several of the loadings are low (.46, .49, and .48) and one is borderline (.58), there were no cross-loadings and each of the items loaded exactly as predicted. This provides some weak support for discriminant reliability.

Hardware

The hardware component of the efficient IT system was measured using three basic variables: configuration, range, and reach. These three measures provide insight into the specifics of each variable, as well as being indicators of integration and number of hardware platforms used by the firm. All measures of this construct were obtained through the survey of CIOs. All of these are new measures based on theory and, thus, no reliability coefficients were available, and no comparison to previous studies is possible. The results of the psychometric tests are shown in Appendix C, Table 12 through Appendix C, Table 17.

Configuration. Configuration will be measured using the three-question, seven-point Likert-type scale developed by Fiedler et al (1996). This scale was used in a survey of 313 firms, which resulted in a reliability index ranging from .82 to .91. The reliability of this scale was well above the .60 deemed acceptable by Price & Muellar (1986) and Grover (2000) and was, therefore, suitable as a measure of this variable. The scale was developed to classify IT systems into a 2X2 matrix depending upon the degree of centralization of hardware, communication ability, and data/application sharing. Each question on the survey measures one of these three aspects. Responses range from "centralized" (1) to "distributed" (7) for the measure of centralization and from "no other computer" (1) to "all other computers in the organization" (7) for the communication ability and data/application sharing measures.

A confirmatory factory analysis could not be performed as the required degrees of freedom were not present. However, as a weaker alternative, an exploratory factor analysis was completed for the measures. The resultant factors were both above the .6 level and only one factor emerged. The reliability coefficient of .95 is high. Reliability is present, while there is weak support for convergent validity and unidimensionality,

Range and Reach. Range was originally measured using a four-question, seven-point Likert-type scale developed from the specific abilities of an IT system as proposed by Keen (1991). These four items were intended to measure the type of services that can be shared automatically and directly across platforms of the IT system, whether those service take place intra- or interorganizationally. Responses ranged from "strongly disagree" (1) to "strongly agree" (7) for each of the four items. The CFA resulted in changes being made to the scales of range. The range items were reduced from four to three by removing that one with the lowest factor loading (.44), decreasing the χ^2 from 34.26 (*df* = 2, p = .00) to .00, while decreasing RMSEA from .33 to 0 and CFI from .83 to 1. Again, while fit tests performed often resulted in acceptable scores, this is primarily due to the small degrees of freedom. The CFA for range resulted in acceptable alpha, $\chi 2$ square, RMSEA and CFI levels, as well as the composite reliability ($P\eta$) and average variance extracted ($Pvc(\eta)$). One of the factor loadings (X_D) was out-of-bounds at 1.01, most likely due to the small number of items used. These analyses show that reliability is present and $P\eta$ (.67) and $Pvc(\eta)$ (.59) indicate unidimensionality and convergent validity are present.

Keen (1991) proposed a categorical scale for measuring the reach of an IT system that is dependent upon its ability to communicate with different locations. However, each possible response encompasses the one before it. Therefore, the coding of these variables will be treated as if they were interval responses. Reach is a single item measure, therefore no analysis was completed.

Overall Fit. Discriminant validity was assessed using EFA, as the CFA model would not converge. While this is not the preferred method, it will give some support to the model.

The EFA indicates that there are, in fact, the three predicted factors; however, three of the items have low factor loadings (.46-.48). Each of the items loaded exactly as predicted and no cross-loadings were present. This provides some weak support for discriminant reliability.

Function

The function portion of the efficient IT system is related to the software of the IT system, and the construct is composed of one variable that indicates application standardization. This area is important to the efficiency of the system as argued in the previous chapter. The variable was measured using a survey of the Chief Information Officer.

Standardization. Standardization of software plays a role in a firm's ability to integrate across departments and interorganizationally, thereby affecting the efficiency of the system. Cross and Earl (1997) have suggested that firms may have standardized applications at the organization or industry level and this measure is based on their case study of British Petroleum. No reliability factor was originally available for this measure as it was created from discussion rather than adopted or adapted from actual or proposed measures. The measure originally consisted of three questions, in a seven-point Likert-type scale ("strongly disagree" = 1, "strongly agree" = 7) format. However, the low factor loadings resulting from the CFA and the relatively low alpha indicated that the one-item measure was a better fit. Despite the acceptable levels of $\chi 2$ ($\chi^2 = 0$, $df = 0$, $p = 1.00$), RMSEA (.00) and CFI (1.00) levels, and reliability ($P_\eta = .63$), the average variance extracted ($P_{vc(\eta)} = .42$) and two of the three factor loadings were well below the acceptable .60 level (.34 and .35). Thus one item, which indicated a high factor loading (1.02) in the original three item model, was retained. Additionally, the single item retained ("The software and applications we use are standardized in our industry") is a good indication of whether or not software applications standardized and used on similar platforms, the ability to disseminate information across organizations, and whether the software is proprietary.

People

The people element of the efficient IT system is measured using ten variables: allocator, entrepreneur, environmental monitor, technology monitor, leadership, liaison, spokesman, strategic role, rank, and services offered by the IT department, as originally proposed. All measures of this composite were gathered through the survey of the CIOs.

With the exception of CIO involvement, all of these are established measures or adapted from established measures. CIO involvement uses a new measure created for this study, and is based on theory, therefore no reliability coefficients were available. The results of the original measures are shown in Table 7 below. The services variable is simply a calculated total of the twenty-three item scores.

As the seven CIO roles were taken directly from previous research (Grover, et al., 1993), no changes were made to the measures, despite some the questionable results of CFA. While no CFA results were originally reported, the reliability coefficients generated in this study are similar to those reported in the previous research. It should again be noted here that fit tests performed often resulted in acceptable scores; however this is primarily due to the small degrees of freedom. Additionally, with the sole exception of CIO involvement, average variance extracted was low for all measures.

The CFA resulted in changes being made to the scales of one variable, CIO involvement. The CIO involvement measure was reduced from eleven items to three by removing those with the lowest factor loadings. This provided better fit of the model;

decreasing the χ^2 from 151.77 (df = 20, p = .00) to .00, while decreasing RMSEA from .22 to 0, CFI from .66 to 1, P_η from .82 to .86 and the average variance extracted ($P_{vc(\eta)}$) from .39 to .68, however, this is due in part to the low degrees of freedom used in the adjusted model.

The results of the psychometric tests are shown in the Appendix C, Table 18 through Appendix C, Table 34.

CIO Leadership Roles. Grover et al (1993), based on a study by Lederer and Mendelow (1990), have posited that there are six distinct managerial or supervisory type roles a CIO may play in an organization. In order to test their hypotheses, Grover et al (1993) developed a measure that asks the CIO the importance of 46 individual duties the CIO may perform. These tasks were then factor analyzed into the six major duties Grover et al (1993) reported. The six roles are Leader (hiring, firing, training functions – 12 items); Spokesman (ability to cross departmental boundaries in order to assist other functional areas – 10 items); Monitor (scanning the business and technological environment for opportunities that may be exploited – 9 items); Liaison (duties involving communication outside the organization – 3 items); Entrepreneur (identifying and solving business problems or exploiting technology to change business situations – 5 items); and Resource Allocator (distributing and charging for IT resources – 7 items). Used in a study involving 111 CIOs, reliability for the six factors ranged from .66 to .84. While .66 is only marginally above the recommended cut-off for acceptability, the measure did have adequate reliability (Grover, 2000; Price & Muellar, 1986). The 48 items were scaled from 1 ("not important") to 7 ("very important").

The scales for the allocator variable were taken from previous research (Grover, et al., 1993). The CFA for range resulted in acceptable alpha, factor loadings, composite reliability (P_{η}), and CFI levels. However, the χ^2 square and RMSEA, as well as the average variance extracted ($P_{vc(\eta)}$) were low. These analyses show that reliability is present and mixed results for unidimensionality and convergent validity.

The entrepreneur scales were taken from Grover, et al.'s (1993) study. As shown in Appendix C, all fit indices indicate that the model is appropriate, with the exception of average variance extracted and one borderline (.53) factor loading. Therefore, reliability, unidimensionality, and convergent validity are assumed to be present.

The scales for the environmental monitor variable were taken from previous research (Grover, et al., 1993). The CFA for range resulted in acceptable alpha, composite reliability (P_{η}). However, the χ^2 square, RMSEA, and CFI levels, as well as the average variance extracted ($P_{vc(\eta)}$) were low. Additionally, there were three items with low to moderate factor loadings (.24, .33, and .52). It is possible that these findings are a result of splitting Grover et al.'s (1993) original "monitoring" role into two components: environmental and technology. These analyses show that reliability is present and mixed results for unidimensionality and convergent validity.

Grover, et al.'s (1993) measures were used for the technology monitor variable. All fit indices indicate that the model is appropriate, with the exception of average variance extracted and one low (.46) factor loading. Therefore, reliability, unidimensionality, and convergent validity are assumed to be present.

The scales for the leadership variable were taken from previous research (Grover, et al., 1993). The CFA for range resulted in acceptable alpha, composite reliability (P_{η}), and CFI levels. However, the χ^2 square and RMSEA, as well as the average variance extracted ($P_{vc(\eta)}$) were low. One of the twelve factor loadings was low (.36) and another borderline (.56). These analyses show that reliability is present and mixed results for unidimensionality and convergent validity.

The liaison variable measures were taken from Grover, et al.'s (1993) study and all fit indices indicate that the model is appropriate, with the exception of average variance extracted and one low (.40) factor loading. Therefore, reliability, unidimensionality, and convergent validity are assumed to be present.

The scales for the spokesman variable were taken from previous research (Grover, et al., 1993). The CFA for range resulted in acceptable alpha, composite reliability (P_η), and CFI levels. However, the χ^2 square and RMSEA, as well as the average variance extracted ($P_{vc(\eta)}$) were low as were four of the factor loadings (.46 to .57). These analyses show that reliability is present and mixed results for unidimensionality and convergent validity.

CIO Involvement. The strategic role of the CIO is an indication of the strategic position the Chief Information Officer has within the firm. The strategic role a CIO may be involved in may range from membership in the top management team to none (Jenks & Dooley, 1999). This eleven-question measure used a seven-point Likert-type scale ("strongly disagree" = 1; "strongly agree" = 7). Taken directly from the study conducted by Karimi et al (1996), the reliability factor was .74 based on 213 respondents. In a later study using the same measure, Jenks and Dooley (1999) surveying 57 CIO's from Fortune 500 firms calculated a reliability index of .94. Both of these (i.e., .74 and .94) are above the acceptable levels (Grover, 2000; Price & Muellar, 1986).

The CFA for range resulted in acceptable alpha, χ^2 square, RMSEA and CFI levels, as well as the composite reliability (P_η) and average variance extracted ($P_{vc(\eta)}$). One of the factor loadings (IV_B) was out-of-bounds at 1.04, most likely due to the small number of items used. These analyses show that reliability is present, while P_η (.86) and $P_{vc(\eta)}$ (.68) indicate unidimensionality and convergent validity are present.

CIO Rank. Rank is reflective of the official power and input the CIO has within the organization. This single-item categorical measure has four available choices and is based on the discussion presented by Karimi et al. (1996). A categorical scheme was used solely for respondent clarity purposes; therefore, the coding of these variables will be treated as if they were interval responses. No reliability index of the original measure was provided, although the survey had 213 respondents. Rank is a single item measure, therefore no analysis was completed.

Infrastructure Services. The view an organization has of its IT department is reflected in the type and number of services offered by the IT department (Broadbent & Weill, 1997). In their study of 27 firms, Broadbent et al (1996) identified 23 generic services provided by IT departments. These measures of service are taken directly from Broadbent et al's (1996) list, but are presented as a seven-point Likert-type scale that ranged from "not important" (1) to "very important" (7). No reliability index of the original measure was provided as these measures were based on discussion.

IT services were not factor analyzed, but rather summed in order to gain a score of overall services provided by the IT department, as suggested by Broadbent and Weill (1997).

Overall Fit. Neither CFA nor EFA would allow the model to converge; therefore the discriminant validity of the model could not be assessed.

Recap

A recap of the original cluster variables, their measures, citations, and, if applicable, number of respondents and alpha values are provided in Table 7 below, while the recap of the constructs, variables and measures for the final model are shown in Table 8 below.

CONSTRUCT	VARIABLE	MEASURE	ORIGINAL CITATION	N	ALPHA
Motivation	Decision support	4 items – 7 point Likert	Alavi, 1991[c]		
	Communication focus	3 items – 7 point Likert	Chan & Davis, 2000; Dunn & Varano, 1999[c]		
	Knowledge management	15 items – 3 to 5 choice categorical – 2 categories	Meyer & Curley, 1991[b]		
Hardware	Configuration	3 item – 7 point Likert (single item on three dimensions)	Fiedler et al, 1996[a]	313	.82-.91
	Range and Reach	4 item – 7 point Likert 1 item – 6 choice categorical	Keen, 1991[b]		
Function	Standardization	3 item – 7 point Likert	Cross & Earl, 1997[c]		
People	CIO Involvement	11 items – 7 point Likert	Karimi et al., 1996[a]	213 57	.74 .94
	CIO Leadership Roles	46 item – 7 point Likert	Grover et al., 1993[a]	111	.66-.84
	CIO Rank	1 item – 4 choice categorical	Karimi et al., 1996[b]	213	
	Infrastructure services	23 item – 7 point Likert	Broadbent & Weill, 1997[b]	27	

[a] unchanged existing and tested measure
[b] adapted from existing measures or proposed measures
[c] developed from discussion

Table 7: Recap of Proposed Variables

COMPONENT	VARIABLE	MEASURE
Motivation	Internal communication	2 items – 7 point Likert
	External communication	2 items – 7 point Likert
	Knowledge management (knowledge)	4 items - 3 to 5 choice categorical
	Knowledge management (technical)	3 items - 3 to 5 choice categorical
Hardware	Configuration	2 items – 7 point Likert
	Reach	1 item – 6 choice categorical
	Range	3 items – 7 point Likert
Function	Standardization	1 item – 7 point Likert
People	Allocator	12 items – 7 point Likert
	Entrepreneur	5 items – 7 point Likert
	Environmental Monitor	6 items – 7 point Likert
	Technology Monitor	3 items – 7 point Likert
	Leadership	12 items – 7 point Likert
	Liaison	3 items – 7 point Likert
	Spokesman	10 items – 7 point Likert
	CIO Involvement	3 items – 7 point Likert
	Rank	1 items – categorical
	Services	23 items – 7 point Likert

Table 8: Recap of Variables Used

Other Variables of Interest

As with any study, certain factors outside the realm of the actual constructs in which the investigator is interested may have an effect on the proposed model. This study has two such factors: organization size and industry membership.

Size

Organizational size may play a role in the ability of a firm to invest in IT system resources, both financially and in terms of human resources (Brynjolfsson et al, 1994; Karimi et al., 1996; Mitra & Chaya, 1996). Therefore, organizational size, as indicated by number of employees (Brynjolfsson et al, 1994; Karimi et al., 1996) has been chosen as a variable of interest for this study. This measure was gathered from ReferenceUSA data.

Industry

The industry in which an organization is a member may affect the type of IT systems that are adopted because of industry information intensity (Duncan, 1995) and the degree and intensity of change in the industry as well as the general environmental characteristics of the industry (Maier, Rainer & Snyder, 1997). Therefore, industry has been chosen as a variable of interest for this study. Industry was indicated by the 2-digit SSIC listed as the organization's primary classification and was gathered from ReferenceUSA data.

A recap of the variables of interest used, and their measures and sources are provided in Table 9 below.

CONSTRUCT	VARIABLE	MEASURE	SOURCE
Size	Firm Size	Number of employees	ReferenceUSA
Industry	Industry	2 digit SSIC code	ReferenceUSA

Table 9: Recap of Other Variables of Interest

As the measures of the components have been tested and found to be acceptable, the next step is to run the cluster analysis to test the hypotheses proposed in Chapter II. The discussion, methods, and results of this analysis may be found in Chapter IV.

CHAPTER IV

RESULTS

Cluster analysis is a multivariate procedure for identifying similarities between components of a proposed grouping. Thus, cluster analysis was used to determine the validity of the classification of IT system types into four distinct groups. The first step was to ascertain the number of groups or clusters that are expected. This was theoretically accomplished in Chapter II by determining that four different types of IT systems are identifiable from the literature: visionary, outreach, traditional, and executive. However, as cluster analysis is highly subjective, three separate tests were conducted.

General Data

Cluster analysis is very sensitive to the presence of outliers. Therefore, the variables were plotted on a profile diagram (see Appendix C, Figure 1) with variables along the x-axis and values along the y-axis to determine if outliers were present and if any patterns were discernable in the data. No outliers were detected using this method.

Additionally, cluster analysis is highly susceptible to multicollinearity affects. The data was analyzed and no variance inflation index exceeded 10 as shown in Appendix C, Table 1, therefore, it may be assumed that multicollinearity is not present.

Finally, the variable scores were standardized by computing the z-scores. Cluster analysis is impacted by the magnitudes of the standard deviations and differing scales; those variables with higher standard deviations or ranges of scores will have more impact on cluster formation than those with lower dispersion. As scales range from three to seven possible responses, there is the chance that some variables will be weighted more heavily in the cluster structure than other. As I have theoretically posited that no single variable is more or less important than any other, the standardization of the variables is required.

Cluster Analysis

The purposes of the cluster analysis are twofold; the first being to ascertain whether the four hypothesized IT system types exist and, if so, whether the differences between them are statistically significant. The second is to determine the characteristics of the clusters that manifest and compare them to those proposed. In order to achieve these goals, a series of three cluster analysis methods was used: Wards, K-means, and Furthest Neighbor. The cluster analysis was performed using SPSS 11.5. The cluster means for use with the MANOVA and ANOVA tests were calculated by the cluster analysis at the variable level, and then summed for means used at the component and model levels. The results and findings of each of the analyses will be discussed, then the overall testing of the hypotheses and the interpretation and analysis of the components of the will follow.

Ward Method of Hierarchical Cluster

The first step toward supporting the hypotheses proposed was to run a hierarchical cluster analysis using the Ward Method of agglomerative hierarchical analysis. As the number of clusters was predetermined in Chapter II, the number of clusters was set at four. The Ward Method of cluster analysis starts by assuming each respondent (with respect to the four components of IT system types: hardware, people, function, and motivation) is a cluster unto itself. Then, in a sequence of stages, the analysis combines similar clusters until only one group remains. As the number of clusters is reduced, a distance (sum of the squares between clusters summed over all variables) between the remaining clusters is calculated, and a coefficient (squared Euclidean distance) between the two clusters that have been combined is generated. When the coefficient is small, the groups that were combined are considered similar, and when the coefficient is large, the groups are dissimilar. Thus, it was expected that the coefficients for the last four clusters would be relatively large, thus indicating that the classification of IT systems into four separate groups was valid. MANOVA was then used to ensure that the clusters were significantly different from each other (with respect to the four components of hardware, people, function, and motivation) and F-statistics were generated, with an expected result that significant differences would be found at $p<=.05$ (Hair et al, 1995; Milligan, 1981).

As can be seen in Appendix C, Table 35, below, the percentage change in the agglomeration coefficient for move from five clusters to four clusters is high at 48.7%. Although there is support for a smaller number of clusters, theory has suggested that four is the correct number and the agglomeration coefficient change corroborates, at the minimum, that a four-cluster solution would be acceptable. The mean values (i.e., random seed points) of variables obtained from the Ward Method analysis are presented in Appendix C, Table 36.

The MANOVA analysis results for all variables in the cluster are reported in Appendix C, Table 37. These tests are the first step in determining if there are actually differences among the clusters given all of the variables. As can be seen, there are significant differences noted as reflected by the F-value. Additionally, with the exception of the Pillai's Trace test, the effect size is acceptable, and power is at its highest level at 1.

While the F-test analysis indicates that there are differences among the clusters, this is just the first step. Next, one must determine if there are significant differences between each cluster and the others. Therefore, a Levene's test of the equality of error variances was performed. If the significance level is below .05, then the variances are not equal and the correct test of the differences between specific pairs of clusters is the Tamhane test which corrects for the variance. Otherwise, with equal error variances assumed, the Tukey HSD test will be used. The Levene's test results were significant at .039 (statistic = 2.864, $df1 = 3$, $df2 = 145$), therefore the Tukey HSD test was used to compare the groups. As can be seen in Table 10, below, each cluster center is significantly different from all others at $p<.01$.

Cluster	Cluster	Mean Difference	Std. Error	Sig.
1	2	4.663	0.293	0.000
	3	2.344	0.299	0.000
	4	7.678	0.332	0.000
2	1	(4.663)	0.293	0.000
	3	(2.319)	0.210	0.000
	4	3.015	0.256	0.000
3	1	(2.344)	0.299	0.000
	2	2.319	0.210	0.000
	4	5.334	0.262	0.000
4	1	(7.678)	0.332	0.000
	2	(3.015)	0.256	0.000
	3	(5.334)	0.262	0.000

Table 10: Tukey HSD Comparison of Ward Method Clusters

K-Means

The second method, to confirm, in a way, the findings of the Ward Method of cluster analysis, is the K-means method. This non-hierarchical test uses a predetermined number of clusters (i.e., the four IT system types argued in Chapter II) and cluster centers. The cluster centers used were those that are generated from the Ward Method discussed above (Appendix C, Table 37). The K-mean method clusters all groups that are a set distance from the predetermined group center. MANOVA was used to generate an F-statistic that was expected to confirm the significant differences between the groups, thus supporting those clusters found in the Ward Method.

As can be seen in the iteration history found in Appendix C, Table 38, there was very little movement from the initial centers initiated by the Ward Method. This provides loose support that the clusters generated by the Ward Method are accurate.

The mean values of variables obtained from the K-Means analysis are presented in Appendix C, Table 39. An overwhelming majority of the changes in the number of cases came from group 2 and were reclassification to group 4.

The MANOVA analysis results for all variables in the cluster are reported in Appendix C, Table 40. These tests are the first step in determining if there are actually differences among the clusters given all of the variables. As can be seen, there are significant differences noted as reflected by the F-value. Additionally, with the exception of the Pillai's Trace test, the effect sizes are above .5, and power is at its highest level at 1.

Once the F-test analysis indicates that there are differences among the clusters, one must determine if there are significant differences between each cluster and the others. Therefore, a Levene's test of the equality of error variances was performed. As the Levene's test results were significant at .00 (statistic = 6.223, *df*1 = 3, *df*2 = 145), the Tamhane test was used to compare the groups. As shown in Table 11, below, each cluster center is significantly different from all others at p<.01.

Cluster	Cluster	Mean Difference	Std. Error	Sig.
1	2	4.709	0.245	0.000
	3	2.505	0.250	0.000
	4	7.108	0.282	0.000
2	1	(4.709)	0.245	0.000
	3	(2.204)	0.131	0.000
	4	2.399	0.185	0.000
3	1	(2.505)	0.250	0.000
	2	2.204	0.131	0.000
	4	4.603	0.191	0.000
4	1	(7.108)	0.282	0.000
	2	(2.399)	0.185	0.000
	3	(4.603)	0.191	0.000

Table 11: Tukey HSD Comparison of K-Means Clusters

Furthest Neighbor Hierarchical Cluster

Finally, another nonhierarchical cluster analysis was completed by specifying four groups without predetermined centers, but maximum distance between groups. Furthest Neighbor Hierarchical Cluster analysis uses random seed points and the four predetermined number of clusters.

Appendix C, Table 41 shows the percentage change in the agglomeration coefficient for a move from five clusters to four clusters is acceptable at 10.8%. Theory has suggested that four is the correct number of clusters, and is supported by the change in Agglomeration coefficient.

The mean values of variables obtained from the Furthest Neighbor analysis are presented in Appendix C, Table 42. As can be seen, a large number of cases were classified into group 2 and very few in groups 3 and 4.

The MANOVA analysis results for all variables in the cluster are reported in Appendix C, Table 43. This first step in determining if there are actually differences among the clusters, given all of the variables, is to show that significant differences exist between the clusters as reflected by a significant F-value, acceptable effect sizes, and high power.

Once the F-test analysis indicates that there are differences among the clusters, one must determine if there are significant differences between each cluster and the others. Therefore, a Levene's test of the equality of error variances was performed. As the Levene's test results were significant at .018 (statistic = 3.479, $df1 = 3$, $df2 = 136$), the Tamhane test was used to compare the groups. As can be seen in Table 12, below, clusters 1 through 3 are significantly different from all others at $p<.05$.

Cluster	Cluster	Mean Difference	Std. Error	Sig.
1	2	1.211	0.475	0.081
	3	3.939	0.963	0.136
	4	3.776	0.878	0.009
2	1	(1.211)	0.475	0.081
	3	2.728	0.880	0.393
	4	2.565	0.786	0.084
3	1	(3.939)	0.963	0.136
	2	(2.728)	0.880	0.393
	4	(0.163)	1.148	1.000
4	1	(3.776)	0.878	0.009
	2	(2.565)	0.786	0.084
	3	0.163	1.148	1.000

Table 12: Tamhane Comparison of Furthest Neighbor Clusters

Comparison of cluster methods

While the preliminary data indicates that the Ward Method and K-Means will generate similar clusters, but that the Furthest Neighbor test generates a vastly different cluster, the final test is to determine whether the three methods generate significantly different cluster centers. This is accomplished by comparing the centers using an ANOVA test. The results of the ANOVA are shown in Table 13 and Table 14. The non-significant F-value ($p > .10$) indicates that the cluster centers are, in fact, stable.

Groups	*n*	Sum	Average	Variance
Ward	4	(0.395)	(0.099)	10.760
K-Means	4	1.574	0.393	9.232
Furthest Neighbor	4	(3.843)	(0.961)	3.774

Table 13: Summary Statistics for ANOVA comparison of Cluster Centers

Source of Variation	SS	*df*	Mean Square	F	Sig.
Between Groups	3.758	2	1.879	0.237	0.794
Within Groups	71.297	9	7.922		
Total	75.055	11			

Table 14: ANOVA results of Cluster Centers

Discussion

The first part of this research is embodied in the four hypotheses that were proposed in Chapter II. The first part of this discussion will cover the actual hypotheses. However, the goal of this research was not only to illustrate that four IT system types existed, but to validate the components of those types. Therefore, following the discussion of the hypotheses, the four IT system type components will be compared to and reconciled with the characteristics of the four clusters found in the above analysis.

As the ANOVA indicated that there were no significant differences between the cluster centers using the various methods, the following discussion will be based on membership in clusters based upon the Ward Method analysis.

Hypotheses

A detailed inspection of the composition of the clusters, which will be discussed in detail below, has allowed for the assigning of each of the four IT system types directly to each of the four clusters found in the analysis above. The four system types and their corresponding clusters are *traditional* (cluster 4); *executive* (cluster 2); *outreach* (cluster 3); and *visionary* (cluster 1).

Hypothesis 1: There will be a significant difference between the combination of IT system components (hardware, function, motivation, and people) between traditional *IT systems and other IT system types.*

An inspection of the cluster analysis results indicates that there are significant differences ($p<.01$) between the *traditional* IT system and the other three system types as shown in Table 15, below. Therefore, Hypothesis 1 is supported.

System	Compared to	Mean Difference	Std. Error	Sig.
Traditional	Visionary	(7.678)	0.332	0.000
	Executive	(3.015)	0.256	0.000
	Outreach	(5.334)	0.262	0.000

Table 15: Traditional System Comparisons

Hypothesis 2: There will be a significant difference between the combination of IT system components (hardware, function, motivation, and people) between executive *IT systems and other IT system types.*

There was also a significant difference ($p<.01$) between the executive IT system and the other three system types as show in Table 16, below. Therefore, Hypothesis 2 is supported; a significant difference exists.

System	Compared to	Mean Difference	Std. Error	Sig.
Executive	Visionary	(4.663)	0.293	0.000
	Executive	(2.319)	0.210	0.000
	Outreach	3.015	0.256	0.000

Table 16: Executive System Comparisons

Hypothesis 3: There will be a significant difference between the combination of IT system components (hardware, function, motivation, and people) between outreach *IT systems and other IT system types.*

Hypothesis 3 was also supported with comparisons between the outreach system and the other three system types all being significant at $p < .01$ as shown in Table 17.

System	Compared to	Mean Difference	Std. Error	Sig.
Outreach	Visionary	(2.344)	0.299	0.000
	Traditional	2.319	0.210	0.000
	Executive	5.334	0.262	0.000

Table 17: Outreach System Comparisons

Hypothesis 4: There will be a significant difference between the combination of IT system components (hardware, function, motivation, and people) between visionary *IT systems and other IT system types.*

As shown in Table 18, all comparisons between the *visionary* IT system type and the other three system types are significant at $p < .01$, thus supporting Hypothesis 4.

System	Compared to	Mean Difference	Std. Error	Sig.
Visionary	Outreach	4.663	0.293	0.000
	Traditional	2.344	0.299	0.000
	Executive	7.678	0.332	0.000

Table 18: Visionary System Comparisons

As can be seen in Figure 4, below, which represents each organization and its distance from its cluster center, there are four distinct clusters. The centers of each cluster are represented by a small square and the center value. Figure 5 represents each cluster and the size as indicated by the organization with the furthest distance from the center. As the figure indicates, the *traditional* IT system contains the members which are furthest from the cluster center, while the *outreach, visionary,* and *executive* clusters are relatively uniform in this regard. Finally, Figure 6, shown below, indicates each cluster size as indicated by group membership. The *executive* cluster is, by far, the largest, followed by *outreach,* while the memberships in the *visionary* and *traditional* clusters are the smallest. This makes intuitive sense as the *visionary* IT system is the most complex and the *traditional* IT system the least complex, therefore, most organizations fall somewhere in between.

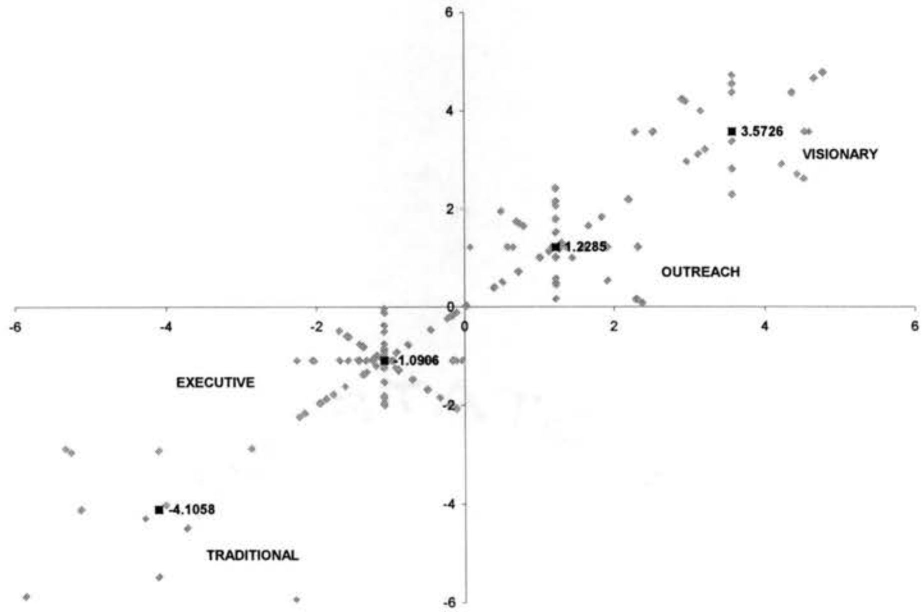

Figure 4: Organizational Distances from Cluster Centers

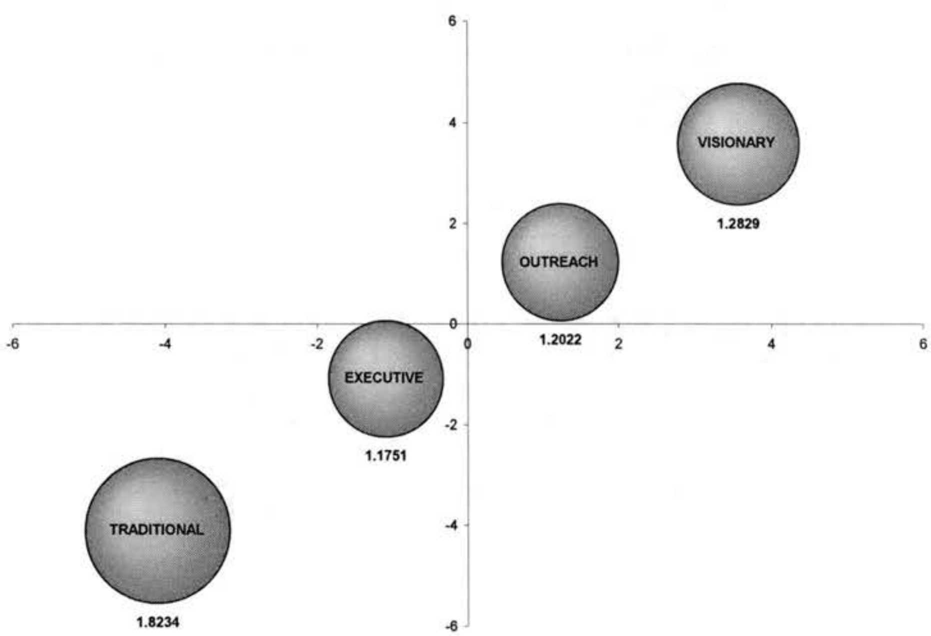

Figure 5: Cluster Sizes as Maximum Distance from Centers

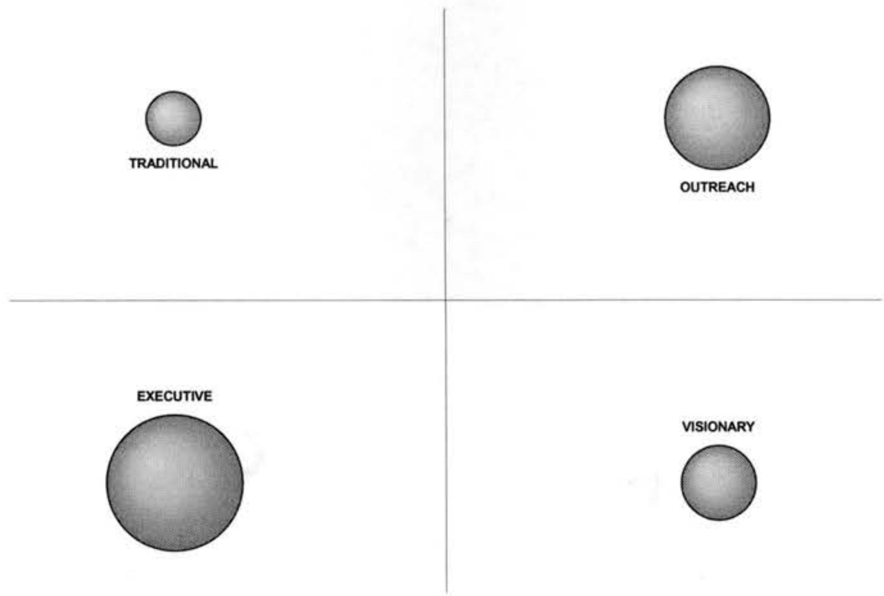

Figure 6: Clusters Sizes as Number of Members

All four of the proposed hypotheses show support and the next step of the typology development may commence: evaluating the characteristics of each of the clusters and comparing them to the components proposed for each of the four IT system types.

IT System Components

This portion of the analysis of results discusses the proposed components of each of the IT system types and the actual characteristics found in the cluster analysis.

Traditional

The *traditional* IT system was proposed to have an internal (bureaucracy cost) focus and an operational direction. Twelve organizations were classified as having *traditional* IT systems. The proposed and actual findings of the cluster analysis are shown in Table 19, below.

Component	Characteristics	Proposed Attributes	Actual Attributes
Motivation	Communication Focus	Internal – high External – low	Internal – low* External – low
	Knowledge management	Knowledge – low Technology – low	Knowledge – low Technology – low
Hardware	Configuration	Centralized	Centralized
	Range and reach	Range – low Reach – low	Range – low Reach – low
Function	Standardization	Business level	Business level
People	Infrastructure services	Little or no services	Little or no services
	CIO involvement	Support only	Support only
	Leader	Low	Low
	Technology monitor	Low	Low
	Environmental monitor	Low	Low
	Liaison	Low	Low
	Spokesman	Low	Low
	Resource allocator	High	Low*
	Entrepreneur	Low	Low
	CIO rank	Line manager	Line manager

* indicates a finding other than that predicted.

Table 19: Traditional System: Proposed vs. Actual Characteristics

The contrary finding of internal communication vs. external communication was uniformly reversed for all four IT system types. The difference in internal communication, which was predicted to be low, but is actually high, may be a factor of technology. Connecting an internal communication network is more technically complicated than connecting to an external system; therefore, a system that has low external communication will most likely have low internal communication. Thus, the finding that internal communication is lower than expected can be explained.

The role of resource allocator was predicted to be high, but the findings indicate that CIOs of *traditional* systems actually spend little time performing duties related to this function. It is possible that complexity of the IT system plays a role. Resource allocator duties may not be as important in firms with less complex systems needing fewer resources as predicted; perhaps because there are not as many on-going projects as would be found in more complex IT systems.

Executive

The *executive* IT system was proposed to have an internal (bureaucracy cost) focus and a non-operational direction. The proposed and actual findings of the cluster analysis for the 73 firms classified as having *executive* IT systems are shown in Table 20, below.

Component	Characteristics	Proposed Attributes	Actual Attributes
Motivation	Communication Focus	Internal – high External – low	Internal – high External – high*
	Knowledge management	Knowledge – high Technology – low	Knowledge – high Technology – low
Hardware	Configuration	Centralized cooperative	Centralized cooperative
	Range and reach	Range – moderate Reach – low to moderate	Range – moderate Reach – high*
Function	Standardization	Business level	Business level
People	Infrastructure services	Low number of services	Low to moderate number of services
	CIO involvement	Decision making with support, moderate strategic involvement	Decision making with support, moderate strategic involvement
	Leader	Low	Low
	Technology monitor	High	High
	Environmental monitor	Moderate	Moderate
	Liaison	Moderate	Moderate
	Spokesman	Moderate	Moderate
	Resource allocator	Low	Low
	Entrepreneur	Moderate	Moderate
	CIO rank	Upper manager	Upper manager

* indicates a finding other than that predicted.

Table 20: Executive System: Proposed vs. Actual Characteristics

The contrary finding of internal communication vs. external communication was uniformly reversed for all four IT system types. The difference in external communication, which was predicted to be low, but is actually high, may be a factor of technology. Connecting an internal communication network is more technically complicated than connecting to an external system such as e-mail and file sharing; therefore, a system that has high internal communication will most likely have high external communication.

Reach may also be a factor of technology. Reach was projected to be low to moderate in the *executive* IT system, yet the findings indicated that reach was high. With high external communication, firms may feel that they can access “anyone, anywhere.” The mean for this variable is close to the moderate to high break point and, as it used only a single item measure, it is possible that a more complex measure with stronger definitions is in order.

Outreach

The *outreach* IT system was proposed to have an external (market cost) focus and an operational direction. Shown in Table 21, below, are the proposed and actual findings of the cluster analysis for the 43 firms classified as having *outreach* IT systems.

Component	Characteristics	Proposed Attributes	Actual Attributes
Motivation	Communication Focus	Internal – low External – high	Internal – high* External – high
	Knowledge management	Knowledge – low Technology – high	Knowledge – high* Technology – high
Hardware	Configuration	Decentralized cooperative	Decentralized cooperative
	Range and reach	Range – moderate Reach – moderate	Range – moderate Reach – moderate
Function	Standardization	Industry level	Industry level
People	Infrastructure services	Moderate number of services	High number of services
	CIO involvement	Support with influence, no strategic involvement	Support with influence, some strategic involvement
	Leader	High	Moderate*
	Technology monitor	High	High
	Environmental monitor	Moderate	High*
	Liaison	Moderate	High*
	Spokesman	Low	High*
	Resource allocator	Low	Low
	Entrepreneur	Low	Low
	CIO rank	Middle manager	Middle manager

* indicates a finding other than that predicted.

Table 21: Outreach System: Proposed vs. Actual Characteristics

The contrary finding of internal communication vs. external communication was uniformly reversed for all four IT system types. The difference in internal communication, which was predicted to be low, but is actually high, may be a factor of technology. Connecting an external communication network is less technically complicated than connecting to an internal system; therefore, a system that has high external communication will most likely have high internal communication.

The finding that the knowledge component of knowledge management was high, when it was predicted to be low, may be a function of clarity and size. Of the 43 firms defined as having an *outreach* IT system, 24 reported using an expert system. Of these, 23 have less than 250 employees. Additionally, the survey defined an expert system as "a single area of knowledge. For example, a financial system, a medical system, an insurance underwriting system are each separate knowledge domains." While it was theorized that the use of expert systems would be low, this was based on the idea that an expert system would be more complex than the use of Quick Books or Turbo Tax, for example. It stands to reason that smaller firms, with fewer resources than larger firms, will buy off-the-shelf packages, and may consider them to be expert systems. Therefore, an additional definition of an expert system or an additional question asking what types of expert systems are being used should be added to the measure in order to better understand the use of expert systems in this group.

While the leader role of the CIO was found to be moderate, rather than high, the distinction is one of degrees; the mean (.132) is very close to the cut-off point (.158) between the two categories. It is possible that another study will, in fact, find that the leader role for the *outreach* system is high. The study also found high involvement in the environmental monitoring duties, which were expected to be moderate. An inspection of the actual responses indicates that, while the overall mean was high, there were higher results for those questions with an external or internal and external focus than for those with a focus on internal duties only. This may also (in part) account for low factor loadings on these same questions. Therefore, it would be suggested in future studies that the environmental monitoring role be broken into internal and external factors. Finally, the results indicate a high involvement in the spokesman and liaison duties, which were expected to be low, and moderate, respectively. Liaison duties are primarily focused on external interaction, while the duties of the spokesman are primarily internal in nature. Additionally, these two variables are highly correlated (.712, p=.000). From a practical sense, the idea that interacting externally in order to increase operational efficiency would also require a high degree of coordination internally in order to assure that internal systems used externally with suppliers and/or customers are compatible.

In recap, the *outreach* IT system attributes are furthest from those predicted, with most of the difference found in the duties of the CIO. However, several of these make sense from a practical stand point, and the others are most likely due to the nature of the measures. One other possible explanation for the differences in the CIO roles is organizational size. Of the 43 firms classified as having an *outreach* IT system, more than half have 10 or more IT employees, with the average for all 43 firms being 12.3. It is possible that with a large number of IT personal, the CIO may be able to spend more time championing the IT department and its projects. This finding needs to be studied further.

Visionary

The *visionary* IT system was proposed to have an external (market cost) focus and an operational direction. Twenty-two firms were indicated to have *visionary* IT systems. Shown in Table 22, below, are the proposed and actual findings of the cluster analysis.

Component	Characteristics	Proposed Attributes	Actual Attributes
Motivation	Communication Focus	Internal – low External – high	Internal – high* External – high
	Knowledge management	Knowledge – high Technology – high	Knowledge – high Technology – high
Hardware	Configuration	Decentralized	Decentralized
	Range and reach	Range – high Reach – high	Range – high Reach – high
Function	Standardization	Industry level	Industry level
People	Infrastructure services	High number of services	High number of services
	CIO involvement	High strategic involvement	High strategic involvement
	Leader	Low	High*
	Technology monitor	High	High
	Environmental monitor	High	High
	Liaison	High	High
	Spokesman	High	High
	Resource allocator	Low	High*
	Entrepreneur	High	High
	CIO rank	Top management team	Top management team

* indicates a finding other than that predicted.

Table 22: Visionary System: Proposed vs. Actual Characteristics

As discussed earlier, the difference in internal communication, which was predicted to be low, but is actually high, may be a factor of technology. Connecting an internal communication network is more technically complicated than connecting to an external system such as e-mail and file sharing. Therefore, the finding that internal communication is higher makes practical sense.

Additionally, as mentioned in the *traditional* IT system discussion, the reversal of findings in the role of resource allocation may also be a function of complex technology. The prediction was that *visionary* IT systems would have a low incidence of CIOs assuming the duties of a resource allocator, when, in fact, the opposite is true. Resource allocator duties may be more important in firms with complex systems and major on-going projects needing a large number of resources than those with less complex systems.

CHAPTER V

CONCLUSIONS

Overview and recap

Information Technology, as a subject, is relatively new, and in order to enhance the field, theory building and simple broad categorization (Rich, 1992) must take place. Therefore, classification schemes must be created that may be used to aid the development of (Glaser & Strauss, 1967) and provide tests for (Bacharach, 1989) theory. It is especially important to a new discipline that these classification schemes have an *a priori* theory base (Rich, 1992). Given the lack of theory based research (e.g., Broadbent, Weill, O'Brien & Neo, 1996: Cross & Earl, 1997; Lam & Ching, 1998), the findings in this study that four distinct IT systems exist and that their components are generally in line with the predictions, are important contributions to the field, as the basis for the typology is, by definition, *a priori*. Thus, one of the major contributions of this research is the extension of the knowledge of the components and complexity of IT systems.

Many practitioners and academics have previously viewed IT systems with a "one-size-fits-all" approach (Ein-Dor & Segev, 1993; Lee & Leifer, 1992; Sabherwal & King, 1995), and the findings that IT systems are more complex and should not be uniform across organizations has several very important implications for theory and practice. Ahituv, Neumann, and Zviran (1989) found that there were weak relationships between firm size, industry membership, and organizational structure with respect to distribution of processing power, while there was a strong relationship between management style and distribution. This would imply that the type of processing depends entirely on the management style of the firm. However, the results of this study indicate that there are other factors that must be considered. CIO position, standardization of software, goal orientation, and focus are also determinants of distribution and whether there is or should be an impact. Leifer (1988) has also suggested that organization structure must be changed in order to increase the efficiency of the IT system. He admits that this may be a challenge for firms. This study indicates that an evaluation of the IT system may require only minor changes (although it is possible that major changes are required as well) to the IT system to increase efficiency. Changing components of the IT system is much easier than reorganizing the entire organization (Fiol, 1991). A final example is Brynjolfsson et al's (1994) study of IT investments on firm efficiency. I contend that the investment in IT does not indicate how efficient that IT system will be. According to this research, while IT investment may be a rough indicator of the number of employees, the processing speed or power, the number of physical computers, and cost of software used by an organization, there is no indication that these items alone determine efficiency. Rather it is the services the employees provide, the structure of the hardware, and the use and type of software that is used (among other things) that indicate the efficiency of the IT system.

The study also provides support for aligning the focus and orientation of the organization and the IT system. When strategy and structures are aligned, greater efficiency should be the result (Jones & Hill, 1988; Williamson, 1975).

Additionally, this study has theoretically developed and supported a comprehensive typology of IT system types, which has been sorely lacking in the Strategy and IT literature. With the exception of Fedorowicz and Konsynski (1992), Zachman (1987), and Sowa and Zachman (1992), simple IT system or single component studies have been the case more often than not in the IT literature. Therefore, while researchers have attempted to fill the gap, this study is the first to provide a classification scheme that is both *a priori* theory based and empirically tested and testable. The interaction of the components of an efficient IT system indicate that studies that examine only one element of an IT system (e.g., Ein-Dor & Segev, 1993; Lee & Leifer, 1992; Sabherwal & King, 1995) are not providing enough information upon which to base decisions or to determine the actual type of IT system in place. Brynjolfsson et al's (1994) study would seem to indicate that the more money spent on IT investments the more efficient the firm will be. Lee and Leifer (1992) posit that information sharing is the component that best links organization structure and Information Technology to create efficiency, while Sabherwal and King, (1995) suggest that IT efficiency is best determined by the type of planning processes used. While each of these studies has merit, as far as it goes, there is more that needs to be considered when trying to determine the best "fit" of an IT system than one or two single components. It is the lack of comprehensive and complex models of IT that has lead to weak findings between efficiency, IT systems, structures, and performance. My research will assist with this lack and help clear up misunderstandings and conflicting information about what comprises an efficient IT system.

The components of the typology can be used by practitioners to determine which system types are in use in a specific organization or at a specific time. Therefore, practitioners may use this typology in order to create an efficient system by aligning the components of their current IT systems more closely with the ideal for their organization's orientation and focus, or to realign IT system components as orientation or focus change in order to maintain an optimally efficient system as suggested by TCE (Williamson, 1975).

Additional examples of research studies that may be conducted include examining the relationship of IT system types and: CIO succession, types of organizational change, and the Miles and Snow (1978) taxonomy. The typology developed in this study provides a broader and more accurate description of IT system types, thus allowing a more comprehensive examination of these issues.

For example, one could use the typology in conjunction with Miles and Snow's (1978) taxonomy. Their taxonomy suggests that defenders have a narrow product market, managers that are experts in the field of operations, do not look outside the organization for new opportunities and pay special attention to improving the efficiency of operations. This sounds much like the overall definition of the *traditional* IT system. Likewise, prospectors are continually scanning the market for opportunities dealing with change and uncertainty and have a strong emphasis on innovation. This could easily describe the *visionary* IT system. Analyzers, using competitive scanning, and excelling in both stable and turbulent markets, may be equated with the *executive* IT system. Finally, reactors just follow along with changes in the environment – this could be either buyer or supplier initiated – therefore the *outreach* system may be a good fit.

Thus, academia will find the typology useful in furthering theoretical development in the areas of IT and all aspects of business. For example, diversification strategies, telecommuting efficiency, decision making effectiveness, and profitability are all areas in which knowing the specific IT system type would be beneficial to the researcher.

In a broader sense, the findings from this study are supportive of previous transaction cost economics literature. Specifically, the study supports the suggestion that transaction costs may occur both externally (market) and internally (bureaucracy) as briefly discussed by Williamson (1975) and further elaborated upon by Hill and Hoskisson (1987) and Jones and Hill (1988). The concept of internal and external transaction costs has serious implications when an organization is dealing with strategic issues such as firm boundaries, outsourcing, and diversification.

For example, Jay Barney (1999) suggests that TCE determines firm boundaries and the outsourcing decision as based primarily on asset specificity and opportunistic behavior. Thus, in order to reduce transaction costs, the firm will choose a hierarchical form of governance. However, he raises an interesting point:

> "What if these hierarchical approaches to gaining access to capabilities are themselves costly? In this setting, the decision about how to gain access to the capabilities that the firm needs does not depend only on the required level of specific investment, but also on the cost of developing these capabilities and on the cost of acquiring another firm that already possess them. Indeed, when the costs of hierarchical governance are high, a firm might want to choose nonhierarchical approaches to gain access to needed capabilities even if there are significant transaction-specific investments – and thus significant threats of opportunism – associated with this approach."

This is exactly the sort of outsourcing and firm boundary question that the division of transaction costs into market and bureaucracy costs is meant to address. Outsourcing or the chosen governance structure of a firm does not depend on asset specificity or the possibility of opportunistic behavior alone, but rather the entire cost of the transaction (Williamson, 1975) and the determination of whether market or bureaucracy costs are higher (Hill & Hoskisson, 1987; Jones & Hill, 1988). It cannot be assumed, then, as Barney has, that the mere presence of high asset specificity automatically requires one type of governance structure or another.

Another example of where both market and bureaucracy costs should be taken into account is in Wang's (2002) study of IT outsourcing. In his study of 163 firms that outsourced their IS functions, Wang found that asset specificity had a negative effect on post-contractual opportunism and positive effect on outsourcing success. However, outsourcing success was measured as costs vs. benefits of the outsourced system, with only general consideration of the bureaucracy costs involved. The measure of consisted of five items: increase in IT competence, access to skilled personnel, cost savings on human resources, cost savings on technological resources, and control of IS expenditures. While this may be a valid measure of IT success, it does not determine whether the total transaction costs were actually higher with internal or external governance structure (i.e., outsourcing). Thus, Wang's findings that asset specificity had a positive effect on success may be impacted by the internal costs of obtaining those same resources.

Diversification studies may also be impacted by consideration of both types of transaction costs. While, transaction cost economics determines within general guidelines the governance structures for different types of strategies, the end result is always to choose that governance mechanism which is most efficient (Williamson, 1975, 1981). As each firm is unique with respect to its culture, history, management style and these are prime determinants of bureaucracy costs, each firm must be studied individually to determine whether market or bureaucracy costs are higher. This implies, then, that future research in the area of diversification and TCE must take both types of transaction costs (and their sources) into account.

Additionally, the study has also shown support for the Sowa and Zackman (1992) framework of IT building blocks. The mere fact that this framework was used as a basis for the formation of a typology that is applied to an entire IT system, as opposed to a single application which was its original purpose, indicates it contains a robust and enduring set of IT components.

Contrary and Interesting Findings

The cluster analysis indicated that there were in fact, four distinct IT types. However, there were several areas in which the attributes of the IT system differed from those predicted. As discussed briefly in Chapter IV, there were contrary findings for internal vs. external communications for all four IT system types as shown in Table 23 below.

IT System Type	Proposed Attribute		Actual Attribute	
	Internal	External	Internal	External
Traditional	High	Low	Low	Low
Executive	High	Low	High	High
Outreach	Low	High	High	High
Visionary	Low	High	High	High

Table 23: Communication Attributes

These findings may be a factor of technology. Creating an internal network is more technically complicated than an external network. For example, communicating via e-mail may be technically simple; it requires nothing more than a modem and phone line. Therefore, it is most likely that any IT system with an internal network will also have external communication capabilities. A second, and also likely, explanation for these contrary findings is that the survey questions did not adequately explore the nature of the communication. Was the external communication strictly e-mail between firms? Perhaps, it consisted of a simple information website for customers. Or was the communication more sophisticated nature; such as EDI or document sharing? This area needs to be explored further in order to determine if these findings were due to measurement error or to an area of TCE theory that needs to be re-examined.

The role of resource allocator also had contradictory findings for two of the four systems: visionary (predicted to be low was actually high) and traditional (predicted to be high was actually low). This may be a combination of technical complexity and a different perspective of TCE than that originally proposed. Visionary and traditional systems are on the opposite ends of complexity, with visionary systems being intricate by nature and traditional systems being relatively simplistic. The primary goal of the traditional system is to lower costs associated with transaction processing, while the visionary system has the primary goal of reducing market costs. As such, the traditional system has projects that are relatively uncomplicated and the resources of the IT department are used only to these ends, thus freeing the CIO from the resource allocator role. The visionary IT system, on the other hand, generally would have many complex projects dealing with internal decision-making and internal and external planning as well as external issues of compatibility, extent of interaction, or standardization with suppliers' or customers' systems. Therefore, the CIO must spend more of his or her time determining which resources would best suit the goals and strategies of the organization.

By slightly changing the perspective thus, it may be that these findings are not contrary to TCE at all.

The contrary finding for reach in the *executive* IT system (projected to be low to moderate, but actually high) may also be a factor of technology and measurement. With high external communication, firms may feel that they can access "anyone, anywhere." The mean for this variable is close to the moderate to high break point and, as it used only a single item measure, it is possible that a more complex measure with stronger definitions is in order.

Using TCE, I theorized that the knowledge management – knowledge attribute for the *outreach* system would be low, while the study indicates that knowledge levels are actually high. Knowledge management was predicted to be low as this is generally considered to be a non-operational, decision-support type attribute of the system. However, since, the *outreach* IT system's goal is to decrease information impactedness and uncertainty between the organization and its trading partners, it would stand to reason that there may be an operational or "how-to" knowledge base that is being employed by the organizations. The contraindicative findings may also be a result of the low number of respondents who said they used a knowledge management system, or the lack of knowing exactly what type of knowledge to which the respondents were referring. This is another indication that this study should be repeated.

Finally, the findings from the *outreach* system which projected leadership roles to be high and liaison and spokesman roles to be moderate and found moderate, high, and high involvement, respectively, may be simply a matter of degrees.

One interesting finding came from the cluster comparison. The traditional system is closest in nature to the executive system – sharing the aspect of internal (bureaucracy cost) efficiency and furthest from the visionary system with which it shares neither goal nor focus. Likewise, there was a great difference between the executive and operational systems, which share neither focus nor goal setting direction. Intuitively this makes sense. The differences between operational and non-operational efficiency is simply a matter of perspective, while changes in internal and external (bureaucracy or market) efficiency requires a greater concentration of resources and effort on the part of the organization.

Hitt (1999) has lamented the fact that there is a lack of comprehensive interdisciplinary models being researched such as those in which the strategy, information technology, and performance constructs are examined together. Lee (2001) has called for interdisciplinary research in IT by non-IT faculty. Finally, Orlikowski, Barley, and Robey (2001) have specifically called for interdisciplinary studies in management and IT saying "cross-fertilization, if not outright collaboration, between the two would seem to be beneficial—even necessary—for documenting and assessing the changes taking place around us." (p. 145). Thus, this research has filled a gap in the Strategy-IT literature and has shown that interdisciplinary research in the areas of information technology and strategy is useful, possible, and practical.

Limitations

All studies and research have their limitations and this research is no different. There are several limitations. The first is that of geographic location. All firms were located in the northwest portion of the United States. While this may have no effect on the findings, additional studies replicating this one in other areas of the U.S. should be undertaken to determine if this is the case.

One of the main limitations of the study was the large number of new measures created and the generally low response rate. It was not possible to determine discriminant validity and there was only weak support for many of the measures with respect to unidimensionality and convergent validity. Cost, time factors, and the exploratory nature of the survey precluded doing a second round of data collection. Thus, the first order of business would be to duplicate this study with another sample (perhaps in a different geographical region) in order to test and verify the measures used.

Another limitation is using the categorical items as continuous variables. While this was primarily done for the ease of the respondent, it does raise concerns that the findings might have been different had the respondents had a different scale choice.

The fact that a single respondent's answers were used is another limitation of the study. When possible and practical, several respondents should be asked to participate in order to verify the similarity of the responses (Nunnally, 1967). As Bowman and Ambrosini state "relying on a single respondent for anything other than factual, objective information may be misleading." (p. 119). However, many of the questions were highly technical in nature, factual and objective, or geared specifically to the CIOs' perceptions of the organizations; no other respondents were likely to be able to complete the survey. Additionally, due to the nature of the survey questions, the length, and number of surveys sent made multiple respondents impractical in this study. Thus, while single response bias may be a limitation of the study, it is mitigated, in part, by the nature of the survey itself.

Finally, the nature of this study requires a cross-sectional analysis, thus reducing the generalizability of findings. It is possible that a firm is in a transition stage from one system type to another. For example, a firm that is changing from an internally focused operational strategy (traditional) to an internally focused non-operational strategy (executive) will be experiencing changes in its IT system. Thus, the component features may be in flux during this period, with attributes of both system types. Additionally, as IT systems are not inexpensive, this transition period may last for some time. During the transition time, the system will not be as efficient as it would were it stable and aligned with the ideal format for the strategy pursued. Although there were two variables used to determine whether this may be the case, they did not make a significant difference in the generation of the clusters and were discarded. However, for the reason discussed above, this may be a consideration when using the typology for organizational research.

Future Research

The greatest contribution of this study is the ability to use the comprehensive typology to test IT system impacts on various business constructs, giving a more accurate picture of how IT systems interact and moderate a large assortment of relationships.

Of course, given the limitations of this study, the first step with respect to future research would be to conduct another survey in order to test the measures used and assess with more certainty their validity and unidimensionality.

As discussed in the Introduction, the purpose of this study was originally to examine performance issues with respect to strategy and structure. This proved to be impossible as no comprehensive and testable typology of IT systems existed. As the ability to classify IT systems makes more comprehensive models available for a wide range of research, the first follow-up study planned by this researcher is to use these findings in a moderated model of strategy – structure – performance. This model will look at the relationship between diversification and integration and performance as moderated by the type of IT system the organization is using. The data for this future study was collected as part of the current research study.

In the strategic management field, the relationship between strategy and performance is well studied (Baysinger & Hoskisson, 1989; D'Aveni & Ravenscraft, 1994; Jones & Hill, 1988; Markides & Williamson 1994; Porter, 1979; Rumelt, 1974). However, while transaction cost economics has been used to make the argument that diversification strategy has a direct impact on financial performance, a review of the strategic management literature has shown that the link between diversification strategies and financial performance is tenuous at best (Chang & Thomas, 1989; D'Aveni & Ravenscraft, 1994; Lubatkin & Rogers, 1989; Markides & Williamson, 1994).

It is possible, then, that a moderating structural variable is missing. The strategy-moderating structure-performance model is supported by transaction cost economics as Williamson (1975) proposes that the strategy a firm adopts (i.e., diversification, vertical integration) will not result in high performance unless the firm embraces structures that optimize the transaction costs associated with that strategy. Strategy literature has indicated that IT systems and the information and use of information are important structural variables (Davis, 1991; Dyer, 1997; Fiedler, Grover, & Teng, 1996). This study, by providing a comprehensive typology, allows more encompassing studies that are based on IT system types. Information technology, with its ability to increase information availability both internally and externally, (Clemons, Reddi, & Row, 1993) increase monitoring and coordination abilities (Gurbaxani & Whang, 1991) and increase communication within the firm or between firms (Davis, 1991), becomes an important factor with respect to reducing transaction costs given that Gurbaxani and Whang (1991) have suggested that all transaction costs result in one way or another from lack of information.

Future research ideas would also include turning this into a longitudinal study by following up with the current respondents every two years to track changes in the IT system and organization in which performance lag and direct performance relationships with IT may be examined. While studies of this type have been conducted in the past (e.g., Brynjolfsson, et al., 1994), the classifications of IT systems were not as complex or as comprehensive as the current typology allows. This proposed study would be an important contribution as the presence of lag may have implications as to why many managers do not realize a direct link between IT and performance (Brynjolfsson, et al., 1994; Schwartz, 1999).

Finally, given the comparisons of the relative positions of the clusters and how they are related to each other, a study that examines the relationship between focus (operational vs. non-operational) and orientation (internal vs. external) efficiency would prove interesting. As discussed earlier, it is possible that the changes in internal and external (bureaucracy or market) efficiency requires a greater concentration of resources and effort on the part of the organization than do changes in operational and non-operational efficiency, which may be a matter of perspective of the part of the managers. This may have implications for transitions between or selection of IT system types and warrants further investigation.

GLOSSARY

Application: software and programs other than operating systems. (Dennis et al., 1998)

Application functionality: "the ability to add, modify, and remove the modules of software applications with little or no widespread effect on the applications collectively." (Byrd & Turner, 2000)

Asset specificity: "unique equipment, processes, or knowledge developed by participants to complete exchanges." (Jones, Hesterly & Borgatti, 1997)

Bounded rationality: "*The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world.*" (Simon, 1957; emphasis in the original)

Bureaucracy costs: "the costs associated with internal organization." (Medema, 1996)

Compatibility: "the ability to share any type of information across any technology component." (Byrd & Turner, 2000)

Connectivity: "the ability of any technology component to attach to any of the other components inside and outside the organizational environment." (Byrd & Turner, 2000)

Coordination costs: "the cost incurred by the firm in coordinating with units actually or potentially producing the product." (Clemons et al., 1993)

Data mining: "A model is created out of current information, and then it is projected onto another situation where the information does not yet exist. It predicts using the reasoning tools of artificial intelligence: neural networks, decision trees, if-then rules, genetic algorithms, and the nearest neighbor method." (Castelluccio, 1996)

Data transparency: "the free retrieval and flow of data between authorized personnel in an organization or between organizations regardless of location." (Byrd & Turner, 2000)

Data warehouse: "a subject-oriented, integrated, nonvolatile, time-variant collection of data organized to support management needs." (Castelluccio, 1996)

Decision room: "a conference room equipped with a variety of hardware and software tools, including interconnected workstations positioned at a conference table, wide-screen computer video projector equipment for displaying and viewing group information, and possibly terminals for accessing remote data bases." (Alavi, 1991)

EDI: "co-operative interorganizational systems that allow trading partners to exchange structured business information electronically between separate computer applications." (Iacovou & Benbasat, 1995)

Extranet: "an intranet that is partially accessible to authorized outsiders." (Wĕbopēdia)

Flexibility: "the ability to easily and readily diffuse or support a wide variety of hardware, software, communications technologies, data, core applications, skills and competencies, commitments, and values within the technical physical base and the human component of the existing IT infrastructure." (Byrd & Turner, 2000)

Information impactedness (asymmetries): "circumstances in which one of the parties to an exchange is much better informed that is the other regarding underlying conditions germane to the trade, and the second party cannot achieve information parity except at great cost – because he cannot rely on the first party to disclose the inform in a fully candid manner." (Williamson, 1975)

Infrastructure: "a set of shared, tangible, IT resources that provide a foundation to enable present and future business applications." (Duncan, 1995)

Internet: "A global network connecting millions of computers." (Wĕbopēdia)

Interorganizational system: "describes a variety of business activities rather than a single entity." Includes electronic data interchange, electronic funds transfer, electronic forms, integrated messaging, and shared databases. (Senn, 2000)

Intranet: "closed networks based on Internet technology that are used for intracompany communications." (Chan & Davis, 2000)

Market costs: the costs associated with external coordination (Medema, 1996)

Operating system (platform): "the set of control programs that manage a computer's operations and determine which other programs can be run." (Keen, 1991)

Opportunistic behavior: "a lack of candor or honesty in transactions, to include self-interest seeking with guile." (Williamson, 1975)

Portability: "compatibility with other systems." (Weill, 1999)

Project rooms: "information sharing, retrieval, and display at a specific location" which may "be visited by different members of a work group to access information (e.g., retrieve data from a computerized data base) or to share information (e.g., post messages on a bulletin board)." (Alavi, 1991)

Proprietary software: "Privately owned and controlled. In the computer industry, proprietary is the opposite of open. A proprietary design or technique is one that is owned by a company. It also implies that the company has not divulged specifications that would allow other companies to duplicate the product." (Wĕbopēdia)

Small numbers exchange: "a single buyer versus a single seller." (Nishiguchi & Brookfield, 1997)

Transparency: see Data transparency.

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APPENDIX A: PROPOSED SURVEY

FOCUS AND DIRECTION

I. CHANGE IN FOCUS

Focus is defined as the efficiency, effectiveness, and use of the overall IT system either WITHIN the organization (e.g., between) departments or OUTSIDE of the organization (e.g., customers, suppliers). Please circle the number that indicates the extent to which your focus has changed in each time frame.

If you have not had a significant change in the focus of your system, please check HERE _____ and continue on to Section II (pg. 2).

Our direction has changed **toward** more efficiency and effectiveness:	Within the organization					Outside the organization
A. In the last **3** months	1	2	3	4	5	6	7
B. In the last **6** months	1	2	3	4	5	6	7
C. In the last **12** months	1	2	3	4	5	6	7
D. In the last **18** months	1	2	3	4	5	6	7
E. In the last **24** months	1	2	3	4	5	6	7

II. CHANGE IN DIRECTION

Direction is defined as the efficiency, effectiveness, and use of the overall IT system either for OPERATIONS (e.g., routine automation, task specialization, short-term) or NON-OPERATIONS (e.g., high-level decision-making, long-term). Please circle the number that indicates the extent to which your focus has changed in each time frame.

If you have not had a significant change in the direction of your system, please check HERE _____ and continue on to Section III (pg. 3).

Our direction has changed **toward** more efficiency and effectiveness:	Operations						Non-Operations
A. In the last **3** months	1	2	3	4	5	6	7
B. In the last **6** months	1	2	3	4	5	6	7
C. In the last **12** months	1	2	3	4	5	6	7
D. In the last **18** months	1	2	3	4	5	6	7
E. In the last **24** months	1	2	3	4	5	6	7

THE CIO & IT DEPARTMENT

III. MANAGERIAL ROLE

Please circle the answer that best reflects the importance of the following tasks as they are related to your job.

	Not Important					Very Important
A. Maintaining your personal network of contacts through visits or phone calls	1	2	3	4	5	6	7
B. Attending social functions which allow you to keep up your contacts	1	2	3	4	5	6	7
C. Evaluating the quality of subordinate job performance	1	2	3	4	5	6	7
D. Integrating subordinate's goals (e.g., career goals, work performances) with the company's work requirements	1	2	3	4	5	6	7
E. Keeping in touch with and helping subordinates with personal problems (maintaining their trust and confidence)	1	2	3	4	5	6	7
F. Assessing political events as they may affect your work	1	2	3	4	5	6	7
G. Planning and implementing change	1	2	3	4	5	6	7
H. Keeping up with market changes and trends that might have an impact on your department	1	2	3	4	5	6	7
I. Distributing budgeted resources	1	2	3	4	5	6	7
J. Making decisions about time parameters for upcoming projects	1	2	3	4	5	6	7
K. Preventing the loss or threat of loss of resources valued by your department	1	2	3	4	5	6	7
L. Resolving conflicts between subordinates	1	2	3	4	5	6	7

	Not Important					Very Important
M. Allocating monies within your unit	1	2	3	4	5	6	7
N. Keeping up with information on the progress of operations in the company	1	2	3	4	5	6	7
O. Attending conferences or meetings to maintain your contacts	1	2	3	4	5	6	7
P. Initiating controlled change in your unit	1	2	3	4	5	6	7
Q. Keeping up with technological developments related to your work or to the company	1	2	3	4	5	6	7
R. Deciding for which programs to provide resources (manpower, material, etc.)	1	2	3	4	5	6	7
S. Keeping tract of subordinates' training and special skills as they relate to job assignments so as to facilitate their personal growth and development	1	2	3	4	5	6	7
T. Allocating manpower to specific jobs or tasks	1	2	3	4	5	6	7
U. Presiding at meetings as a representative of your department	1	2	3	4	5	6	7
V. Providing new employees with adequate training for the introduction to the job at hand	1	2	3	4	5	6	7
W. Gathering information about trends outside your department	1	2	3	4	5	6	7
X. Attending social functions as a representative of your department	1	2	3	4	5	6	7
Y. Allocating equipment or materials	1	2	3	4	5	6	7

	Not Important					Very Important
Z. Gathering information about customers, competitors, associates, etc.	1	2	3	4	5	6	7
AA. Touring facilities for observational purposes	1	2	3	4	5	6	7
BB. Seeing to it that subordinates are alert to problems that need attention	1	2	3	4	5	6	7
CC. Serving as an expert to people outside of your immediate department	1	2	3	4	5	6	7
DD. Learning about new ideas originating outside of your department	1	2	3	4	5	6	7
EE. Reading reports on activities in your own or others' Information System departments	1	2	3	4	5	6	7
FF. Using your authority to ensure that your subordinates accomplish important tasks	1	2	3	4	5	6	7
GG. Maintaining supervision over changes in department	1	2	3	4	5	6	7
HH. Providing guidance to your subordinates on the basis of your understanding of the organization	1	2	3	4	5	6	7
II. Joining boards, organizations, clubs, etc., which might provide useful work-related contacts	1	2	3	4	5	6	7
JJ. Solving problems by instituting needed changes in your department	1	2	3	4	5	6	7
KK. Informing others of your department's future plans	1	2	3	4	5	6	7
LL. Giving negative feedback (criticizing subordinates' actions when appropriate)	1	2	3	4	5	6	7

	Not Important						Very Important
MM. Directing the work of your subordinates	1	2	3	4	5	6	7
NN. Staying attuned to the grapevine	1	2	3	4	5	6	7
OO. Developing new contacts by answering requests for information	1	2	3	4	5	6	7
PP. Developing personal relationships with people outside your unit who feed you work or services (e.g., purchasing, suppliers, consultants, inspectors, etc.)	1	2	3	4	5	6	7
QQ. Answering letters of inquiries on behalf of your department	1	2	3	4	5	6	7
RR. Forwarding important information to your subordinates	1	2	3	4	5	6	7
SS. Keeping other people informed about your department's activities and plans	1	2	3	4	5	6	7
TT. Developing contacts with important people outside your immediate department	1	2	3	4	5	6	7

IV. STRATEGIC ROLE

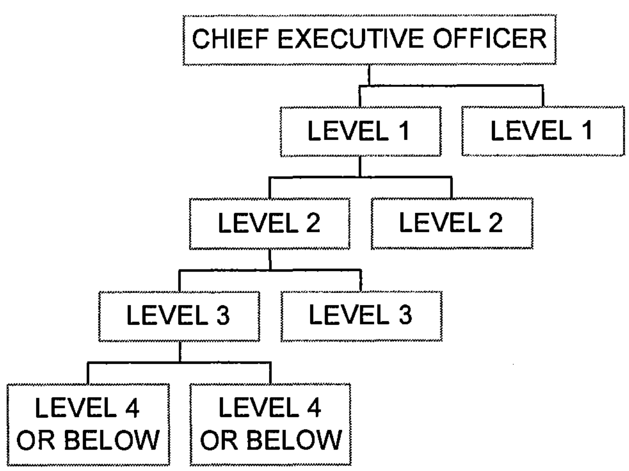
Please circle the number that indicates the extent to which you agree with the following statements.

	Strongly Disagree						Strongly Agree
A. I see myself as a corporate officer	1	2	3	4	5	6	7
B. In my organization I am seen by others as a corporate officer	1	2	3	4	5	6	7
C. I am a general business manager, not an IT specialist	1	2	3	4	5	6	7

	Strongly Disagree						Strongly Agree
D. I am a candidate for top-line management positions	1	2	3	4	5	6	7
E. I have a high-profile image in the organization	1	2	3	4	5	6	7
F. I have political as well as rational perspectives of my firm	1	2	3	4	5	6	7
G. I spend most of my time outside the IT department focusing on the strategic and organizational aspects of IT	1	2	3	4	5	6	7
H. I spend most of my time inside the IT department managing the function on a day-to-day basis	1	2	3	4	5	6	7
I. IT management is constantly involved in Organizational Strategic Planning	1	2	3	4	5	6	7
J. The Chief Information Officer is considered part of the Top Management Team	1	2	3	4	5	6	7
K. IT management contributes significantly to Organizational Strategic Planning	1	2	3	4	5	6	7

V. STRATEGIC LEVEL

Please circle the level that best describes your position on the official organization chart for your organization.



VI. SERVICES PROVIDED BY THE IT DEPARTMENT

Please rate the importance of the following tasks as they are related to the IT department.

	Not Important					Very Important
A. Manage corporate communication network services	1	2	3	4	5	6	7
B. Manage groupwide or firmwide messaging services	1	2	3	4	5	6	7
C. Recommend standards for at least one component of IT architecture (e.g., hardware, operating systems, data, communication)	1	2	3	4	5	6	7
D. Establish security, disaster planning, and business recovery services for firmwide installations and applications	1	2	3	4	5	6	7
E. Provide technology advice and support services	1	2	3	4	5	6	7
F. Manage, maintain, and support large-scale data processing facilities (e.g., mainframe operations)	1	2	3	4	5	6	7
G. Manage groupwide or firmwide applications and databases	1	2	3	4	5	6	7
H. Perform IS project management	1	2	3	4	5	6	7
I. Provide data management advice and consultancy services	1	2	3	4	5	6	7
J. Enforce IT architecture and standards	1	2	3	4	5	6	7
K. Manage business unit-specific networks (e.g., LANs)	1	2	3	4	5	6	7

	Not Important					Very Important
L. Identify and test new technologies for business purposes	1	2	3	4	5	6	7
M. Manage and negotiate with suppliers and outsourcers	1	2	3	4	5	6	7
N. Develop business unit-specific applications (usually on a chargeback or contractual basis)	1	2	3	4	5	6	7
O. Implement security, disaster planning, and recovery for business units	1	2	3	4	5	6	7
P. Provide management information electronically (e.g., ELS)	1	2	3	4	5	6	7
Q. Manage groupwide or firmwide data, including standards	1	2	3	4	5	6	7
R. Manage business unit-specific applications	1	2	3	4	5	6	7
S. Develop and manage on-line and/or EDI linkages to suppliers and customers	1	2	3	4	5	6	7
T. Develop a common systems development environment	1	2	3	4	5	6	7
U. Provide IS planning for business units	1	2	3	4	5	6	7
V. Provide technology education services (e.g., training)	1	2	3	4	5	6	7
W. Develop multimedia operations (e.g., videoconferencing)	1	2	3	4	5	6	7

HARDWARE, SOFTWARE & DATA

VII. CENTRALIZATION OF PROCESSING

Please circle the number that most closely matches conditions in your organization.

	Centralized					Distributed
A. Your organization's computer processing power is primarily	1	2	3	4	5	6	7

	No other computer					All other computers in the organization
B. Individual computers (including PCs) in your organization are networked and can communicate with	1	2	3	4	5	6	7
C. Individual computers (including PCs) in your organization can share common data and applications programs through a network with	1	2	3	4	5	6	7

VIII. SOFTWARE DEVELOPMENT AND STANDARDIZATION

Please circle the number that indicates the extent to which you agree with the following statements.

	Strongly Disagree						Strongly Agree
A. The software and applications we use are standardized in our industry	1	2	3	4	5	6	7
B. The software and applications we use are standardized throughout our organization	1	2	3	4	5	6	7
C. The software and applications we use are standardized with our suppliers/customers	1	2	3	4	5	6	7

DECISION SUPPORT

IX. EXPERT SYSTEMS

A knowledge domain is defined as a single area of knowledge. For example, a financial system, a medical system, an insurance underwriting system are each separate knowledge domains.

If you do not use an expert system, please check HERE _____ and continue on to Section X (pg. 14).

A. Which of the following best describes your expert system domain usage?

_____ a. We use only a single domain
_____ b. We use two domains in conjunction with each other
_____ c. We use three or more domains in conjunction with each other

B. Which of the following best describes the expert knowledge upon which your expert system is based?

_____ a. Common – To be an expert, the individual(s) did not need to have the knowledge gained through as advanced degree in the given domains(s) (i.e., Ph.D., M.D.), nor substantial applied work experience in the specific domain(s)
_____ b. Deep – To be an expert, the individual(s) required either an advanced degree and less than 10 years work experience in the specific domain(s), or more than 10 years' work experience but no advanced degree
_____ c. Deepest – To be an expert, the individual(s) required both an advanced degree and more than 10 years' work experience

C. Which of the following best describes the changes in expert knowledge in your expert system?

_____ a. Low – Someone who was an expert 5 years ago who added no new knowledge could still be an expert today
_____ b. Moderate – An expert of 2 years ago, and who added no new knowledge, could still be an expert today
_____ c. High – Remaining an expert requires updating of knowledge on a continuous (i.e., yearly) basis

D. Which of the following best describes the depth of knowledge embodied in your expert system?

_____ a. Little
_____ b. Partial
_____ c. Moderate
_____ d. Substantial
_____ e. Complete

E. Which of the following best describes the outputs from your expert system? Outputs are described as 1) Problem Diagnosis, 2) Recommended Actions, 3) Actual Solutions, 4) Hypothesis Testing

_____ a. Any one output
_____ b. Any two outputs
_____ c. Any three outputs
_____ d. All four outputs

F. Which of the following best describes the inputs of your expert system? Outputs are the "raw" information inputs. For example, employee data on past travel and planned future travel dates constitute two inputs.

_____ a. One or two inputs
_____ b. Three or four inputs
_____ c. Five or more inputs

G. Which of the following best describes the ambiguity of inputs of your expert system? Ambiguity refers to whether the information that is input is clear or needs to be interpreted by the user before it is entered into the system.

_____ a. Low – Little or no additional interpretation required
_____ b. Moderate – Some interpretation of the inputs is required
_____ c. High – A high degree of additional interpretation is required for the information inputs to be useful in decision making

H. Which of the following best describes the operating system and platform that is used in your expert system

_____ a. A single hardware and operating system environment
_____ b. Two hardware and operating system environments
_____ c. Three or more hardware and operating systems environments

I. Which of the following best describes the technologies available for use with your expert system?

_____ a. No other technologies
_____ b. One or two other technologies (e.g., voice, imaging, spreadsheets)
_____ c. More than two other technologies

J. Which of the following best describes the size of the underlying database of your expert system?

_____ a. Less than 1Mb
_____ b. 1 to 10 Mb
_____ c. More than 10 Mb

K. Which of the following best describes the networking capabilities of your expert system?
_____ a. Stand-alone systems
_____ b. Infrequent networking
_____ c. Regular networking

L. Which of the following best describes the scope of programming effort or size of your expert system (do not include underlying database)
_____ a. Less than 500 rules or less than 500Kb
_____ b. Between 500 and 1,500 rules or between 500Kb and 1.5Mb
_____ c. More than 1,500 rules or greater than 1.5 Mb

M. Which of the following best describes the number of data sources of your expert system?
_____ a. One or two
_____ b. Three or four
_____ c. Five or more

N. Which of the following best describes the number of users of your expert system?
_____ a. A single user
_____ b. Two or three users in a single department
_____ c. Three or more users in a single department
_____ d. Many users in several departments
_____ e. Company-wide usage

O. Which of the following best describes the effort made to integrate your expert system with existing information systems?
_____ a. Not a factor
_____ b. Some effort
_____ c. Moderate effort
_____ d. Major effort
_____ e. Largest most difficult effort

COMMUNICATION AND NETWORKING

X. RANGE AND REACH

A. Which of the following best describes what locations you can access through or can access your IT system?

______ a. A single location
______ b. Intracompany domestic locations
______ c. Intracompany locations abroad
______ d. Customers and suppliers with the same IT base as ours
______ e. Customers and suppliers regardless of IT base
______ f. Anyone, anywhere

Please circle the number that indicates the extent to which you agree with the following statements regarding the types of services that can be shared automatically and directly across platforms of your IT system (either intra- or interorganizationally).

	Strongly Disagree						Strongly Agree
B. Standard messages (e.g., telephone messages, e-mail, fax, Lotus Notes®)	1	2	3	4	5	6	7
C. Stored data (e.g., databases, word processing files, spreadsheet files)	1	2	3	4	5	6	7
D. Independent transactions (e.g., customer queries, payments, orders)	1	2	3	4	5	6	7
E. Cooperative transactions (e.g., integrated product ordering and accounts payables, just-in-time systems, cross-functionally integrated system)	1	2	3	4	5	6	7

XI. GROUP COMMUNICATIONS

Please circle the number that indicates the extent to which you agree with the following statements regarding the ability of your IT system to allow individual or group communications.

	Strongly Disagree						Strongly Agree
A. Communications may take place at the same time and in the same place (e.g., face-to-face meetings, decision rooms)	1	2	3	4	5	6	7
B. Communications may take place at the same time but in the different place (e.g., video conferencing)	1	2	3	4	5	6	7
C. Communications may take place at different times but in the same place (e.g., project rooms with ability to access data and post messages to bulletin boards)	1	2	3	4	5	6	7
D. Communications may take place at different times and in different places (e.g., e-mail, voice mail)	1	2	3	4	5	6	7

XII. NETWORKING

Please circle the number that indicates the extent to which you agree with the following statements.

	Strongly Disagree						Strongly Agree
A. Our organization makes extensive use of IT to communicate internally (i.e., interfirm)	1	2	3	4	5	6	7
B. Our organization makes extensive use of IT to communicate externally (e.g., customers, suppliers)	1	2	3	4	5	6	7
C. Our organization makes extensive use of IT to share data internally (i.e., interfirm)	1	2	3	4	5	6	7
D. Our organization makes extensive use of IT to share data externally (e.g., customers, suppliers)	1	2	3	4	5	6	7

GENERAL INFORMATION

A. Ownership _____ Public _____ Private _____ Government

B. Number of IT employees _________

C. Number of TOTAL employees _________

DEMOGRAPHICS

A. Number of years in current position _________

B. Number of years with current company _________

C. Education Level (please check one)
_______ High School _______ Associate's Degree
_______ Bachelor's Degree _______ Master's Degree
_______ Doctorate

D. Educational Background (please check one)
_______ English _______ Fine Arts
_______ Math/Science _______ History/Political Science
_______ Psychology/Sociology _______ Engineering
_______ Marketing _______ Economics
_______ Finance/Accounting _______ Management
_______ Computer Science _______ MIS
_______ Other (specify) ______________________________

E. Age _________

F. Sex _________ Male _________ Female

THANK YOU VERY MUCH FOR YOUR TIME AND EFFORT

You will receive a hard copy of the aggregated results of this study in approximately 3 months. If you prefer to receive the results via e-mail, please provide your address:

E-mail: ____

APPENDIX B: ON-LINE SURVEY COPY

Information Technology Systems Efficiency OREGON STATE UNIVERSITY

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A survey of top IT executives to determine the components that make up optimally efficient systems. Open minds. Open doors.

Information Technology Systems Efficiency

Survey of Top IT Executives

Jennifer Leonard

leonardj@bus.oregonstate.edu

with the support of

Oklahoma State University & Oregon State University

Estimated Time to Complete: 20 minutes

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Take This Survey

Information Technology Systems Efficiency OREGON STATE UNIVERSITY

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A survey of top IT executives to determine the components that make up optimally efficient systems. Open minds. Open doors.

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SIGN IN

Please enter your USER ID, which may be found either on the letter you were sent or on the back of the hard copy survey.

[ ]

FOCUS AND DIRECTION

I. CHANGE IN FOCUS

Focus is defined as the efficiency, effectiveness, and use of the overall IT system either WITHIN the organization (e.g., between) departments or OUTSIDE of the organization (e.g., customers, suppliers). Please select the number that indicates the extent to which your focus has changed in each time frame.

If you have not had a significant change in the focus of your system, please check the box and click here to continue on to the next section.

☐ No significant change in focus

Our direction has changed toward more efficiency and effectiveness:

	Within the Organization						Outside the Organization
	1	2	3	4	5	6	7
A. In the last 3 months	○	○	○	○	○	○	○
B. In the last 6 months	○	○	○	○	○	○	○
C. In the last 12 months	○	○	○	○	○	○	○
D. In the last 18 months	○	○	○	○	○	○	○
E. In the last 24 months	○	○	○	○	○	○	○

II. CHANGE IN DIRECTION

Direction is defined as the efficiency, effectiveness, and use of the overall IT system either for OPERATIONS (e.g., routine automation, task specialization, short-term) or NON-OPERATIONS (e.g., high-level decision-making, long-term). Please select the number that indicates the extent to which your focus has changed in each time frame.

If you have not had a significant change in the direction of your system, please check the box and click here to continue on to the next section.

☐ No significant change in direction

Our direction has changed toward more efficiency and effectiveness:

	Operations						Non-Operations
	1	2	3	4	5	6	7
A. In the last 3 months	○	○	○	○	○	○	○
B. In the last 6 months	○	○	○	○	○	○	○
C. In the last 12 months	○	○	○	○	○	○	○
D. In the last 18 months	○	○	○	○	○	○	○
E. In the last 24 months	○	○	○	○	○	○	○

THE CIO & IT DEPARTMENT

III. MANAGERIAL ROLE

Please rate the importance of the following tasks as they are related to your job.

Not Important — Very Important

	1	2	3	4	5	6	7
A. Maintaining your personal network of contacts through visits or phone calls	○	○	○	○	○	○	○
B. Attending social functions which allow you to keep up your contacts	○	○	○	○	○	○	○
C. Evaluating the quality of subordinate job performance	○	○	○	○	○	○	○
D. Integrating subordinate's goals (e.g., career goals, work performances) with the company's work requirements	○	○	○	○	○	○	○
E. Keeping in touch with and helping subordinates with personal problems (maintaining their trust and confidence)	○	○	○	○	○	○	○
F. Assessing political events as they may affect your work	○	○	○	○	○	○	○
G. Planning and implementing change	○	○	○	○	○	○	○
H. Keeping up with market changes and trends that might have an impact on your department	○	○	○	○	○	○	○
I. Distributing budgeted resources	○	○	○	○	○	○	○
J. Making decisions about time parameters for upcoming projects	○	○	○	○	○	○	○
K. Preventing the loss or threat of loss of resources valued by your department	○	○	○	○	○	○	○
L. Resolving conflicts between subordinates	○	○	○	○	○	○	○

Task importance continued

	Not Important 1	2	3	4	5	6	Very Important 7
M. Allocating monies within your unit	○	○	○	○	○	○	○
N. Keeping up with information on the progress of operations in the company	○	○	○	○	○	○	○
O. Attending conferences or meetings to maintain your contacts	○	○	○	○	○	○	○
P. Initiating controlled change in your unit	○	○	○	○	○	○	○
Q. Keeping up with technological developments related to your work or to the company	○	○	○	○	○	○	○
R. Deciding for which programs to provide resources (manpower, material, etc.)	○	○	○	○	○	○	○
S. Keeping tract of subordinates' training and special skills as they relate to job assignments so as to facilitate their personal growth and development	○	○	○	○	○	○	○
T. Allocating manpower to specific jobs or tasks	○	○	○	○	○	○	○
U. Presiding at meetings as a representative of your department	○	○	○	○	○	○	○
V. Providing new employees with adequate training for the introduction to the job at hand	○	○	○	○	○	○	○
W. Gathering information about trends outside your department	○	○	○	○	○	○	○
X. Attending social functions as a representative of your department	○	○	○	○	○	○	○
Y. Allocating equipment or materials	○	○	○	○	○	○	○

Task importance continued

	Not Important 1	2	3	4	5	6	Very Important 7
Z. Gathering information about customers, competitors, associates, etc.	○	○	○	○	○	○	○
AA. Touring facilities for observational purposes	○	○	○	○	○	○	○
BB. Seeing to it that subordinates are alert to problems that need attention	○	○	○	○	○	○	○
CC. Serving as an expert to people outside of your immediate department	○	○	○	○	○	○	○
DD. Learning about new ideas originating outside of your department	○	○	○	○	○	○	○
EE. Reading reports on activities in your own or others' Information System departments	○	○	○	○	○	○	○
FF. Using your authority to ensure that your subordinates accomplish important tasks	○	○	○	○	○	○	○
GG. Maintaining supervision over changes in department	○	○	○	○	○	○	○
HH. Providing guidance to your subordinates on the basis of your understanding of the organization	○	○	○	○	○	○	○
II. Joining boards, organizations, clubs, etc., which might provide useful work-related contacts	○	○	○	○	○	○	○
JJ. Solving problems by instituting needed changes in your department	○	○	○	○	○	○	○
KK. Informing others of your department's future plans	○	○	○	○	○	○	○
LL. Giving negative feedback (criticizing subordinates' actions when appropriate)	○	○	○	○	○	○	○

Task importance continued

	Not Important 1	2	3	4	5	6	Very Important 7
MM. Directing the work of your subordinates	○	○	○	○	○	○	○
NN. Staying attuned to the grapevine	○	○	○	○	○	○	○
OO. Developing new contacts by answering requests for information	○	○	○	○	○	○	○
PP. Developing personal relationships with people outside your unit who feed you work or services (e.g., purchasing, suppliers, consultants, inspectors, etc.)	○	○	○	○	○	○	○
QQ. Answering letters of inquiries on behalf of your department	○	○	○	○	○	○	○
RR. Forwarding important information to your subordinates	○	○	○	○	○	○	○
SS. Keeping other people informed about your department's activities and plans	○	○	○	○	○	○	○
TT. Developing contacts with important people outside your immediate department	○	○	○	○	○	○	○

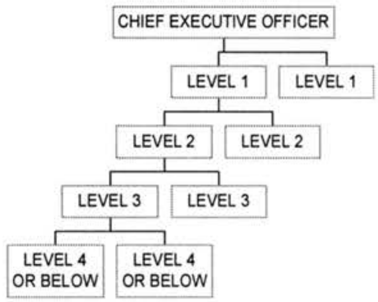
IV. STRATEGIC ROLE

Please select the number that indicates the extent to which you agree with the following statements.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
A. I see myself as a corporate officer	○	○	○	○	○	○	○
B. In my organization I am seen by others as a corporate officer	○	○	○	○	○	○	○
C. I am a general business manager, not an IT specialist	○	○	○	○	○	○	○
D. I am a candidate for top-line management positions	○	○	○	○	○	○	○
E. I have a high-profile image in the organization	○	○	○	○	○	○	○
F. I have political as well as rational perspectives of my firm	○	○	○	○	○	○	○
G. I spend most of my time outside the IT department focusing on the strategic and organizational aspects of IT	○	○	○	○	○	○	○
H. I spend most of my time inside the IT department managing the function on a day-to-day basis	○	○	○	○	○	○	○
I. IT management is constantly involved in Organizational Strategic Planning	○	○	○	○	○	○	○
J. The Chief Information Officer is considered part of the Top Management Team	○	○	○	○	○	○	○
K. IT management contributes significantly to Organizational Strategic Planning	○	○	○	○	○	○	○

V. STRATEGIC LEVEL

Please select the level that best describes your position on the official organization chart for your organization.



○ Level 1
○ Level 2
○ Level 3
○ Level 4 or below

VI. SERVICES PROVIDED BY THE IT DEPARMENT

Please rate the importance of the following tasks as they are related to the IT department.

	Not Important 1	2	3	4	5	6	Very Important 7
A. Manage corporate communication network services	○	○	○	○	○	○	○
B. Manage groupwide or firmwide messaging services	○	○	○	○	○	○	○
C. Recommend standards for at least one component of IT architecture (e.g., hardware, operating systems, data, communication)	○	○	○	○	○	○	○
D. Establish security, disaster planning, and business recovery services for firmwide installations and applications	○	○	○	○	○	○	○
E. Provide technology advice and support services	○	○	○	○	○	○	○
F. Manage, maintain, and support large-scale data processing facilities (e.g., mainframe operations)	○	○	○	○	○	○	○
G. Manage groupwide or firmwide applications and databases	○	○	○	○	○	○	○
H. Perform IS project management	○	○	○	○	○	○	○
I. Provide data management advice and consultancy services	○	○	○	○	○	○	○
J. Enforce IT architecture and standards	○	○	○	○	○	○	○
K. Manage business unit-specific networks (e.g., LANs)	○	○	○	○	○	○	○
L. Identify and test new technologies for business purposes	○	○	○	○	○	○	○
M. Manage and negotiate with suppliers and outsourcers	○	○	○	○	○	○	○

IT Services continued

	Not Important 1	2	3	4	5	6	Very Important 7
N. Develop business unit-specific applications (usually on a chargeback or contractual basis)	○	○	○	○	○	○	○
O. Implement security, disaster planning, and recovery for business units	○	○	○	○	○	○	○
P. Provide management information electronically (e.g., ELS)	○	○	○	○	○	○	○
Q. Manage groupwide or firmwide data, including standards	○	○	○	○	○	○	○
R. Manage business unit-specific applications	○	○	○	○	○	○	○
S. Develop and manage on-line and/or EDI linkages to suppliers and customers	○	○	○	○	○	○	○
T. Develop a common systems development environment	○	○	○	○	○	○	○
U. Provide IS planning for business units	○	○	○	○	○	○	○
V. Provide technology education services (e.g., training)	○	○	○	○	○	○	○
W. Develop multimedia operations (e.g., videoconferencing)	○	○	○	○	○	○	○

HARDWARE, SOFTWARE, & DATA

VII. CENTRALIZATION OF PROCESSING

Please select the number that most closely matches conditions in your organization.

	Centralized 1	2	3	4	5	6	Distributed 7
A. Your organization's computer processing power is primarily	○	○	○	○	○	○	○

	No other computer 1	2	3	4	5	6	All other computers in the organization 7
B. Individual computers (including PCs) in your organization are networked and can communicate with	○	○	○	○	○	○	○
C. Individual computers (including PCs) in your organization can share common data and applications programs through a network with	○	○	○	○	○	○	○

VIII. SOFTWARE DEVELOPMENT AND STANDARDIZATION

Please select the number that indicates the extent to which you agree with the following statements.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
A. The software and applications we use are standardized in our industry	○	○	○	○	○	○	○
B. The software and applications we use are standardized throughout our organization	○	○	○	○	○	○	○
C. The software and applications we use are standardized with our suppliers/customers	○	○	○	○	○	○	○

DECISION SUPPORT

IX. EXPERT SYSTEMS

A knowledge domain is defined as a single area of knowledge. For example, a financial system, a medical system, an insurance underwriting system are each separate knowledge domains.

If you do not use an expert system, please check the box and click here to continue on to the next section.

☐ No expert system

A. Which of the following best describes your expert system domain usage?

○ We use only a single domain

○ We use two domains in conjunction with each other

○ We use three or more domains in conjunction with each other

B. Which of the following best describes the expert knowledge upon which your expert system is based?

○ Common – To be an expert, the individual(s) did not need to have the knowledge gained through as advanced degree in the given domains(s) (i.e., Ph.D., M.D.), nor substantial applied work experience in the specific domain(s)

○ Deep – To be an expert, the individual(s) required either an advanced degree and less than 10 years work experience in the specific domain(s), or more than 10 years' work experience but no advanced degree

○ Deepest – To be an expert, the individual(s) required both an advanced degree and more than 10 years' work experience

C. Which of the following best describes the changes in expert knowledge in your expert system?

○ Low – Someone who was an expert 5 years ago who added no new knowledge could still be an expert today

○ Moderate – An expert of 2 years ago, and who added no new knowledge, could still be an expert today

○ High – Remaining an expert requires updating of knowledge on a continuous (i.e., yearly) basis

D. Which of the following best describes the depth of knowledge embodied in your expert system?

○ Little

○ Partial

○ Moderate

○ Substantial

○ Complete

E. Which of the following best describes the outputs from your expert system? Outputs are described as 1) Problem Diagnosis, 2) Recommended Actions, 3) Actual Solutions, 4) Hypothesis Testing

○ Any one output

○ Any two outputs

○ Any three outputs

○ All four outputs

F. Which of the following best describes the inputs of your expert system? Outputs are the "raw" information inputs. For example, employee data on past travel and planned future travel dates constitute two inputs.

○ One or two inputs

○ Three or four inputs

○ Five or more inputs

G. Which of the following best describes the ambiguity of inputs of your expert system? Ambiguity refers to whether the information that is input is clear or needs to be interpreted by the user before it is entered into the system.

○ Low – Little or no additional interpretation required

○ Moderate – Some interpretation of the inputs is required

○ High – A high degree of additional interpretation is required for the information inputs to be useful in decision making

H. Which of the following best describes the operating system and platform that is used in your expert system

○ A single hardware and operating system environment

○ Two hardware and operating system environments

○ Three or more hardware and operating systems environments

I. Which of the following best describes the technologies available for use with your expert system?

○ No other technologies

○ One or two other technologies (e.g., voice, imaging, spreadsheets)

○ More than two other technologies

J. Which of the following best describes the size of the underlying database of your expert system?

○ Less than 1Mb

○ 1 to 10 Mb

○ More than 10 Mb

K. Which of the following best describes the networking capabilities of your expert system?

- Stand-alone systems
- Infrequent networking
- Regular networking

L. Which of the following best describes the scope of programming effort or size of your expert system (do not include underlying database)

- Less than 500 rules or less than 500Kb
- Between 500 and 1,500 rules or between 500Kb and 1.5Mb
- More than 1,500 rules or greater than 1.5 Mb

M. Which of the following best describes the number of data sources of your expert system?

- One or two
- Three or four
- Five or more

N. Which of the following best describes the number of users of your expert system?

- A single user
- Two or three users in a single department
- Three or more users in a single department
- Many users in several departments
- Company-wide usage

O. Which of the following best describes the effort made to integrate your expert system with existing information systems?

- Not a factor
- Some effort
- Moderate effort
- Major effort
- Largest most difficult effort

COMMUNICATION AND NETWORKING

X. RANGE AND REACH

A. Which of the following best describes what locations you can access through or can access your IT system?

- A single location
- Intracompany domestic locations
- Intracompany locations abroad
- Customers and suppliers with the same with the same IT base as ours
- Customers and suppliers regardless of IT base
- Anyone, anywhere

Please select the number that indicates the extent to which you agree with the following statements regarding the types of services that can be shared automatically and directly across platforms of your IT system (either intra- or interorganizationally).

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
B. Standard messages (e.g., telephone messages, e-mail, fax, Lotus Notes®)	○	○	○	○	○	○	○
C. Stored data (e.g., databases, word processing files, spreadsheet files)	○	○	○	○	○	○	○
D. Independent transactions (e.g., customer queries, payments, orders)	○	○	○	○	○	○	○
E. Cooperative transactions (e.g., integrated product ordering and accounts payables, just-in-time systems, cross-functionally integrated system)	○	○	○	○	○	○	○

XI. GROUP COMMUNICATIONS

Please select the number that indicates the extent to which you agree with the following statements regarding the ability of your IT system to allow individual or group communications.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
A. Communications may take place at the same time and in the same place (e.g., face-to-face meetings, decision rooms)	○	○	○	○	○	○	○
B. Communications may take place at the same time but in the different place (e.g., video conferencing)	○	○	○	○	○	○	○
C. Communications may take place at different times but in the same place (e.g., project rooms with ability to access data and post messages to bulletin boards)	○	○	○	○	○	○	○
D. Communications may take place at different times and in different places (e.g., e-mail, voice mail)	○	○	○	○	○	○	○

XII. NETWORKING

Please select the number that indicates the extent to which you agree with the following statements.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
A. Our organization makes extensive use of IT to communicate internally (i.e., interfirm)	○	○	○	○	○	○	○
B. Our organization makes extensive use of IT to communicate externally (e.g., customers, suppliers)	○	○	○	○	○	○	○

C. Our organization makes extensive use of IT to share data internally (i.e., interfirm)	○	○	○	○	○	○	○
D. Our organization makes extensive use of IT to share data externally (e.g., customers, suppliers)	○	○	○	○	○	○	○

GENERAL INFORMATION

A. Ownership
○ Public
○ Private
○ Government

B. Number of IT employees

[ ]

C. Number of TOTAL employees

[ ]

DEMOGRAPHICS

A. Number of years in current position

[ ]

B. Number of years with current company

[ ]

C. Education Level
○ High School
○ Associate's Degree
○ Bachelor's Degree
○ Master's Degree
○ Doctorate

D. Educational Background
English

If you selected "other" above, please specify

[ ]

E. Age

[ ]

F. Sex
○ Male
○ Female

CONTACT INFORMATION

If you would like to have the aggregate results of this survey sent to you, please provide your address or e-mail.

Name

E-mail

Address

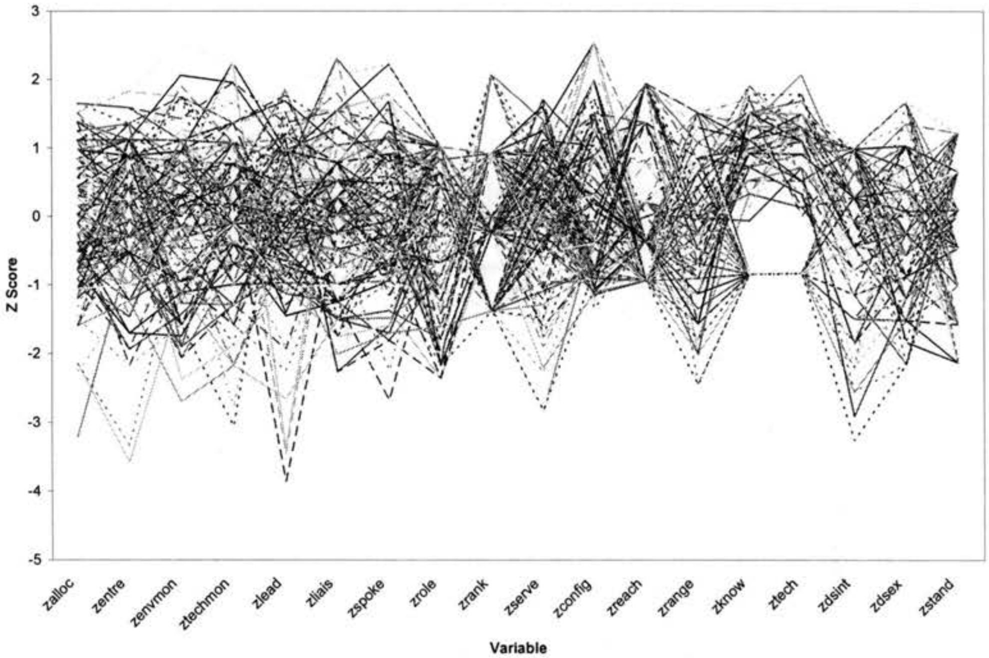
City

State

Zip Code

Submit

APPENDIX C: TABLES OF STATISTICAL RESULTS



Appendix C, Figure 1: Profile Diagram

Variable	Tolerance	VIF
zalloc	0.522	1.917
zentre	0.354	2.825
zenvmon	0.402	2.486
ztechmon	0.404	2.473
zlead	0.494	2.023
zliais	0.368	2.719
zspoke	0.268	3.727
zrole	0.585	1.710
zrank	0.586	1.705
zserve	0.640	1.563
zconfig	0.821	1.218
zreach	0.665	1.503
zrange	0.686	1.459
zknow	0.134	7.482
ztech	0.137	7.282
zdsint	0.496	2.016
zdsex	0.581	1.720
zstand	0.801	1.248

Appendix C, Table 1: Multicollinearity Statistics

VARIABLE	ITEMS	*n*	α	X^2	*df*	*p*	P_n	$P_{vc(n)}$	RMSEA	CFI
Internal communication	2	148	.67	CFA-Not Available: Negative Degrees of Freedom EFA-total variance explained: 72.45%, Eigenvalue: 1.51						
External communication	2	148	.69	CFA-Not Available: Negative Degrees of Freedom EFA-total variance explained: 76.23%, Eigenvalue: 1.53						
Knowledge management (knowledge)	4	58	.65	.04	2	.98	.67	.35	.00	1.00
Knowledge management (technical)	3	49	.68	.00	0	1.00	.68	.43	.00	1.00

Appendix C, Table 2: CFA Fit tests – Motivation Component

	FACTOR LOADING
XII_A	0.87
XII_C	0.87

Appendix C, Table 3: EFA Factor Loadings – Internal Communication

	FACTOR LOADING
XII_B	0.87
XII_D	0.87

Appendix C, Table 4: EFA Factor Loadings – External Communication

ITEM	FACTOR LOADING	t-VALUE	SQUARED MULTIPLE CORRELATION
IX_C	0.68	4.40	0.46
IX_D	0.64	4.17	0.41
IX_E	0.57	3.76	0.33
IX_G	0.44	2.87	0.19

Appendix C, Table 5: CFA Factor Loadings – Knowledge Management, Knowledge

ITEM	FACTOR LOADING	t-VALUE	SQUARED MULTIPLE CORRELATION
IX_J	0.52	3.28	0.27
IX_N	0.84	4.68	0.71
IX_O	0.66	3.97	0.44

Appendix C, Table 6: CFA Factor Loadings – Knowledge Management, Technical

	XII_A	XII_C
XII_A	1.0000	
XII_C	0.5090	1.0000

Appendix C, Table 7: Correlation Matrix – Internal Communication

	XII_B	XII_D
XII_B	1.0000	
XII_D	0.5247	1.0000

Appendix C, Table 8: Correlation Matrix – External Communication

	IX_C	IX_D	IX_E	IX_G
IX_C	1.0000			
IX_D	0.4276	1.0000		
IX_E	0.3877	0.3688	1.0000	
IX_G	0.3056	0.2830	0.2366	1.0000

Appendix C, Table 9: Correlation Matrix – Knowledge Management, Knowledge

	IX_J	IX_N	IX_O
IX_J	1.0000		
IX_N	0.4375	1.0000	
IX_O	0.3451	0.5565	1.0000

Appendix C, Table 10: Correlation Matrix – Knowledge Management, Technical

	FACTORS		
	1	2	3
IX_C			0.68
IX_D			0.63
IX_E			0.49
IX_G			0.48
IX_J		0.46	
IX_N		0.84	
IX_O		0.64	
XII_A	0.58		
XII_B	0.72		
XII_C	0.61		
XII_D	0.64		

Appendix C, Table 11: EFA Factor Loadings – Motivation Component

VARIABLE	ITEMS	n	α	X^2	df	p	P_n	$P_{vc(n)}$	RMSEA	CFI
Configuration	2	150	.95	CFA-Not Available: Negative Degrees of Freedom EFA-total variance explained: 95.25%, Eigenvalue: 1.91						
Reach	1	147	Single Item Measure							
Range	3	146	.76	.00	0	1.00	.80	.59	.00	1.00

Appendix C, Table 12: CFA Fit tests –Hardware Component

	FACTOR LOADING
CONF1	0.95
CONF2	0.95

Appendix C, Table 13: EFA Factor Loadings – Configuration

ITEM	FACTOR LOADING	t-VALUE	SQUARED MULTIPLE CORRELATION
X_C	0.51	6.04	0.26
X_D	1.00	11.10	1.01
X_E	0.71	8.18	0.50

Appendix C, Table 14: CFA Factor Loadings – Range

	CONF1	CONF2
CONF1	1.0000	
CONF2	0.9057	1.0000

Appendix C, Table 15: Correlation Matrix – Configuration

	X_C	X_D	X_E
X_C	1.0000		
X_D	0.5152	1.0000	
X_E	0.3647	0.7115	1.0000

Appendix C, Table 16: Correlation Matrix – Range

	FACTORS		
	1	2	3
IX_C			0.68
IX_D			0.63
IX_E			0.49
IX_G			0.48
IX_J		0.46	
IX_N		0.84	
IX_O		0.64	
XII_A	0.58		
XII_B	0.72		
XII_C	0.61		
XII_D	0.64		

Appendix C, Table 17: EFA Factor Loadings – Hardware Component

VARIABLE	ITEMS	*n*	α	X^2	*df*	*p*	P_n	$P_{vc(n)}$	RMSEA	CFI
Allocator	7	149	.85	42.30	14	.00	.85	.44	.12	.95
Entrepreneur	5	150	.76	.54	5	.99	.77	.40	.00	1.00
Environmental Monitor	6	149	.72	38.70	9	.00	.71	.31	.15	.86
Technology Monitor	3	150	.57	.00	0	1.00	.59	.33	.00	1.00
Leadership	12	148	.90	172.80	54	.00	.90	.44	.12	.95
Liaison	3	149	.69	.00	0	1.00	.73	.49	.00	1.00
Spokesman	10	148	.83	124.30	35	.00	.84	.34	.13	.90
CIO Involvement	3	143	.87	.00	0	1.00	.86	.68	.00	1.00
Rank	1	Single Item Measure								
Services	23	Non-factored item								

Appendix C, Table 18: CFA Fit tests – People Component

ITEM	FACTOR LOADING	t-VALUE	SQUARED MULTIPLE CORRELATION
III_I	0.73	9.64	0.53
III_J	0.73	9.58	0.53
III_K	0.62	7.80	0.39
III_M	0.67	8.60	0.45
III_R	0.65	8.31	0.43
III_T	0.63	7.92	0.40
III_Y	0.62	7.77	0.38

Appendix C, Table 19: CFA Factor Loadings – Allocator

ITEM	FACTOR LOADING	t-VALUE	SQUARED MULTIPLE CORRELATION
III_G	0.64	7.58	0.41
III_BB	0.64	7.66	0.41
III_DD	0.53	6.15	0.28
III_JJ	0.62	7.40	0.39
III_P	0.71	8.61	0.50

Appendix C, Table 20 CFA Factor Loadings – Entrepreneur

ITEM	FACTOR LOADING	t-VALUE	SQUARED MULTIPLE CORRELATION
III_A	0.64	7.59	0.41
III_B	0.80	9.79	0.65
III_F	0.33	3.64	0.11
III_H	0.24	2.64	0.06
IIII_W	0.52	6.02	0.27
III_II	0.62	7.37	0.39

Appendix C, Table 21: CFA Factor Loadings – Environmental Monitor

ITEM	FACTOR LOADING	t-VALUE	SQUARED MULTIPLE CORRELATION
III_O	0.59	4.98	0.35
III_Q	0.65	5.22	0.43
III_EE	0.46	4.36	0.21

Appendix C, Table 22: CFA Factor Loadings – Technology Monitor

ITEM	FACTOR LOADING	t-VALUE	SQUARED MULTIPLE CORRELATION
III_C	0.63	8.25	0.40
III_D	0.63	8.29	0.40
III_E	0.56	7.16	0.32
III_L	0.61	7.92	0.37
III_S	0.59	7.59	0.35
III_V	0.36	4.37	0.13
III_FF	0.81	11.53	0.65
III_GG	0.80	11.37	0.64
III_HH	0.82	11.96	0.68
III_LL	0.62	8.15	0.39
III_MM	0.73	10.00	0.58
III_RR	0.66	8.68	0.43

Appendix C, Table 23: CFA Factor Loadings – Leadership

ITEM	FACTOR LOADING	t-VALUE	SQUARED MULTIPLE CORRELATION
III_Z	0.40	4.48	0.16
III_OO	0.90	7.87	0.81
III_QQ	0.71	6.86	0.50

Appendix C, Table 24: CFA Factor Loadings – Liaison

ITEM	FACTOR LOADING	t-VALUE	SQUARED MULTIPLE CORRELATION
III_N	0.63	7.90	0.40
III_U	0.49	5.88	0.24
III_X	0.46	5.43	0.21
III_AA	0.56	6.88	0.32
III_CC	0.48	5.67	0.23
III_KK	0.64	8.14	0.42
III_NN	0.57	6.96	0.32
III_PP	0.60	7.37	0.35
III_SS	0.67	8.57	0.45
III_TT	0.71	9.27	0.51

Appendix C, Table 25: CFA Factor Loadings – Spokesman

ITEM	FACTOR LOADING	t-VALUE	SQUARED MULTIPLE CORRELATION
IV_A	0.89	12.10	0.79
IV_B	1.02	14.66	1.04
IV_D	0.47	5.78	0.22

Appendix C, Table 26: CFA Factor Loadings – CIO Involvement

	III_I	III_J	III_K	III_M	III_R	III_T	III_Y
III_I	1.0000						
III_J	0.5594	1.0000					
III_K	0.3778	0.5719	1.0000				
III_M	0.6218	0.4081	0.3724	1.0000			
III_R	0.4678	0.4303	0.3952	0.4511	1.0000		
III_T	0.4000	0.5054	0.3927	0.3366	0.4317	1.0000	
III_Y	0.3966	0.3814	0.3786	0.4467	0.4585	0.4830	1.0000

Appendix C, Table 27: Correlation Matrix – Allocator

	III_G	III_P	III_BB	III_DD	III_JJ
III_G	1.0000				
III_P	0.4044	1.0000			
III_BB	0.3334	0.3656	1.0000		
III_DD	0.3860	0.4038	0.3326	1.0000	
III_JJ	0.4663	0.4452	0.3638	0.4489	1.0000

Appendix C, Table 28: Correlation Matrix – Entrepreneur

	III_A	III_B	III_F	III_H	IIII_W	III_II
III_A	1.0000					
III_B	0.5467	1.0000				
III_F	0.1419	0.1933	1.0000			
III_H	0.0750	0.1583	0.2086	1.0000		
IIII_W	0.3524	0.3789	0.2926	0.4104	1.0000	
III_II	0.3537	0.5275	0.3158	0.0649	0.2786	1.0000

Appendix C, Table 29: Correlation Matrix – Environmental Monitor

	III_O	III_Q	III_EE
III_O	1.0000		
III_Q	0.3848	1.0000	
III_EE	0.2716	0.3009	1.0000

Appendix C, Table 30: Correlation Matrix – Technology Monitor

	IV_A	IV_B	IV_D
IV_A	1.0000		
IV_B	0.9061	1.0000	
IV_D	0.5818	0.5699	1.0000

Appendix C, Table 31: Correlation Matrix – CIO Involvement

	III_Z	III_OO	III_QQ
III_Z	1.0000		
III_OO	0.3611	1.0000	
III_QQ	0.2842	0.6382	1.0000

Appendix C, Table 32: Correlation Matrix – Liaison

	III_C	III_D	III_E	III_L	III_S	III_V	III_FF	III_GG	III_HH	III_LL	III_MM	III_RR
III_C	1.0000											
III_D	0.6584	1.0000										
III_E	0.3769	0.4899	1.0000									
III_L	0.4053	0.3941	0.4800	1.0000								
III_S	0.3805	0.4182	0.4245	0.4894	1.0000							
III_V	0.1557	0.1553	0.2868	0.3263	0.3681	1.0000						
III_FF	0.4485	0.4500	0.3784	0.4385	0.4317	0.2317	1.0000					
III_GG	0.4493	0.3708	0.3650	0.3952	0.4271	0.2792	0.7587	1.0000				
III_HH	0.5337	0.5723	0.5128	0.4770	0.4546	0.2820	0.6666	0.6638	1.0000			
III_LL	0.3459	0.3561	0.2689	0.4284	0.3758	0.1884	0.5615	0.5104	0.5050	1.0000		
III_MM	0.4147	0.3711	0.3444	0.4135	0.3730	0.3092	0.6385	0.6971	0.5491	0.4585	1.0000	
III_RR	0.4589	0.4916	0.3663	0.4803	0.4224	0.2532	0.4452	0.4591	0.5659	0.3975	0.5042	1.0000

Appendix C, Table 33: Correlation Matrix – Leadership

	III_N	III_U	III_X	III_AA	III_CC	III_KK	III_NN	III_PP	III_SS	III_TT
III_N	1.0000									
III_U	0.4456	1.0000								
III_X	0.2255	0.2639	1.0000							
III_AA	0.3882	0.2527	0.4304	1.0000						
III_CC	0.4229	0.2429	0.1585	0.2368	1.0000					
III_KK	0.4731	0.3405	0.2580	0.2137	0.2784	1.0000				
III_NN	0.3940	0.3499	0.1999	0.3552	0.3792	0.3059	1.0000			
III_PP	0.2888	0.1892	0.3666	0.4545	0.2166	0.2590	0.3442	1.0000		
III_SS	0.4358	0.3667	0.2263	0.2473	0.2863	0.6261	0.3364	0.3312	1.0000	
III_TT	0.3120	0.2232	0.3537	0.4580	0.3188	0.4643	0.3842	0.6043	0.4950	1.0000

Appendix C, Table 34: Correlation Matrix – Spokesman

Number of Clusters	Agglomeration Coefficient	Percentage Change in Coefficient to Next Level
10	3.500	37.2%
9	4.803	34.3%
8	6.450	27.2%
7	8.206	21.9%
6	10.003	29.5%
5	12.953	48.7%
4	19.261	107.7%
3	40.010	56.0%
2	62.433	138.7%
1	149.000	

Appendix C, Table 35: Analysis of Agglomeration Coefficient for Ward Method

	Group 1 (n=22)		Group 2 (n=73)		Group 3 (n=43)		Group 4 (n=12)	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Allocator	0.606	0.772	(0.207)	1.022	0.189	0.927	(0.528)	0.906
Entrepreneur	0.497	0.634	(0.154)	1.010	0.133	0.925	(0.449)	1.374
Environmental Monitor	0.298	0.778	(0.075)	1.056	0.206	0.878	(0.828)	1.010
Technology Monitor	0.236	0.836	(0.059)	1.012	0.258	0.867	(0.996)	1.073
Leadership	0.302	0.649	(0.149)	1.052	0.138	1.035	(0.144)	0.989
Liaison	0.149	0.770	(0.072)	1.040	0.158	0.909	(0.401)	1.353
Spokesman	0.263	0.768	(0.007)	1.114	0.033	0.866	(0.558)	0.975
CIO Involvement	0.162	1.058	(0.140)	0.975	0.146	0.959	0.030	1.148
Rank	0.063	0.993	0.079	0.928	(0.059)	0.956	(0.383)	0.971
IT Services	0.561	0.663	(0.345)	0.903	0.523	0.736	(1.696)	1.125
Configuration	1.634	0.626	(0.448)	0.635	0.110	0.842	(0.664)	0.499
Reach	0.332	1.109	0.071	1.051	(0.136)	0.870	(0.555)	0.374
Range	0.484	0.891	(0.175)	0.988	0.236	0.918	(0.669)	0.977
KM - Knowledge	0.278	1.079	(0.179)	0.916	0.298	1.063	(0.485)	0.736
KM - Technical	0.238	1.068	(0.128)	0.961	0.224	1.018	(0.458)	0.733
DS - Internal	0.614	0.646	(0.159)	0.989	0.190	0.744	(0.918)	1.536
DS - External	0.503	0.826	(0.153)	1.034	0.191	0.880	(0.736)	0.914
Standardization	0.705	0.663	(0.292)	1.024	0.291	0.786	(0.611)	1.116

Appendix C, Table 36: Results of Ward Method Hierarchical Cluster with Random Seed Points

Test	Value	F	Hypothesis *df*	Error *df*	Sig.	Effect Size	Power
Pillai's Trace	1.161	4.243	54	363	0.000	0.387	1.000
Wilks' Lambda	0.100	7.684	54	355	0.000	0.536	1.000
Hotelling's Trace	6.587	14.354	54	353	0.000	0.687	1.000
Roy's Largest Root	6.229	41.871	18	121	0.000	0.862	1.000

Appendix C, Table 37: MANOVA Results of Wards Method

Iteration	Change in Cluster Centers			
	1	2	3	4
1	0.0346	0.0081	0.0029	0.4842
2	0.0000	0.0485	0.0000	0.1053
3	0.0000	0.0897	0.0252	0.1457
4	0.0517	0.0734	0.0254	0.1237

Appendix C, Table 38: Iteration History of Change in Cluster Centers

Variable	Group 1 (n=18)		Group 2 (n=52)		Group 3 (n=48)		Group 4 (n=31)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Allocator	0.637	0.763	(0.156)	0.956	0.203	1.029	(0.414)	0.946
Entrepreneur	0.594	0.632	(0.162)	0.994	0.172	0.860	(0.338)	1.216
Environmental Monitor	0.316	0.719	(0.059)	1.043	0.209	0.925	(0.393)	1.087
Technology Monitor	0.428	0.933	(0.084)	0.934	0.281	0.851	(0.492)	1.129
Leadership	0.107	1.074	(0.160)	1.091	0.256	0.865	(0.202)	0.956
Liaison	0.290	0.720	(0.217)	0.963	0.239	0.985	(0.158)	1.148
Spokesman	0.367	0.758	(0.011)	1.005	0.011	0.967	(0.184)	1.149
CIO Involvement	0.243	0.945	(0.193)	1.002	0.204	0.916	(0.147)	1.101
Rank	0.115	0.857	0.119	0.943	(0.086)	0.983	(0.133)	0.981
IT Services	0.636	0.725	(0.208)	0.972	0.381	0.671	(0.715)	1.150
Configuration	1.301	1.095	(0.202)	0.795	0.139	0.950	(0.589)	0.515
Reach	0.327	1.056	0.207	1.104	(0.040)	0.955	(0.463)	0.607
Range	0.524	0.766	(0.120)	0.963	0.310	0.924	(0.524)	0.977
KM - Knowledge	0.788	0.940	(0.349)	0.817	0.445	1.024	(0.534)	0.685
KM - Technical	0.766	0.987	(0.287)	0.894	0.409	0.990	(0.570)	0.576
DS - Internal	0.690	0.416	(0.040)	0.915	0.302	0.718	(0.800)	1.214
DS - External	0.599	0.751	0.104	0.829	0.245	0.937	(0.901)	0.932
Standardization	0.870	0.608	(0.278)	0.921	0.445	0.695	(0.729)	1.035

Appendix C, Table 39: Results of K-Means Cluster with Predetermined Seed Points

Test	Value	F	Hypothesis *df*	Error *df*	Sig.	Effect Size	Power
Pillai's Trace	1.195	4.449	54	363	0.000	0.398	1.000
Wilks' Lambda	0.081	8.713	54	355	0.000	0.567	1.000
Hotelling's Trace	8.189	17.844	54	353	0.000	0.732	1.000
Roy's Largest Root	7.823	52.590	18	121	0.000	0.887	1.000

Appendix C, Table 40: MANOVA Results of K-Means

Number of Clusters	Agglomeration Coefficient	Percentage Change in Coefficient to Next Level
10	58.694	0.9%
9	59.203	4.5%
8	61.845	5.9%
7	65.512	18.9%
6	77.879	1.0%
5	78.649	10.8%
4	87.118	11.2%
3	96.835	12.9%
2	109.302	34.5%
1	146.963	

Appendix C, Table 41: Analysis of Agglomeration Coefficient for Furthest Neighbor Method

	Group 1 (n=37)		Group 2 (n=93)		Group 3 (n=3)		Group 4 (n=7)	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Allocator	0.836	0.615	(0.254)	0.859	(2.542)	0.703	(0.088)	0.751
Entrepreneur	0.767	0.574	(0.252)	0.802	(3.423)	0.136	0.479	0.444
Environmental Monitor	0.789	0.802	(0.244)	0.898	(0.688)	0.399	(0.427)	0.565
Technology Monitor	0.525	0.846	(0.033)	0.804	(2.174)	0.589	(1.332)	1.289
Leadership	0.630	0.650	(0.267)	0.941	(2.309)	0.325	0.811	0.723
Liaison	0.660	0.694	(0.245)	0.898	(1.331)	0.775	(0.123)	1.152
Spokesman	0.812	0.765	(0.253)	0.824	(2.245)	0.870	(0.084)	0.926
CIO Involvement	0.370	0.924	(0.129)	1.010	(0.921)	1.405	0.317	0.646
Rank	(0.615)	0.834	0.249	0.873	(0.612)	0.663	(0.033)	1.226
IT Services	(0.107)	1.238	0.117	0.785	(1.002)	0.558	(0.564)	1.763
Configuration	0.511	1.266	(0.199)	0.804	(0.207)	1.073	0.015	0.767
Reach	(0.152)	0.880	0.139	1.037	(0.747)	0.332	(0.446)	1.071
Range	0.205	0.892	0.074	0.961	(0.247)	0.381	(1.442)	0.879
KM - Knowledge	0.206	1.077	(0.083)	0.961	0.134	0.852	(0.563)	0.739
KM - Technical	0.127	1.007	(0.042)	0.998	0.325	1.075	(0.668)	0.437
DS - Internal	0.036	0.962	0.204	0.815	(1.497)	0.936	(1.800)	0.749
DS - External	0.037	1.088	0.141	0.864	(1.093)	0.971	(0.926)	1.224
Standardization	0.383	0.996	(0.070)	0.939	(0.645)	1.159	(0.698)	1.358

Appendix C, Table 42: Results of Further Neighbor Cluster with Random Seed Points

Test	Value	F	Hypothesis *df*	Error *df*	Sig.	Effect Size	Power
Pillai's Trace	1.384	5.760	54	363	0.00	0.46	1.00
Wilks' Lambda	0.140	6.151	54	355	0.00	0.48	1.00
Hotelling's Trace	3.013	6.565	54	353	0.00	0.50	1.00
Roy's Largest Root	1.807	12.150	18	121	0.00	0.64	1.00

Appendix C, Table 43: MANOVA Results of Further Neighbor Hierarchical Cluster Analysis

APPENDIX D: IRB APPROVAL

Oklahoma State University
Institutional Review Board

Protocol Expires: 8/29/2003

Date: Friday, August 30, 2002

IRB Application No BU031

Proposal Title: A INTEGRATED OF INFORMATION TECHNOLOGY: A TRANSACTION COST APPROACH

Principal Investigator(s):

Jennifer Leonard
Oregon State Univ, 200 Bexell
Corvallis, OR 97330

Robert Dooley
206 Business
Stillwater, OK 74078

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Dear PI :

Your IRB application referenced above has been approved for one calendar year. Please make note of the expiration date indicated above. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved projects are subject to monitoring by the IRB. If you have questions about the IRB procedures or need any assistance from the Board, please contact Sharon Bacher, the Executive Secretary to the IRB, in 415 Whitehurst (phone: 405-744-5700, sbacher@okstate.edu).

Sincerely,

Carol Olson, Chair
Institutional Review Board

VITA

Jennifer Crawford Leonard (2)

Candidate for the Degree of

Doctor of Philosophy

Dissertation: AN INTEGRATED TYPOLOGY OF INFORMATION TECHNOLOGY: A TRANSACTION COST APPROACH

Major Field: Business Administration

Biographical:

Personal Data: Born in Gettysburg, Pennsylvania, on July 15, 1959. Married to Ben J. Leonard on July 7, 2000.

Education: Graduated from Manzano High School, Albuquerque, New Mexico, June, 1977; received Associates of Arts and Bachelor of Arts in Business Administration from Louisiana Tech University, Ruston, Louisiana, May 1982 and May, 1983, respectively. Received Masters of Business Administration from Northeastern State University, Tahlequah, Oklahoma, in May 1995. Completed the requirements for the Doctor of Philosophy degree with a major in Business Administration at Oklahoma State University in December, 2003.

Experience: Spent four years in the U.S. Air Force as an accounting and finance specialist. Subsequently spent twelve years with various organizations as the Chief Finance and Chief Information officers. Employed by Northeastern State University, Oklahoma State University, Oregon State University and, currently, Montana State University as adjunct through assistant tenure-track professor.

Professional Memberships: Academy of Management, Decision Sciences Institute