2006

Information Technology Outsourcing in U.S. Hospital Systems

Mark L. Diana
Virginia Commonwealth University

Information Technology Outsourcing in U.S. Hospital Systems

A Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

Mark L. Diana
M.S.I.S., Virginia Commonwealth University, 2003
M.B.A., Shenandoah University, 1994
B.S., Shenandoah University, 1989

Committee Chairman – Robert E. Hurley, Ph.D.
Associate Professor
Department of Health Administration

Virginia Commonwealth University
Richmond, Virginia
December 2006

Acknowledgements

No one makes it far in life without the help of so many others. This dissertation is in many ways the culmination of a lifetime of effort; there are simply too many people to thank. I have had the amazing good fortune to land in a department made up of dedicated men and women who are at the top of their field. Without exception, each one of them has offered me support and guidance. In particular, I would like to thank Dr. Michael McCue, the Director of the Doctoral Program, for his unfailing support. Ms. Beverly DeShazo, the Administrative Coordinator of the Doctoral Program, is, of course, the person who keeps the whole thing together, and is one of those rare people who does not think she always has the answer, but in fact does.

Having the more than 30-year long educational experience that I have had, I can hold out my committee Chair, Dr. Robert E. Hurley, as the finest example of an educator and mentor I have had the luck to run across. His intellect is keen, his vision clear, his wit sharp, and his manner congenial. He gently forced me to think through and communicate clearly with unsurpassed patience. I will be forever grateful for his guidance. Even before I began working on this dissertation, I began working for the department, under the direction of Dr. Stephen S. Mick. Dr. Mick is without question the most supportive and collegial boss I have ever had. I am in his debt for the guidance and encouragement he has offered me over the years, but even more so for his insistence on quality work. One

need only look at anything he has produced to know that he expects only the best of himself, an expectation he extends to those around him. Dr. Dolores Clement was the first faculty member I had contact with at the Doctoral level at VCU, and I have rarely seen anyone demonstrate the dedication to students that she does. It is obvious the passion she brings to all she does for each of her students. Dr. Larry Williams is one of those wonderful people that can work hard and have fun at the same time, and I am grateful to him for not only his guidance, but also for his friendship. These are the members of my committee, and to each of you I extend my heartfelt thanks.

All of my fellow doctoral students have provided support in one way or another. I would like to single out Trish Edinboro and Lea Anne Gardner for their moral support; Henry Carretta for his willingness to share his considerable analytical talents; Askar Chukmaitov and Darrell Burke for their friendship; and Diana Vensksus, Pat Selig, and Jeff Legg for their patience.

Finally, I come to my family. To my father, Dr. Lewis Diana, you are my role model for clear analytical thinking and academic integrity. To my mother, Dr. Jeanne Diana, you are my inspiration for perseverance and achievement in spite of the obstacles that stand in your way. To my children, Phillip, Bryan, and Krystyn, I thank you for understanding the need for me to take time to do this. And lastly, because it truly is the place of honor, I thank my wonderful, amazing wife and my best friend, Sharon, who has never faltered in her support and confidence in me, and who makes me believe that with her by my side anything is possible.

Table of Contents

List of Tables

Page

List of Figures

Page

Abstract

INFORMATION TECHNOLOGY OUTSOURCING IN U.S. HOSPITAL SYSTEMS

By Mark L. Diana, Ph.D.

A Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

Virginia Commonwealth University, 2006

Committee Chairman – Robert E. Hurley, Ph.D.
Associate Professor, Department of Health Administration

The purpose of this study was to determine the factors associated with outsourcing of information systems (IS), and if there is a difference in IS sourcing based on the strategic value of the outsourced functions. The theoretical framework is based upon a synthesis of strategic management theory (SMT) and transaction cost economics (TCE) as they apply to vertical integration in the health care sector; therefore, IS sourcing behavior was conceptualized as a case of vertical integration. The conceptual model proposed that sourcing behavior would be determined by asset specificity, uncertainty, the interaction of asset specificity and uncertainty, bargaining power, corporate strategy needs, and the strategic value of the IS functions outsourced.

A cross sectional design was used, consisting of data from the American Hospital Association (AHA), the Area Resource File (ARF), the HIMSS Analytics database, and the Centers for Medicare and Medicaid Services (CMS) hospital cost reports for 2003.

The final sample consisted of 1,365 health care delivery systems and 3,452 hospitals.

Analysis was conducted using a two-stage negative binomial regression model (using instrumental variables) to correct for suspected endogeneity. Tests of joint restrictions using the group of variables derived from TCE and SMT, respectively, were done with the dependent variable divided between strategic and non-strategic IS functions (the division was done based on a model of Core IS Capabilities developed as a model for a high-performance IS function).

The results supported the relationship between bargaining power and IS outsourcing. Results for asset specificity and corporate strategy needs were significant in the opposite direction than hypothesized. No other findings were significant. These results suggest that hospital system managers are likely not considering significant factors when making sourcing decisions, including the relative strategic value of the functions they are outsourcing.

This study contributes to the limited body of knowledge surrounding IS sourcing behavior in the health care sector. Future research should examine the effect of cost on IS sourcing decisions, and consider the use of alternative theoretical frameworks, particularly Institutional Theory.

CHAPTER 1: INTRODUCTION

Hospitals are under increasing pressures to use information more effectively to reduce medical errors and improve patient outcomes (Institute of Medicine, 1999, 2001; The Leapfrog Group, 2000). There is mounting evidence that applications such as computerized physician order entry (CPOE) systems can reduce medication errors and adverse drug events (Bates et al., 1998; Evans et al., 1998; Leape et al., 1991; Teich et al., 2000). However, these systems require a significant amount of new information systems (IS) development, as they require a functioning electronic medical record (EMR) system and elements of a decision support system (DSS) in order to be effective. This type of information system is relatively new in hospitals, as the traditional practice has been to accumulate the vast amount of information generated while caring for patients, sometimes by quite sophisticated technologies, and painstakingly transcribe it all onto paper. The physician then manually assembled and assimilated this information in order to develop a set of services to provide to the patient. The information is also used for a variety of administrative functions, notably charge capture and claims processing.

Most of the CPOE systems described in the literature cited above were developed in-house, perhaps because there was no CPOE product on the market at the time, while many administrative systems are available on the market. However, as hospitals face the need to adopt these newer systems, and how to integrate them with existing systems, they

will have to determine whether it is best to develop them in-house or acquire them in the market. Acquisition of new IS capabilities is expensive, whether done internally or through outsourcing arrangements. Hospital systems are dealing with multiple demands on their capital resources, in part because of the continued rising costs of health care and in part because of increasing competition. This makes the question of how to acquire new IS capabilities most efficiently a crucial one for hospital systems.

Background

Outsourcing of information systems is a viable and significant option for organizations. Outsourcing is generally defined as the purchase of a good or service that was previously produced internally. Often the outsourcing arrangement includes a transfer of assets and a long-term contract. IS outsourcing is the purchase of IS services from an outside firm. It is useful to think of this in terms of the phases of IS services, including software development, installation, customization and integration, operation, and maintenance. Each of these phases can be outsourced, as can various combinations. Estimates of the outsourcing market range from $9 billion in 1990, to $40 billion in 1998, to a projected $70 to $100 billion in 2003 (Yost & Harmon, 2002). Public announcements of outsourcing arrangements often claim a substantial cost savings, but there are little data supporting these claims (Lacity & Hirschheim, 1993a, 1993b, 1995). The outsourcing decision is often framed as a cost minimization strategy, within Williamson's transaction cost economics framework (Williamson, 1981). This argument is one of efficiency; that is, organizations will choose whether or not to outsource based on the relative efficiency of doing so compared to not doing so. Others argue that there is a

strong institutional aspect to the phenomenon at the organizational level (Lacity & Hirschheim, 1993b). This argument is one of mimicry; that is, organizations will choose whether or not to outsource based on the perceived success or failure of other similar organizations' outsourcing activities. Still others argue that the outsourcing decision is strategic in nature (Poppo & Zenger, 1998; Steensma & Corley, 2001). This argument is one of power and advantage, that is, organizations will choose whether or not to outsource based on the perceived ability to gain an advantage over competitors.

Statement of the Problem

There has been little work done in the hospital industry to determine which hospital systems outsource information systems and which do not, and none that compares their performance based on the IS outsourcing decision. Nor has there been any study of which IS functions are more or less likely to be outsourced. Further, the hospital industry is in the midst of an expansion of its information systems capabilities, and so management will increasingly face this decision. This situation makes these questions worthy of researching, both for theoretical and practical implications. Moreover, understanding the determinants of the decision is an important first step in understanding the impact of the decision on performance. The logical next step would then be to examine the effects of this decision on performance, since the pressures influencing the development of these systems in hospitals derive largely from the perceived benefits to quality of care and financial performance.

Given that the movement to outsourcing in general, and IS outsourcing in particular, is purported to be one answer to escalating IS costs, and to the ability to gain

access to new capabilities, it is likely to become increasingly attractive to hospital systems. This combination of public pronouncements of significant cost savings through outsourcing contracts and a lack of an objective understanding of the phenomenon could lead to costly mistakes in the use and application of IS outsourcing.

Purpose

The primary purpose of this research is to delineate the factors that contribute to the decision to outsource IS functions among hospital systems.[1] The problem is more complex than this, because there are different levels of outsourcing, and it is possible that strategic aspects of IS will be outsourced while non-strategic aspects are kept internal. Despite the recent interest in the proposition that IS are commodities without strategic value (Carr, 2003), the view that certain aspects of IS have the nature of a commodity while others have strategic value has been discussed in the literature since at least the early 1990s (Lacity & Hirschheim, 1993b, 1995). Carr argues that IS does not give strategic advantage any more than does electricity, but the absence of IS, like electricity, would result in a significant disadvantage. Lacity & Hirschheim argue that some aspects of IS have this characteristic (e.g., the network infrastructure or computer hardware), whereas other aspects have strategic value to the organization (e.g., systems that gather

---

[1] The hospital industry today has evolved into one of hospital systems; indeed, 53 percent of hospitals in the 2003 American Hospital Association (AHA) Annual Survey of Hospitals are members of a system. This phenomenon moves the locus of control away from the individual hospital to the hospital system, or the corporate level rather than the facility level. For this reason, the level of analysis for this dissertation is the hospital system.

information specific to the organization's business). The nature of this strategic value of certain aspects of IS, and how an organization goes about developing it, are key questions in the outsourcing decision.

This dissertation attempts to answer these two questions:

1. What factors are associated with outsourcing or integration of information systems in hospitals?
2. Is there a difference in outsourcing and integration behavior based on the strategic value of the IS functions?

Theoretical Framework

The decision of whether to provide information systems internally or to acquire them on the market may be viewed as a case of vertical integration. Vertical integration is the internalization of the steps in the production and distribution process (Mick, 1990). Clement (1988) developed a more precise definition of vertical integration within the acute care hospital industry. This definition defines the product of the hospital as a unique or customized bundle of services provided on demand as each patient presents with specific treatment requirements. This bundle of services is assembled based on the information gathered and processed through a variety of activities, both clinical and non-clinical. Therefore, information is the primary input to the process of providing patient care, and information systems are integral to the customization process.

Mick (1990) analyzed the case of vertical integration in health care within the opposing frameworks of transaction-costs economics (TCE) and strategic management theory (SMT). Transaction cost economics argues that firms vertically integrate (or de-

integrate) in order to reduce transaction costs, an essentially efficiency-based argument. Strategic management theory, however, argues that vertical integration is a strategy used to gain competitive advantage, even in the case where transaction and production costs may increase. Mick proposes a number of factors as contributors to these opposing views, and then proposes a synthesis of the frameworks that allows for the differing predictions of when organizations choose to integrate vertically.

The conceptual model is developed from Mick's synthesis of TCE and SMT. This model predicts that both cost efficiency and strategic factors influence the decision to outsource IS functions. The model also predicts that TCE factors will have more explanatory power over outsourcing of IS functions that do not have strategic value, and that strategic factors will have more explanatory power over outsourcing of functions that do have strategic value. The delineation of the strategic value of various outsourced IS functions is done based on a framework of core IS capabilities (Feeny & Willcocks, 1998a, 1998b).

Data Sources

The data sources are the HIMSS Analytics[sm] database, a database of information systems for integrated health delivery systems provided by the Health Information Management Systems Society (HIMSS); the American Hospital Association (AHA) Annual Survey of Hospitals; the Healthcare Cost Report Information System (HCRIS) data set provided by the Centers for Medicare and Medicaid Services (CMS); and the Area Resource File (ARF), assembled by the Bureau of Health Professions. Standard multiple regression analysis is used to determine the factors associated with the

outsourcing decision, and a sequential multiple regression analysis is used to differentiate the relative contributions of variables derived from TCE and SMT respectively. Endogeneity in the research design is addressed using the instrumental variable technique.

Research Contribution

Hospitals and hospital systems face continued rises in costs and utilization, increasing competition, and continued pressures to improve patient safety through the use of IS. These factors combine to create a situation where there is competition for limited capital. IS systems are costly investments, and since many hospitals require significant upgrades to their existing technology infrastructures before they can implement integrated software applications like CPOE, the costs are amplified. Given this environment, the lure of an outsourcing contract to solve these problems allows the hospital system to present a public pronouncement that it is taking action to address public concerns over patient safety. Further, an outsourcing contract presents the system with a fixed budget, which makes planning and forecasting more reliable.

There is evidence that outsourcing arrangements do not always deliver the value they are purported to, and that the contracts often do not cover aspects of integration and modification, which leads to additional fees (Lacity & Hirschheim, 1993a, 1993b). The result is that budget forecasts are less reliable, and the promised functionality may be less than expected. Much of the early literature surrounding IS outsourcing is descriptive in nature, although there is a growing body of literature that is theoretically driven. However, virtually all of this literature is outside of the hospital industry. This research

will contribute to the body of knowledge surrounding IS outsourcing in general and in the hospital industry specifically, thereby increasing the practical and theoretical understanding of the phenomenon. This will benefit both management as it struggles to determine how best to implement IS-based solutions to its strategic and operational problems, and researchers' understanding of the theoretical frameworks used to predict these types of arrangements.

Policy Implications

The use of information technology to improve patient safety has been a policy concern since the first Institute of Medicine (IOM) report on the quality of care in the U.S. health care system (Institute of Medicine, 1999), and the following report emphasized the recommendation to use IT to address safety concerns (Institute of Medicine, 2001). More recently, the Bush administration has appointed a National Coordinator for Health Information Technology within the Department of Health & Human Services, charged with the goal of the majority of Americans having an interoperable electronic health record within 10 years. The office has developed a strategic framework outlining both technical and policy recommendations for achieving this goal (Brailer, 2004).

Outsourcing is only one of many factors influencing the ability to achieve the goal of an interoperable electronic health record for most Americans, but its importance lies in the area of financing, which is one of the main obstacles to achieve the goal. This research will provide valuable insight into the use of outsourcing as a means of acquiring needed IS capabilities in a cost-effective manner. Policy makers can make use of this

information while making decisions about what types of IS development and acquisition activities to support with taxpayer funds.

Management Implications

Management will benefit from this research by gaining a better understanding of the use of outsourcing in acquiring IS capabilities and improving service, economizing on IS costs, or gaining strategic advantage over competitors. A better understanding of the factors that lead others to make outsourcing decisions can inform management decisions about when it is appropriate to consider outsourcing as a viable option. Given the high costs involved and the potential strategic, operational, and financial consequences, this insight can be invaluable.

Overview of the Chapters

The next chapter provides a review of the cost, utilization, and quality concerns facing the hospital industry. This is followed by a review of the literature surrounding the information technology-based responses to these pressures, the structural arrangements used to provide IS services, and the decision to outsource or in-source these services. Chapter three develops the conceptual framework used to derive testable hypotheses from the research questions. Chapter four describes the methodology of the study, including the design, data, and analytical approach. Chapter five presents the results of the analysis, and Chapter six discusses the results and the implications and conclusions of the study.

CHAPTER 2: BACKGROUND AND LITERATURE REVIEW

The purposes of this chapter are to review: 1) the financial and competitive pressures facing the hospital industry, 2) the quality concerns facing the hospital industry, 3) information technology-based responses to these pressures, 4) the structural arrangements for delivering information technology, and 5) the decision to outsource or in-source all or portions of the information systems function. This review will serve to illustrate that the combination of financial, competitive, and quality concerns, along with information technology-based responses to these concerns, pressure the hospital industry into choosing the most efficient and effective way to structure their information technology activities and investments. One of the key questions in that decision is whether to utilize outsourcing as a part of their strategy, and if so to what extent.

Financial and Competitive Pressures

Hospitals continue to face increasing cost pressures despite efforts to keep costs under control. National health care costs are steadily rising. Total national health expenditures were $1.7 trillion in 2003, a 7.7 percent increase over the previous year. That compares to a 9.3 percent increase from 2001, 8.5 percent increase from 2000, and 7.4 percent from 2001 (Levit, Smith, Cowan, Sensenig, & Catlin, 2004; Smith, Cowan, Sensenig, & Catlin, 2005). National health expenditures comprised 15.3 percent of the gross domestic product in 2003, compared to 14.9 percent on 2002, 14.1 percent in 2001,

and 13.3 percent in 2000. The medical care component of the Consumer Price Index (CPI) rose 4.6 percent and 4.7 percent in 2001 and 2002, respectively, declining to 4.0 percent in 2003. The CPI for hospital services had the highest growth rate over the three years from 2001 – 2003, rising 6.6, 9.0, and 7.4 percent respectively (Levit, Smith, Cowan, Sensenig, & Catlin, 2004; National Center for Health Statistics, 2004).

Hospital expenditures rose 6.5 percent in 2001 and 8.5 percent in 2002, representing 28 percent and 32 percent of the aggregate spending increases in 2001 and 2002, respectively. In the period from 1993 to 2000, this figure averaged 3.7 percent (Levit, Smith, Cowan, Sensenig, & Catlin, 2004). Hospital expenditures rose 6.5 percent in 2003, the first slowing of the growth rate since 1998 (Smith, Cowan, Sensenig, & Catlin, 2005). This slowdown is attributed to a drop in public spending, while private spending growth remained relatively stable. Hospital expenditures as a percentage of total national health expenditures have remained relatively constant during this time, hovering around 32 –33 percent (National Center for Health Statistics, 2004; Smith, Cowan, Sensenig, & Catlin, 2005).

The growth in hospital spending can be attributed primarily to price increases, which result from rising labor costs and from the higher rates hospitals with increased market power have been able to secure from private insurance plans. Other factors contributing to the growth in hospital spending include population growth and changes in the quantity and intensity of services demanded (Levit, Smith, Cowan, Sensenig, & Catlin, 2004).

Shactman and colleagues (2003) project that, based on the current rate of growth, over the period from 2000 – 2012, hospital spending will increase annually at an average rate of 4.8 percent, and bed capacity will need to be increased anywhere from 18 to 28 percent (136,000 – 211,000 beds). These projections are higher than those from the Centers for Medicare and Medicaid Services (CMS), which the authors attribute to an aggressive estimate of the ability of managed care to control spending, and on conservative estimates of labor costs, hospital admission rates, and total inpatient spending by the CMS (Shactman, Altman, Eliat, Thorpe, & Michael, 2003).

Shactman and colleagues (2003) propose that increases in hospital spending are affected by the aging of the population and overall population growth, the excess of hospital inflation over inflation in the general economy, and greater utilization of new technology and of hospital care overall. Their analysis found that the increases in the use of new technology and overall hospital care contribute 43 percent of the total projected growth in hospital spending. This factor consists of an increased propensity of the baby boomers to consume more than previous generations, the use of new medical technologies, and the overall health status of the population, particularly the elderly.

Interestingly, they did not find the aging of the population to be a major contributor to their projections. Indeed, this factor only accounted for 10 percent of the overall projected growth in spending. This finding echoes that of Reinhardt (2003), who cites an overall rise in per capita income, costly new medical technologies, workforce shortages, and the asymmetric distribution of market power (with the supply side having undue influence over the demand side) as the factors most responsible for rising costs.

Both of these analyses point to the common theme of new medical technologies as a source of rising costs. These technologies include both medical technologies applied directly to clinical procedures, such as MRI and PET scanners or pharmacy and surgical robots, as well as those that provide information to clinicians and other hospital personnel, such as electronic medical records (EMR) and computerized physician order entry (CPOE) and decision support systems (DSS).

Competitive Pressures

In addition to the increases in costs, hospitals face increasing competition, although the strategies that hospitals use to compete have changed over the last decade. During the early to mid 1990s, hospitals competed primarily on price, as they faced increasing levels of managed care and health plan consolidation and the resulting pressures to drive down costs. In the early 2000s, there is evidence that hospitals are increasingly competing on service offerings and less on price, although price pressures remain high (Devers, Brewster, & Casalino, 2003). The main factors leading to this shift are decreases in managed care activity (i.e., selective contracting and capitation), a shift of resources away from horizontal and vertical integration activities, and the rise of hospital competitors, both on the inpatient and outpatient side.

Essentially, what Devers and colleagues have found is that as managed care enrollment has stagnated or declined and provider networks have expanded, payment pressures have reduced somewhat, and the previously prevailing model of an integrated delivery system that could offer "one-stop-shopping" was no longer a pre-requisite to successful contract negotiations and patient inflows. Hospitals therefore have begun to

focus on providing services and amenities that are attractive to physicians and their patients. They are accomplishing this by shifting resources from horizontal and vertical integration activities (e.g., mergers and acquisitions), to the development of attractive specialty services. Lastly, because specialty services are typically the most profitable, there is increasing level of competition in providing these services.

The physician-owned specialty hospital is one source of competition for hospitals in the specialty services arena. There has been a rapid growth in the number of such facilities. According to the United States Government Accountability Office (GAO), the number of specialty cardiac, orthopedic, surgical, and women's hospitals tripled from 1990 to 2003, and there were another twenty under development in April of 2003 (United States Government Accountability Office, 2003). Further, physicians owned seventy percent of these hospitals at least in part, and such ownership averaged just over fifty percent of total ownership. In most cases, some of the physician owners were members of a single group practice. The Community Tracking Study found similar trends (Casalino, Devers, & Brewster, 2003).

Contributing factors to the growth in physician-owned specialty hospitals include the ban on physician referrals to hospitals in which they have invested, the proposition that such facilities can provide more efficient and higher quality services, and that services can be provided at a lower cost. Further, since most of the facilities are newly constructed, they are likely to have state-of-the-art, fully integrated clinical and administrative information systems that enhance their operational efficiency, and arguably contribute to better outcomes. Traditional hospitals will have a much more

difficult time implementing integrated information systems since they are not newly constructed, but have to be built alongside, or from the existing systems. An additional concern is that they will be left to treat the sicker patients while the specialty hospitals treat those that are less sick, all of which may lead to apparently poor outcomes. Given that most of the growth in specialty facilities has been in the cardiac and orthopedic areas (54 of 92), two of the most profitable for hospitals, along with general surgical care (another 22 facilities), these concerns may not be unfounded (Casalino, Devers, & Brewster, 2003; United States Government Accountability Office, 2003).

In summary, hospitals face rising cost and competition pressures. As hospital spending continues to increase, hospitals will face renewed pressure to reduce their costs, while at the same time they face increased competition from organizations like physician-owned specialty hospitals and ambulatory surgery centers. Hospitals will therefore need to become more efficient in their operation. One means of improving operational efficiency is to improve the overall level of information systems support provided throughout the organization.

Quality and Safety Concerns

Hospitals continue to face rising costs and significant competition, despite the consolidation and formation of systems that have occurred in the industry over the last decade or so. However, hospitals are also facing significant pressures to improve the quality of the medical care they provide.

In 1999, the Institute of Medicine (IOM) released a report (Institute of Medicine, 1999) that estimated there were more than one million injuries and nearly 100,000 deaths

annually attributable to medical errors. There has been some debate over the accuracy of these figures (McDonald, Weiner, & Hui, 2000), but most would agree that whatever the actual number, it is too high. According to the findings of the Harvard Medical Practice Study (Leape et al., 1991), the most common types of medical injury are drug complications (19 percent), followed by wound infections (14 percent) and technical complications (13 percent).

In 2001, the IOM issued a follow-up report aimed at quality in the health care delivery systems as a whole (Institute of Medicine, 2001). This report argues that the quality problems present are systemic in nature, and that the system needs to be redesigned to improve overall quality. The report recommends that care should be safe, effective, patient-centered, timely, efficient, and equitable. Among the many recommendations made to achieve these goals is the expanded use of information technologies (the 1991 IOM report also included a call to increase the use of computerized clinical records). The 2001 report discusses many benefits to the adoption of IT and notes that the care process is largely composed of information gathering activities, and that long term readily retrievable information can enhance the ability to care for patients, particularly those with chronic conditions. Further, the report notes that achieving this recommendation will require significant capital investments that many facilities, such as non-profit organizations, health plans and small physician groups, may have difficulty making. Even for facilities that have access to the capital, demonstrating the return on investment of large IT expenditures is difficult (Brailer, 2004; Brynjolfsson, 1993).

The Leapfrog Group, a national consortium of Fortune 500 companies and other large public and private health care purchasers founded by The Business Roundtable, is working with hospitals in an effort to advance patient safety. They attribute most medication errors to one of three factors: (a) illegible handwritten prescriptions, (b) overdosing from decimal place errors, and (c) overlooked interactions and allergies (The Leapfrog Group, 2000). In recognition of the high rate of drug complications, they have included Computerized Physician Order Entry (CPOE) as one of the first three focus areas for hospital recognition and reward (the other two are ICU physician staffing and evidence-based hospital referral).

The main initiative of Leapfrog is an ongoing hospital quality and safety survey, aimed at the progress each facility has made towards each of the three initiatives, with the results published on the Web. The survey results are in turn used as the basis for information provided to employees designed to inform them about their provider choices, and as the basis for paying providers based on performance. Participation in the survey has increased, and there is evidence that hospitals are implementing the initiatives, although adoption of CPOE was only about five percent in 2003. The pay-for-performance initiatives have increased pressures on hospitals, not only directly, but also through indirect effects on public reimbursement. The Medicare Payment Advisory Commission (MedPAC) cited Leapfrog in part in a 2003 recommendation that Medicare adopt performance-based payment (Medicare Payment Advisory Commission, 2003). The Medicare Prescription Drug, Improvement, and Modernization Act of 2003 included

a requirement that hospitals submit performance measures for public release (Galvin, Delbanco, Milstein, & Belden, 2005).

There are other indications that the quality of medical care delivered in the United States is less than desirable. The Harvard Medical Practice Study (Leape et al., 1991) was one of the first efforts to document and categorize the occurrence and types of medication errors. This study found that medication complications were the most frequent type of error, and that 71 percent of adverse drug events resulted in disability that lasted less than six months, 3 percent caused permanent disabilities, and 14 percent were fatal. Further, they found that 69 percent of these errors were preventable. More recently, McGlynn and colleagues examined the quality of care delivered to adults in the U. S. and found that only 55 percent of adults received care recommended by a set of quality indicators developed specifically for this study (McGlynn et al., 2003).

In summary, there is increasing focus on the quality of care provided by hospitals, and there are initiatives that are focused on making hospitals accountable for their performance. Two of the most prominent are the dissemination of quality and outcome information to enrollees, to provide them with the knowledge to choose providers with better outcomes, thereby bringing market-based pressure on providers to improve quality; and the threat of basing reimbursement on quality and performance measures. Both IOM reports and The Leapfrog Group have endorsed the increased use of information systems as one means of improving quality and outcomes.

Information Technology-based Responses

The initial uses of information systems in hospitals was in administrative applications focused on cost savings through automation and increased productivity, starting with payroll and patient accounting systems. Administrative systems now include financial, human resource, materials management, resource utilization and scheduling, and facilities and project management systems (Austin & Boxerman, 2003). The common impetus for implementing these systems was improved financial management, cost control, and charge capture. This progression mirrors that of other industries' adoption of early information systems to automate processes, reduce costs, and capture transactions.

Indeed, most of the data captured by today's information systems are administrative data, although much of it is also used as a proxy for clinical data. These systems are transaction-processing systems designed with the goal of capturing billable, line-item services and securing reimbursement for those services. As such, they offer a poor representation of the complexities of a patient's clinical status, even though they are used for such purposes. Further, many of the difficulties of implementation of so-called clinical information systems, or clinical decision support systems, stems from the fact that they are based on data from legacy mainframe transaction processing systems that were never designed to provide a patient's true clinical picture (Kleinke, 1998, 2000).

Most of the research looking at the use of information systems in quality improvement has focused on the role of CPOE systems in reducing the rate of medication errors. In many of these studies, a distinction is made between medication errors and adverse drug events. Medication errors are generally defined as errors in ordering,

transcribing, dispensing, administering, or monitoring. Adverse drug events (ADEs) are injuries that occur as the result of the use of a drug. ADEs can be divided into potential, preventable, and non-preventable ADEs. Preventable ADEs are associated with medication errors, while non-preventable ADEs are not. An example would be the development of an allergic reaction to a medication in a patient with a known allergy (preventable) as opposed to the development of the same reaction in a patient with no known allergy (non-preventable).

Bates and colleagues at Brigham and Women's have been responsible for much of the research done on ADEs and CPOE systems. Some of this research has been done on ADEs alone (Bates et al., 1995; Leape et al., 1995), but most of it involves the same institution, the same CPOE system, and the same or similar data sets. Bates and colleagues (Bates et al., 1998) evaluated the effect of a CPOE and a team intervention on medication error rates and adverse drug events. The CPOE system included aspects of a clinical decision support system, such as the display of pertinent laboratory values for the patient, consequent orders (appropriate following orders for the type of order being entered), and limited drug-allergy, drug-drug interaction, and drug-laboratory checking. The results showed a drop in medication errors of 55 percent and a drop in potential ADEs of 84 percent as a result of the CPOE system while the team intervention had no effect.

Bates and colleagues (Bates et al., 1999) conducted a time-series analysis of the same CPOE system over four phases of its implementation. The first phase was the baseline phase where there was no CPOE in place. Phase two represented the

implementation of the CPOE system, and phases three and four represented enhancements to the system made after analyzing information from phase two. They demonstrated an 81 percent reduction in the medication error rate (excluding missed doses) and an 86 percent reduction in serious medication error rates.

In another study of the same system, they found that the CPOE system could effectively influence the prescribing practices of physicians. For example, the proportion of orders with doses that exceeded the recommended maximum dose fell from 2.1 percent to 0.6 percent, and the use of the appropriate frequency of administration for the drug ondansetron hydrochloride rose from 6 percent to 75 percent (Teich et al., 2000).

There has been other research demonstrating the effectiveness of CPOE in improving quality. Evans et al. (Evans et al., 1998) evaluated the use of a clinical decision support system in a 12 bed ICU in LDS Hospital in Salt Lake City, UT. The decision support system was built on top of an electronic medical record system. The focus of the system was on antibiotic treatment. It was effective in reducing orders for patients with drug allergies, for doses greater than acceptable, and in reducing antibiotic-susceptibility mismatches.

Raschke et al. (1998) at Good Samaritan Regional Medical Center in Phoenix, AZ, developed a computerized system to generate automatic alerts when certain conditions had been met, including prescriptions that may lead to ADEs in certain patients. This system was not a full-fledged CPOE system, but linked to portions of the patient's medical records. The system generated alerts of possible risk for ADEs at the

rate of 64 per 1000 admissions. Of these alerts, 44 percent were unrecognized by the physician before the alert.

While these studies focused on the ability of CPOE systems to improve the quality of care, there have also been efforts to demonstrate the ability of these systems to reduce costs, primarily by reducing ADEs and length of stay (as a result of ADEs). Bates and Spell et al. (Bates et al., 1997) evaluated the costs of ADEs at Brigham and Women's and Massachusetts General Hospital. The analysis used hospital charges converted to costs by a hospital-specific ratio, which may affect the accuracy and generality of their findings. They found that a patient experiencing an ADE had a length of stay two days longer and a cost of $2,600 more than similar patients who did not experience an ADE. Those figures were roughly twice as high for patients experiencing preventable ADEs. Researchers at LDS Hospital found an average two-day increase in the length of stay, an average of $2,000 in increased costs, and a likelihood of death twice as high among patients experiencing an ADE (Classen, Pestotnik, Evans, Lloyd, & Burke, 1997). Costs in this study were calculated using a computerized system that uses time and motion studies to estimate the actual costs of hospital care, which again may not accurately reflect true hospital costs.

While efforts to determine the actual costs of ADEs are few and not without methodological problems, it seems reasonable to assume there is some increase in costs associated with the occurrence of ADEs. The literature also supports the view that CPOE systems may be effective at reducing the rate of ADEs. There is no evidence in the literature that the costs saved by reducing ADEs will offset the costs of implementing

CPOE systems. Bates and Leape et al. (Bates et al., 1998) estimated the cost of developing a CPOE system in-house to be $1.9 million, with maintenance costs of $500,000 per year. They also estimated the cost of preventable ADEs to be $2.8 million per year. However, they still argued that when adding other costs not factored in, such as re-admissions, injuries borne by patients, and malpractice suits, the overall savings to the institution would be between $5 and $10 million per year.

That figure seems optimistic, even for a large urban tertiary care center. In addition, it must be said that the question of whether the cost savings from reducing ADEs can pay for the systems needed to reduce them should be a moot one. One is reminded of the Ford Pinto fiasco when imagining hospital management making the decision that it is more cost effective not to implement systems that will prevent injury and death. However, if the data clearly show that the cost savings can pay for the systems to prevent ADEs, it should make the investment easier to justify. Such evidence may be hard to come by, particularly for the small community hospitals where the cash to invest in such systems is likely to be difficult to accumulate, and where the in-house IT staff that could develop such a system, as they did at Brigham and Women's and LDS, is often not available. Despite these considerations, hospital management will be increasingly pressured to investigate the implementation of such systems.

Implementation Difficulties

Effective systems are costly investments, and particularly complex in the health care setting, where clinical information management is an additional component to the standard set of administrative information systems. This complexity complicates the

implementation of such systems. For example, an effective CPOE system relies on an infrastructure of an electronic medical record (EMR) that is a costly and complex information system in itself, and which is not available in most institutions. Often the clinical information that is collected exists in separate systems that do not communicate with each other, which therefore require additional costly investments to create the necessary interfaces so they can communicate. This problem is often exacerbated in hospitals that have been merged into or acquired by other systems.

The complexity of the health care information environment also makes it difficult to find suppliers with effective solutions. For example, financial transaction providers (companies that provide transaction services like credit card authorizations to financial institutions—a case of outsourcing of administrative functions) have attempted to enter the health care claims processing market, but found the complexity of the transactions daunting. The approval of a credit card transaction involves little more than checking on the cardholder's available credit, whereas a health care claim requires answering ten or more complex questions before the claim can be approved (Kleinke, 2000).

Not all barriers to implementing these systems are technical. If hospitals do not build consensus among physicians and other caregivers about the processes and guidelines the information system will follow, they may resist its implementation and use (Garg et al., 2005; Koppel et al., 2005). Physicians are notorious for their resistance to information systems, particularly those that rely on administrative data and are used to evaluate performance. They argue that these data do not adequately adjust for risk, which others see as an attempt to avoid accountability and to maintain their clinical autonomy.

What physicians may be either directly or intuitively resisting is the inability of reimbursement-based systems to reflect the complexity of a patient's clinical condition (Kleinke, 1998). Regardless, without physician support, it is difficult to implement complex clinical information systems like an EMR or CPOE (Chau & Hu, 2002a, 2002b; Garg et al., 2005; Giuse, 2003; Kaushal, Shojania, & Bates, 2003; Koppel et al., 2005; Lowenhaupt, 2004).

The Electronic Health Rcord (EHR)

Kleinke argues that the foundation of an effective clinical information system is the electronic health record (EHR) (Kleinke, 1998), in part because it is developed with the goal of collecting clinical data, not administrative or reimbursement data. The problems of implementing a comprehensive EHR that is interoperable with other EHRs across the spectrum of care sites has been brought to the forefront by a report from the Office of the National Coordinator for Health Information Technology within the Department of Health & Human Services. This office was created with the goal of the majority of Americans having interoperable electronic health records within ten years. This office issued a report in 2004 that delineates a strategic framework for achieving this goal (Brailer, 2004). The report establishes the goals of informing clinical practice, interconnecting clinicians, personalizing care, and improving population health. The main strategy for achieving the goal of informing clinical practice is to implement EHRs.

This report cites several reasons for the slow rate of adoption of EHRs, including the difficulty in demonstrating a positive return on investment (ROI) and the large capital expense, both of which contribute to the conclusion by many organizations that EHRs are

bad financial investments, despite their demonstrated benefits to their mission. One recommendation in the report for overcoming this problem is for the CMS to use pay-for-performance programs to encourage adoption.

Another reason for the slow rate of adoption is the risk of failed or underused implementations. This concern is also based in part on cost concerns, because ongoing support is needed to reorganize workflow processes to align with the EHR and in the proper use of the many information tools included. Further, there is wide variability in the products available in the market, and these products are not required to meet any set of minimum standards to be used in care delivery. While the report mentions this with regard to EHR products, the same is true for outsourcing vendors, which are often the same companies that provide the EHR product. Additional factors related to the adoption of EHRs include the geographic location and the size of organizations, with smaller and rural organizations less likely to have adopted EHRs.

The other goals of the Brailer report, while important to realizing the long-term benefits of improving the use of information systems in clinical practice in the nation's health care system, have less bearing on the question of how to implement these systems. The issues the report identifies as barriers to the adoption of EHRs, however, are directly related to the this question, and serve to highlight the increasing pressure coming to bear on hospitals to move ahead in this area.

Summary

The two IOM reports, the efforts of the Leapfrog Group, and the report of the National Coordinator for Health Information Technology have brought the role of

information technology in addressing cost, quality, and purchaser pressure, to the forefront of public awareness. Managers in health care delivery organizations are aware of the need to improve quality and reduce costs, and many are looking at information systems as a means of doing so, despite the difficulty in implementing effective systems. Given the number of individuals affected by poor quality of care, the implementation of information systems has the potential to have a positive effect on the health outcomes of these individuals. This makes the primary question one of how best to implement such systems.

There are essentially two answers to this question: do it yourself or have someone else do it for you (outsource). There are significant risks with either approach. At the time of the CPOE studies cited above, there were no commercially available CPOE systems, so hospitals had little choice other than to build their own systems. There are now many such products on the market, including outsourcing companies, that purport to offer the necessary functions, but there are numerous problems with these systems. One is that they are often built on top of legacy systems designed to capture charge and reimbursement data in an episodic fashion, which results in data that are poorly suited to clinical management (Kaushal, Shojania, & Bates, 2003; Kleinke, 1998; Peabody et al., 2004). Another is that many of these products and services are not functional to the degree advertised, and may not even be in use by any health care organization, for both technical and market-based reasons (Kleinke, 2000; Reinhardt, 2001). Further, there is evidence to suggest that there are advantages to building a customized system, particularly the fact that such an approach is more likely to garner the support of the

physicians who will use the system (Kaushal, Shojania, & Bates, 2003; Kleinke, 2000). Therefore, one of the most fundamental questions hospital management is faced with in today's environment, where cost and quality pressures are significant, and the expanded use of information systems is viewed as an integral part of the solution to these concerns, is whether to build these systems in-house, or whether to outsource them to another organization. Examining this question requires a look at the structure of the information systems function in organizations.

Structural Arrangements for Information Technology Provision

The literature on structural arrangements for providing the IT function within an organization is mostly generic in nature, with little if any reference to industry setting. There is evidence to suggest that IS unit structure is determined largely by the overall organization structure and culture, and the industry setting has little or no impact on the decision (Brown & Magill, 1994). Common elements of an IS unit include operations, systems development and maintenance, technical services, and administration. According to Martin and colleagues (2002), other activities like end-user support, IS auditing, Web-based systems development, and research and development are becoming common elements as well.

- Operations involve hardware and network maintenance, data entry, disk and file management, and centralized machine operations (e.g., mainframes).
- Systems development involves systems analysis and design, programming, software acquisition, installation, and training.

- Technical services involve software maintenance, technology assessment, and data administration.
- Administration includes project planning, budgeting, personnel management and training, and standards development.
- End-user support includes both help desk activities and support for end-user software development.
- Research and development includes researching new technologies, forecasting trends in technology, and diffusing their use throughout the organization.

Martin and colleagues (2002) describe four generic structures for the IS organization: classic, functional, service, and distributed. The classic organization is highly centralized and task-oriented. The functional organization breaks the IS staff into separate groups to support different line units within the business. For example, there may be an individual IS development group for marketing systems, production systems, and corporate systems. The service-oriented organization explicitly incorporates data center operations and data administration, research and development, planning and technical services, along with systems development and maintenance. This arrangement may also include telecommunications. The distributed IS organization incorporates a central IT group that is concerned with common issues such as the tools, techniques, and standards used in systems development, or the management of the backbone network and a consolidated data center, while the business divisions have their own IS staff that manages systems development activities, and other activities specific to the division.

In some cases businesses may choose to set up the IS function as a wholly owned subsidiary, making it responsible for its own financial survival. This move is often seen as an attempt to improve the efficiency and responsiveness of the IS unit. It may also be an attempt to gauge the feasibility of outsourcing the function entirely.

The two central questions that emerge over how best to organize the IS functions within an organization are how centralized or decentralized the structure should be, and the alignment of the IS structure with the overall organization structure (Brown & Magill, 1994). Brown & Magill (1994) identified an increasing inclusion of telecommunications within the IS function and a view of telecommunications and computer operations as utility functions where economies of scale are prime concerns, and a dichotomy view between managing technology and managing the use of technology. The management of technology functions included computer operations, communications and networking, emerging technologies, and technology planning, while the management of the use of technology functions included systems development, end-user computing support, and applications planning. These concepts begin to illustrate the emergence of a view that some IT functions are of strategic value (the use of technology), while others are more like utility functions (the technology itself).

This view of two separate types of IT management is apparent in a framework for developing an effective IT management architecture that emphasizes splitting responsibility for IT management between business line managers and a central IS group (Boynton, Jacobs, & Zmud, 1992). The argument here is that as technology has become increasingly central to the function of the business, managing that technology to serve the

needs of the business cannot be effective through a central IS group. The only effective means of managing the use of technology is through business managers. The actual distribution of functions between the central IS group and the business managers is moderated by firm-specific factors, but the underlying argument is that there are strategic issues that IS can address that the business managers are able to identify, while at the same time there are utility functions with little strategic impact that a central IS group can manage.

Core IS Capabilities

Feeny, Lacity, and Willcocks (Feeny & Willcocks, 1998a, 1998b; Lacity & Willcocks, 2001) lay out a framework for organizing the IT function that is based on the strategy of focusing on core capabilities and that explicitly addresses the sourcing question. The framework includes core capabilities they believe are essential to the IT function. There are four environmental pressures shaping the development of these core capabilities. First is the increasing reliance on information technology. The authors cite the devastating effect a 24-hour stoppage of IT systems in a bank would have. A hospital with a fully integrated electronic medical record system would suffer no less catastrophic effects from a similar outage. Second, the authors cite successive recessions and intense competition leading to cost containment pressures, which, as discussed above, is certainly present in the hospital industry. This pressure has lead to an increasing concern for IT to demonstrate its value to the business.

The third pressure is more complex, but no less relevant. The argument is that there is a long-term shift in organizational structure as a whole, not just in the way the IT

function is organized. The focus of this shift is on the concept of core capabilities or core competencies. This concept is that organizations can only be effective at a few core functions, and it should develop those to the highest level. These functions should define what the organization does and is in business for. Any non-core functions should be eliminated, minimized, or outsourced. The obvious question that arises is: how does this affect the IS function? Is the IS function as a whole viewed as core (strategic) or support (commodity), or are there parts of it that are core and parts that are support? The answer to this question should help determine which IS functions to retain in-house and which to outsource. A related development the authors identify in this respect is the growing number and maturity of external IS providers. A diagram of the pressures identified here on the IS function is shown in Figure 1.

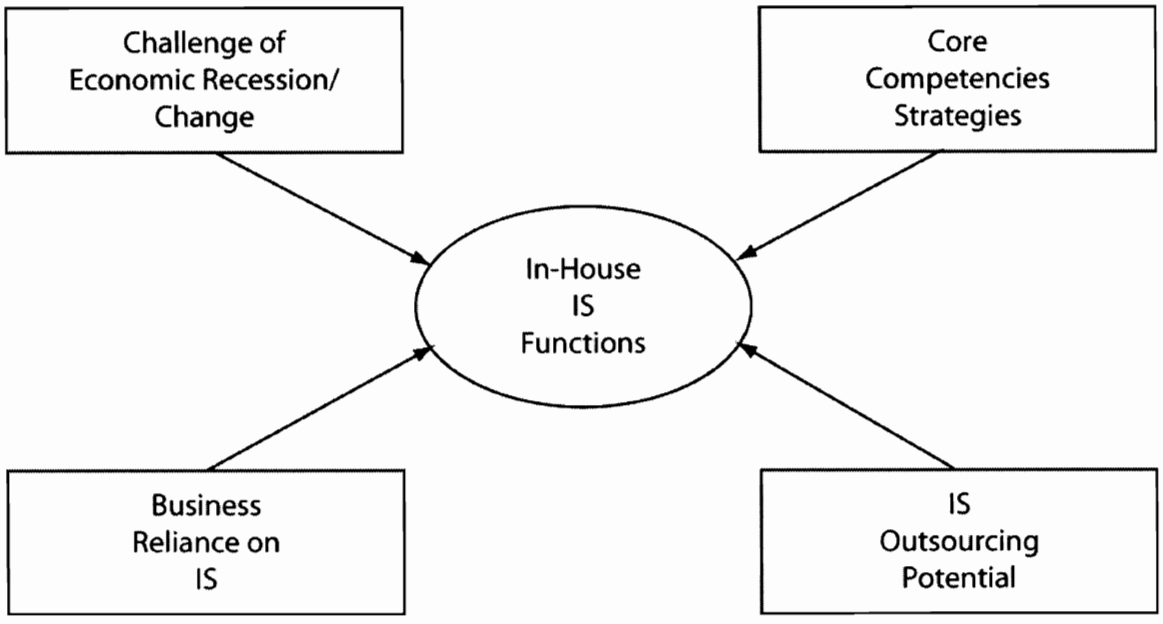

Figure 1. Forces Shaping the Future IS Function (Feeny & Willcocks, 1998b)

The authors cite several separate research streams as the basis for the model they have developed, one of which focuses on outsourcing experience. It is interesting and instructive to note that this outsourcing stream tended to identify organizations as coming from two opposite perspectives. The one perspective starts with the premise that IS/IT is to be outsourced, and the only question becomes what capability should remain in-house. The other starts with the premise that IS/IT represents a significant strategic resource, and the question becomes what capabilities must exist to exploit this strategic potential. This would seem to suggest that organizations decide to outsource IS functions based on a general overall view of the strategic nature of IS.

The authors define the IS function "...as the set of activities, personnel and IT assets set up to define and ensure delivery of the information systems requirements of the business" (Feeny & Willcocks, 1998b, p. 356). The basic tasks of the IS function are instructive in terms of terminology, which is a source of considerable confusion, as well as in delineating the core capabilities of this framework. These tasks are information management (IM), information technology (IT), information systems (IS), and market sourcing.

- The IS task is concerned with the business and information systems strategy. The focus is on meeting business requirements by defining the systems to be developed or acquired, their relationship to the business, and their integration with existing systems.

- The IT task is concerned with ensuring the business has access to the technical capabilities it requires. The focus here is on information technology strategy, or the information technology architecture and its ability to support target systems over time.
- The IM task is concerned with the governance of the IS function. The focus here is on the role and mission of IS/IT in the business, personnel responsibilities in achieving the role and mission, processes for evaluating proposals for IT/IS investments, development of standards, and other governance types of activities.
- The market sourcing task is concerned with the use of the external IS/IT market. The focus here is on what to outsource and in-source, on which external suppliers to use, and how to use them.

Feeny and Willcocks (1998a, 1998b) define nine specific capabilities that encompass seven tasks, four of which are the four fundamental tasks just described. The three additional tasks represent interfaces between the fundamental tasks necessary for the integration of efforts by the IS unit. Two of these interfacing tasks are specifically directed towards outsourcing.

- Informed buying involves the analysis of the external market, selection of a sourcing strategy allied to the business strategy, and leadership of the contracting process.
- Contract facilitation focuses on providing a single point of contact between the business users and the external IT/IS market regarding service provision on a daily basis.

This framework then explicitly addresses the need for the IS unit to manage outsourcing through informed buying and contract facilitation. Of course, this framework assumes that the entire IS function is not outsourced. Indeed, Feeny, Lacity, and Willcocks (1998a, 1998b) clearly perceive IT as capable of providing a strategic advantage, as evidenced by their reliance on a core competency strategic model as the basis for their framework. In their assessment of the ability for IT to provide a strategic advantage, they directly address the question of outsourcing. They argue that the "minimalist strategy," whereby the IM (governance) task is the only one owned by the business and all else is outsourced, makes it impossible for the organization to remain informed of its demand-side needs and in control of its IT investments.

What the authors argue is that their model specifically provides the capability to make and enforce these choices in-house. They propose a two-dimensional model of the sourcing decision that consists of information management, information systems, and information technology (alternatively described as policy, application, and delivery, respectively) on the vertical axis, and strategy and enactment on the horizontal axis (Table 1).

In this model, all information management activities remain under the control of in-house IS staff. These are the policy and strategy level activities that determine IT's role in the business, sourcing strategies, and the development and implementation of best practices. Contract workers may assist with the implementation of some of these capabilities, but they would function under the direction and control of in-house management, and therefore fit the definition of in-sourcing. The first two levels of

Table 1. IS Core Capability Domain (Feeny & Willcocks, 1998a, 1998b)

	Strategy	→	**Enactment**
Information Management (Policy)	Positioning of IT Role	IS/IT Sourcing Strategy	IT Management Practices
Information Systems (Application)	Business/IT Relationship Development	Business/IT Systems Vision	Systems Development *
Information Technology (Delivery)	IT Architecture Scope and Design	IT Platform Construction *	Operational Services *

* Potentially outsourced services and core capability monitoring/facilitation

information systems activities—the development of good relationships between business and IT and the vision of improved business strategies and processes—also remain in-house. Only now does the decision to follow through with in-house systems development or to outsource that function come into play. Put differently, the internal unit is to decide what systems are needed, in concert with the business strategy, but the acquisition of those systems can be outsourced as needed. Presumably, this decision is to be based on efficiency factors, rather than strategic ones, but the model does not directly address this question. Lastly, in the information technology or delivery dimension, the in-house staff develops the scope and design of the IT architecture, but increasingly leaves it to external providers to construct and operate that infrastructure. This model illuminates the argument that there is a rationale for outsourcing functions that are not strategic in nature, including systems development (but not the decision of what systems to develop), and

operational activities, such as administrative and transaction processing systems. The same rationale argues for retaining functions with strategic value in-house.

Summary

The structural design of the IS/IT function has changed over time as the capabilities and importance of the function have increased. Two central questions are evident in the literature over the most effective and efficient way to organize the IS/IT function: (1) whether to centralize, decentralize, or to engage in some combination of the two, and (2) whether IS/IT offers strategic value or is simply a commodity function. The two questions are intertwined with the question of what, if any, aspects of the function to outsource. The strategic orientation of the firm vis-à-vis the IS/IT function defines the starting point of the outsourcing question. The literature seems clear on one point—there is no longer a question of whether or not to outsource, but rather the questions are what to outsource, what to base that decision on, and how to manage the outsourcing relationship. The emerging consensus is that IS/IT functions can be divided based on their strategic value to the organization, and that division can serve as the basis for the outsourcing decision. There also appears to be an emerging view that operational types of activities are of less strategic value.

The Outsourcing Decision

Lacity and Hirschheim were the first authors to provide a significant investigation of the IS outsourcing decision, and they continue to be leaders in the investigation of the phenomenon. Their first investigation consisted of a series of case studies of Fortune 500 organizations in both service and manufacturing settings (Lacity & Hirschheim, 1993a,

1993b). The cases studies examined the factors leading to the decision of whether or not to outsource, and these factors were evaluated in the context of transaction cost economics (Williamson, 1979, 1981, 1985) and the political model developed by Pfeffer (1981).

According to Lacity and Hirschheim, the two major trends responsible for the outsourcing phenomenon are (1) the increasing view by senior management that IS is a utility service that specialized vendors can provide more efficiently through economies of scale, and (2) the public pronouncements of outsourcing arrangements that have claimed to attain ten to fifty percent cost savings. In their case studies, they identified three themes associated with the outsourcing decision that they challenge: (1) outsourcing vendors are strategic partners, (2) outsourcing vendors are inherently more efficient than internal IS departments, and (3) savings of ten to fifty percent of IS costs can only be achieved through outsourcing.

They argue that the belief that outsourcing vendors are strategic partners is incorrect because they do not share the profit motive. The outsourcing vendor is trying to maximize profits, and a primary means of doing so is by charging fees for additional services not specified in the contract. The result is that as the business costs increase, so do the vendor's profits, which does not represent a strategic relationship. The danger the authors see in the view that vendors are strategic partners is that the contract will be too loose, leading to significant excess fees. One point the authors fail to make is that the premise that IS is a utility function implies it has no strategic value, so why then would

the relationship with the vendor be strategic in nature? How many businesses view their electric supplier as a strategic partner?

The belief that outsourcing vendors are inherently more efficient than internal departments is based on the theory that the vendors enjoy economies of scale. Economies of scale are attainable through mass production and labor specialization. A primary problem with this is that of measuring the efficiency of the IS department. The only area where efficiency has been measured adequately is in data processing, where cost per millions of instructions per second (MIPS) is used. Most of the efficiency arguments are based on the belief that the larger data centers are more efficient and that vendors have lower hardware and software costs. Lacity and Hirschheim present evidence to the contrary, pointing out that most organizations can get similar hardware discounts, that software vendors have changed licensing arrangements in response to outsourcing (they now charge based on the size of the computer running the software, rather than by geographic location), and that small data centers have demonstrated efficiencies similar to or better than large ones (Lacity & Hirschheim, 1993a, 1993b, 1995).

The belief that outsourcing arrangements can save ten to fifty percent of IS costs is suspect for three reasons. First, these reports of outsourcing deals are made in the trade press during the "honeymoon period" when the contract is first negotiated. Second, the trade literature only reports projected savings rather than actual savings. These two factors lead to projected savings that are based on expectations rather than reality. Third, the trade literature under-represents outsourcing failures because most companies do not want to advertise mistakes (Lacity & Hirschheim, 1995).

Lacity and Hirschheim identify six reasons for undergoing an evaluation of outsourcing as an option. It should be noted that their case studies indicated that senior management had an overall view of the IS function as a cost burden with little strategic value. First, outsourcing was evaluated as a reaction to the efficiency imperative. Most of the companies they studied accounted for IS as an overhead function, so they tended to be evaluated based on cost efficiency. An outsourcing evaluation was initiated either to improve efficiency or to prove the function was already efficient.

Second, outsourcing was evaluated in an effort to acquire new resources, such as machine upgrades, more personnel, or higher budgets. This was either an effort to show that a vendor could not provide the resource at a lower cost and so push management to provide the resource internally, or it was an actual effort to acquire the resources. The third reason was a reaction to the bandwagon effect. Senior management wanted to duplicate the cost savings they read about in the trade press. The fourth reason was to reduce uncertainty. IS demand is erratic, which makes planning difficult. An outsourcing contract could be seen as relatively stable, making planning simpler.

The fifth reason for outsourcing evaluations was to eliminate a troublesome function. This stems from the view of senior management that the IS function is of little strategic value. The only time they notice it is when it is not working. By outsourcing it, they would not have to worry about it. The last reason was to enhance credibility. IS managers rarely break into upper management, and the services they provide are not valued by senior management, so by offering to outsource their department for the good of the company, they demonstrate they are good corporate team players. Often, these

offers amount to an offer to evaluate the outsourcing option in a limited way, based on factors the IS manager is confident outsourcing companies cannot improve.

All of these reasons have at their base the view by senior management that the IS function is of little value—that it is essentially a utility function. Lacity and Hirschheim disagree with this view, summed up best by the following quote discussing comparisons of the IS department to utility type functions:

> These metaphors are based on the assumption that IS services are homogenous...one unit of IS service is equal to any other. The problem with this metaphor is it ignores the idiosyncratic nature of an organization's information needs. Close communication between the organization and IS must occur to accurately relay requirements. As utility users, we typically do not call the power company to communicate our complicated changing business needs. As IS users, we do. So, how is an IS department like electricity?
>
> If the utility metaphor is at all appropriate, perhaps it should be restricted to data processing and telecommunications. These functions are inherently more capital intensive and less labor intensive than applications development, applications support, end user support and IS management. Even then, one might question the prudence of farming out the data center. Unlike true utilities, regulatory bodies do not monitor and control vendor prices. (Lacity & Hirschheim, 1993a, p. 260)

If Lacity and Hirschheim are correct, this mistaken view of IS among senior management could lead to the decision to outsource functions that are critical to the competitiveness of the organization. Doing so could place the organization at risk for a number of reasons, including the need of the outside provider for profit-making, which can lead to excessive fees, poor service, and difficult negotiations at contract renewal periods.

IS Outsourcing in Health Care

There is little research into the practice of IS/IT outsourcing in hospitals or other health care organizations, but it is clear that the practice is gaining attention in the trade press (Beardwood & Alleyne, 2004; Brewin & Perez, 2003; Moon, 2004; Morrissey, 2001; Romano, 2004). In one of the few studies conducted within the health care setting, Wholey et al (2001) examined the determinants of IT outsourcing in health maintenance organizations (HMOs). They used TCE and selected components of organizational theory to develop hypotheses for two distinct studies. In the first study, they characterized IS functions along developmental and operational dimensions, and predicted both that operations would be less likely to be outsourced than development, and that asset specificity increases the likelihood of integration. Asset specificity was hypothesized to be least for data center operations, and higher for claims processing systems, and highest for reporting systems. In the second study, they predicted that an organization with a high IT capability will be less likely to outsource, that the complexity of IT functions in the organization will produce an inverted "u" shape in the propensity to outsource, and that high IT costs will increase the propensity to outsource. The findings from the first study

indicate that HMOs outsource operations more than development, and that HMOs that internalize development are likely also to internalize operations. Asset specificity did increase the likelihood of integration. The second study only demonstrated support for the hypothesis that increased IT costs leads to increased outsourcing.

Lorence and Spink (2004) examined IS outsourcing in health care organizations through a survey of health care information managers in a variety of practice settings. Their survey used only descriptive analysis of the data and found that transcription was the most commonly outsourced function, and that only 1 percent of respondents outsourced the entire IS function. Satisfaction was much higher with in-house performance (74.8 percent) vs. outsourced performance (2.9 percent), with 22 percent expressing no preference. The most commonly cited reasons for outsourcing were to improve patient care (35.5 percent) and to save money over time (22.3 percent). Their results indicate that technical rather than managerial functions were more likely to be outsourced. They also noted that organizations that had higher adoption rates of EHRs were more likely to outsource, but this may not indicate the use of outsourcing to support the adoption of EHRs, as there is a significant endogeneity problem with such an assumption, and their analysis was not capable of handling this problem. Moreover, this study did not provide a theoretical foundation for the outsourcing decision.

Menachemi and colleagues examined the characteristics of hospitals in Florida that outsource information systems (Menachemi, Burke, Diana, & Brooks, 2005). Their findings indicate that rural hospitals are more likely to outsource than urban ones, that smaller hospitals were more likely to outsource than larger ones, that the more strategic

value the hospital placed on the IS function, the less likely it was to outsource, and that there appears to be no association between for-profit status or the reporting structure of the CIO and the level of IS outsourcing. Interestingly, this study did find that the presence of a physician in a senior level IS management position was related to an increased tendency to outsource some IS functions, including the CIO position. The findings of this study are also limited by the descriptive nature of the analysis and the lack of a conceptual model grounded in a theoretical framework.

There is little known about the factors that lead to the decision to outsource selected IS functions among health care organizations beyond the few descriptive studies presented here. What information these studies do provide is not grounded in a theoretical framework, which demonstrates the need to develop a theory-based assessment of the factors associated with the outsourcing decision in the health care setting.

Summary

The confluence of factors leading to the outsourcing decision in hospitals should now be apparent, as should the potential impact that decision could have on their ability to implement necessary IS services successfully. Hospitals face significant cost pressures due to rising national health expenditures, increased use of medical technology, changes in the propensity to consume health care, and changes in health status. Hospitals also face significant competition from various sources, such as physician-owned specialty centers and ambulatory care centers. All of these cost pressures increase the competition for capital, which makes securing funding for expensive IS projects difficult.

Hospitals also face significant pressures to improve quality of care and patient safety. Quality and safety concerns have been brought to the forefront by the IOM reports and groups like Leapfrog and the Department of Health and Human Services through the Office of the National Coordinator for Health Information Technology. Reimbursement and accreditation are now or will soon be tied to demonstrable improvements in quality and safety. At the same time, information technology has been shown to have the potential to decrease costs through automation and streamlining of administrative functions, and to reduce errors in patient care. The latter effect is the result of these systems' ability to provide relevant, timely, useful, and accessible information, leading to more accurate diagnosis and treatment. All of these factors leave hospitals with the pressure to improve the IS services they provide, but with no clear means of acquiring these services.

There is a real possibility that hospital executives will turn to outsourcing as an answer to this problem. The reasons for this include the perception that vendors can provide the service more efficiently and that IS services are utility services that can be acquired on the market much like laundry and housekeeping services. The danger in such a view is that hospitals will choose to outsource the IS functions that have the potential to provide them with a strategic edge, and thereby give up the potential to compete effectively. There is also the danger that the development of IS service by an external vendor may be unsuccessful, because those services are not customized to the organization.

There are a number of arrangements of the IS function within organizations, but the emerging trend is one that acknowledges the varying levels of strategic value of different IS activities. Some IS activities have a strategic impact and value, while others have little or none. For an organization to use IS successfully in a strategic fashion, its outsourcing strategy should recognize this, and retain strategic activities in-house, and then determine on a case-by-case basis which of the non-strategic activities to retain and which to outsource.

At present, there is little research illuminating the decisions hospitals are making in this regard, and none of it is theory-based. How much of the IS functions are hospitals outsourcing? Which ones are they outsourcing? Do individual hospital characteristics influence the degree and type of outsourcing? Does system membership, and the type of system influence the answers to these questions? These are the questions that this research is attempting to illuminate. The answers to these questions are clearly important in understanding the behavior of hospitals in their attempts to implement new IS services, but they are equally important in laying the groundwork for further research into the question of how these decisions actually affect cost, quality, and safety.

CHAPTER 3: THEORETICAL FRAMEWORK

Introduction

The purpose of this chapter is to develop a conceptual framework that delineates the organizational and environmental factors influencing the decision of whether to outsource some or all of an organizations IT functions, and which of those functions to outsource and which to retain in-house. The framework is developed from a synthesis of transaction cost economics and strategic management theories. The chapter will first address the suitability of these theoretical perspectives to the question of IT outsourcing. Next will be a discussion of each of the individual frameworks, followed by the presentation of a synthesis of these two frameworks that is particularly well suited to this issue. This will be followed by the development of a conceptual model and the derivation of testable hypotheses that incorporates the IS core capabilities domain model introduced in the previous chapter.

The decision of whether to provide information systems internally or to acquire them on the market may be viewed as a case of vertical integration. Vertical integration is the internalization of the steps in the production and distribution process (Mick, 1990). In the hospital industry, this is often thought of as the stages of caring for the patient, so vertical integration might refer to the acquisition of a primary care clinic on the input side, or a nursing home on the output side. Clement (1988) developed a more precise

definition of vertical integration within the acute care hospital industry. This definition defines the product of the hospital as a unique or customized bundle of services provided on demand as each patient presents with specific treatment requirements. This bundle of services is assembled based on the information gathered and processed through a variety of activities, both clinical and non-clinical. Therefore, information systems are integral upstream and proximal inputs to the customization process, as they provide the information for many, if not most, of the decisions regarding which services are provided to patients.

Mick (1990) analyzed the case of vertical integration in health care within the opposing frameworks of transaction-costs economics (TCE) and strategic management theory. Mick argues that they are opposing because these two frameworks contend that vertical integration strategies arise for completely different reasons. Transaction cost economics argues that firms vertically integrate (and de-integrate) in order to reduce transaction costs, an essentially efficiency-based argument. Strategic management theory, however, argues that vertical integration is a strategy used to gain competitive advantage, even in the case where transaction and production costs may increase. Mick proposes a number of factors as contributors to these opposing views, and then proposes a synthesis of the frameworks that allows for the differing predictions of when organizations choose to integrate vertically. This synthesis includes a broadened conceptualization of the environment that reflects uncertainty and complexity, and the inclusion of factors from both frameworks for the vertical integration decision. This debate between efficiency and

strategy as the driving forces behind vertical integration is common in the literature on outsourcing information systems.

Steensma and Corley (2001) used transaction costs economics, an options perspective, and a resource-based view of the firm in an examination of the effect of organizational context on firm boundaries for technology sourcing. Steensma and Corley argue that managers will consider all three perspectives in making integration decisions, but that the risk-taking orientation of the managers will also affect their decisions. Further, they argue that organizational context, as evidenced by the firms' incentive system, general risk orientation, and wealth, will moderate the manager's risk-taking orientation. Their empirical analysis demonstrated general support for the notion that organizational context affects managerial risk-taking behavior, which in turn moderates the affects of the three frameworks on the firms sourcing decisions.

Afuah (2001) examined the effect on firm performance of vertically integrated firms subjected to a technological change, also using transaction cost economics along with the knowledge-based view of the firm[2] to frame the question. Afuah was interested in the effect of what he calls a competency-destroying technological change on firms that either are or are not vertically integrated into that technology. Competency-destroying technological changes are those that are so different from the existing technology that the skills and knowledge of the organization become obsolete. The integrated firm is thus

---

[2] The knowledge-based view of the firm is a strategic management framework that classifies knowledge as either explicit or implicit, posits that firms consist of collections of both kinds of knowledge, and that this unique collection of knowledge is a main determinant of the firm's competitive advantage (Grant, 1996).

handicapped in attempting to exploit the new technology because it is embedded in the old. The most interesting notion in this paper is that organizations may not want to integrate backwards into areas where there is rapid technological change, because it will be more efficient to acquire the new technologies on the market than to learn to produce the new technology internally every time the technology changes.

Poppo and Zenger (1998) also explored the differences between the transaction cost economic and strategic explanations for the information outsourcing decision. They included the problem of measurement difficulty, an aspect of agency theory, and production costs and economies of scale, aspects of neoclassical economics in their model. Their model conceptualized the effect of these frameworks on market or firm performance, which then led to the boundary choice. When firm performance is higher than market performance, the firm would integrate, and the firm would outsource in the opposite case. Their general findings support the TCE framework, i.e., that as asset specificity increases firms tend to integrate, and as asset specificity decreases, firms de-integrate. Their findings do not provide support for the strategic, knowledge-based view of the firm. They attribute this to a similar phenomenon of rapid technological change discussed by Afuah. Their findings also support the contention that measurement difficulties negatively affect performance, both internally and in the market, although the findings were mixed in the market.

Most of the studies discussed previously did not empirically examine the IS function. Ang and Straub (1998) looked at the decision to outsource the IS function in the banking industry, another industry that, like health care, is an intense user of information.

However, unlike the previous studies, they did not use a strategic framework at all; rather, they used both neoclassical and transaction cost economics, along with the notion of slack resources. Essentially, they hypothesized that according to neoclassical economics, firms will outsource when it reduces production costs below what it costs to internalize the function; and that according to TCE, firms will outsource when transaction costs are below what they would be to internalize the function. Slack resources were hypothesized to lead to internalizing the IS function. Their findings support the assertion that production costs play the major role in the outsourcing decision, but that transaction costs did moderate the decision to some extent. Slack resources did not explain the outsourcing decision. The size of the firm (a control variable in this study), however, had a significant impact on the decision to outsource, with smaller firms more likely to outsource.

Nam et al (1996) investigated outsourcing the IS function within a TCE framework. They characterized the decision by an organization to outsource along two dimensions: the extent of substitution by vendors and the strategic impact of IS applications. The first dimension refers to how much in-house operations are transferred to outside vendors. The second dimension refers to the effect on business goals and operations of the outsourcing decision. They develop several hypotheses along these dimensions, two of which are relevant for this discussion: (a) as asset specificity of the relevant IS functions increases, the extent of substitution by vendors decreases and the strategic impact of IS applications increases; (b) as the uncertainty of IS functions increases, the extent of substitution by vendors decreases. Their empirical data did not

support either of these hypotheses, which is contrary to the findings of other studies. It is possible these findings are the result of sampling or measurement problems, and the lack of a strategic framework, despite the operationalization of the outsourcing decision along strategic lines.

The nature of the outsourcing arrangement is not dichotomous. There are typically a variety of levels of outsourcing arrangements, from a few selected functions to the entire enterprise-wide function. Slaughter and Ang looked at the specific case of outsourcing IS employment (Slaughter & Ang, 1996). This study used a labor economics framework, which views workers as moving freely and frequently between various jobs to take advantage of better opportunities. Their model has the need to focus on the core business, the need for flexibility, and the dynamics of the IS skills markets as the determinants of the choice to in-source or outsource the IS employees. They found the level of outsourcing was positively associated with the desired to focus on core activities, the need for greater flexibility, and the need for IS skills that were relatively scarce in the marketplace. This notion of focusing on the core business is similar to the strategic versus efficiency question (Feeny & Willcocks, 1998a, 1998b; Lacity & Willcocks, 2001). If the IS function was viewed as a core function, then firms were more likely to maintain the function in-house, indicating a view that the IS function is of strategic value.

In the only theory-based study conducted within the health care setting, Wholey and colleagues (2001) examined the determinants of IT outsourcing in health maintenance organizations (HMOs). They used TCE and selected components of organizational theory to develop hypotheses for two distinct studies. In the first study,

they characterized IS functions along developmental and operational dimensions, and predicted both that operations would be less likely to be outsourced than development (which is counter to other literature, since operations can be considered less strategic in nature), and that asset specificity increases the likelihood of integration. Asset specificity was hypothesized to be least for data center operations, and higher for claims processing systems, and highest for reporting systems. In the second study, they predicted that an organization with a high IT capability will be less likely to outsource, that the complexity of IT functions in the organization will produce an inverted "u" shape in the propensity to outsource, and that high IT costs will increase the propensity to outsource. The findings from the first study indicate that HMOs outsource operations more than development, and that HMOs that internalize development are also likely to internalize operations. Asset specificity did increase the likelihood of integration. The second study only demonstrated support for the hypothesis that increased IT costs leads to increased outsourcing. HMOs are not the same kind of organizations as hospitals, so the applicability of this study to hospitals may be limited.

Summary

The theory-based literature on IS outsourcing demonstrates clearly competing views of the determinants of the decision, along with a number of attempts to combine various frameworks, particularly TCE and strategic management theory. The empirical findings are mixed, which may be a result of measurement difficulties arising from TCE, or from variations in the strategic frameworks applied in these studies. Further, none of it exists in the context of the hospital, and only the Wholey study was done in a health care

related industry. Given the prevalence of the TCE and strategic frameworks in this area, they will be used to develop the framework for this study.

Transaction Cost Economics

Williamson (1975, 1979, 1981, 1985, 1991a, 1991b) has been the primary developer of transaction costs economics or transaction cost theory. Markets that balance supply and demand through efficient exchanges between individuals govern traditional economic behavior. Production is most efficient for specialized firms that have achieved economies of scale, yet many organizations internalize the production of functions that are available in the market, even when they may not be able to produce them as efficiently. Williamson proposes that is because companies must consider not only production costs, but also transaction costs. Transaction costs are coordination costs, or the costs of monitoring, controlling, and managing transactions. If transaction costs can be lowered sufficiently to offset the production efficiencies external providers achieve through economies of scale, the company will choose to internalize the function. Eliminating the costs of managing the interaction between the firm and the outside provider by internalizing the function lowers transaction costs.

Williamson's view is that managers will make decisions as proposed by Simon (1961). Managers make decisions based on an evaluation of the alternatives and the costs associated with each alternative, where they choose the least costly alternative. Managers make these decisions with the information they have within the inherent limits of human decision-making, or bounded rationality, a concept also devised by Simon. Each transaction presents two essential choices: produce internally (hierarchy) or acquire from

a vendor (market). There is a third intermediate option that Williamson develops in later writings that he calls hybrid structures, which include joint ventures, franchises, and the like. Williamson uses the terms markets and hierarchies while referring to transactions that take place outside or inside of the organization, while hybrid structures fall somewhere between. A hierarchy then represents a single organization or firm, hybrid structures represent cooperative arrangements between organizations, and the market represents everything outside of the organization and its cooperative arrangements with other organizations.

The basic construct of TCE then is cost efficiency. Williamson acknowledges that costs are difficult to assess, so he develops three constructs that serve as a means of estimating costs. These are the type of transaction, the threat of opportunism, and uncertainty.

Williamson maintains that organizing transactions in an efficient way requires the consideration of both production and transaction costs. In Williamson's words: "The criterion for organizing commercial transactions is assumed to be the strictly instrumental one of cost economizing. Essentially this takes two parts: economizing on production expense and economizing on transaction costs." (Williamson, 1979, p. 245); and "Holding the nature of the good or service to be delivered constant, economizing takes place with reference to the sum of production and transaction costs, whence tradeoffs in this respect must be recognized." (Williamson, 1985, p. 22)

The general case Williamson builds is that when economies of scale exist, markets are able to provide lower production costs than hierarchies. This is the basis for

the position that outsourcing vendors can provide lower production costs than internal IS departments (Lacity & Hirschheim, 1993a, 1993b, 1995). Markets also incur higher transaction costs because the firm must spend money establishing contracts, monitoring supplier behavior against the threat of opportunism, settling disputes, and so on. On the other hand, Williamson argues that hierarchies have higher production costs than markets because the firm cannot achieve the same economies of scale as the market when producing internally for their own consumption. Hierarchies have lower transaction costs than markets because, according to Williamson, internal employees are less prone to opportunism and structures to monitor employees are already in place.

Williamson proposes that when market failures occur, costs accrue to the parties in a transaction. These market failures and associated costs give rise to organizational arrangements designed to minimize these transaction costs. Thus, the unit of analysis in TCE is the transaction, or the exchange between the buyer and the seller. Williamson characterizes transactions and then develops a framework that relates the type of transaction to the choice of a market or hierarchy.

Transactions are characterized based upon their frequency and asset specificity. Frequency is simply how often a transaction occurs, which can be either occasionally or recurrent. Frequency refers to buyer activity in the market, or how often a firm seeks to initiate the transaction. For example, capital acquisitions could be characterized as occasional, while the purchase of supplies could be characterized as recurrent.

Asset specificity refers to the degree of customization of an asset, or how specific the asset's use is to the firm in question. Other firms cannot readily use an asset with high

specificity. Williamson cites six types of asset specificity: site, physical, human, brand name capital, dedicated assets, and temporal. Site specificity arises when stages in production are located in close proximity to reduce expenses (e.g., inventory and transportation costs). Physical specificity refers to specialized equipment required to produce a component. Human specificity refers to how specialized the knowledge, skills, training, and experience of the workforce need to be to produce the component. Williamson relies on the work of Hayek (1945) as the foundation for human asset specificity and the concept of idiosyncratic knowledge. This is important in general, as many traditional economic theories tend to treat labor inputs as homogenous, and the idea of idiosyncratic information needs is central to the debate over the strategic value of information systems to organizations. Moreover, as discussed previously, the process of providing care to a patient in a hospital consists of the delivery of a customized bundle of services, developed based on assessments and diagnoses made repeatedly throughout a patient stay. The information needs for this process are highly specific, or idiosyncratic, to each individual patient's individual episode.

Brand name capital refers to the reputation developed for a product or service. Dedicated assets are investments in the general plant made at the request of a particular customer. Lastly, temporal specificity is similar to site specificity, refers to the need for timely responsiveness by on-site employees.

Williamson characterizes the general asset specificity of transactions as non-specific, idiosyncratic, or mixed, and then develops a framework based on transaction frequency and asset specificity that categorizes transactions into types. This framework

can be seen in Table 2. Williamson then matches each transaction type to the governance structure most efficient for that type of transaction, as show in the Table 3.

Table 2. Six Types of Transactions with Illustrative Transactions (adapted from Williamson, 1979, page 247)

	Asset Specificity		
Frequency of Transaction	Non-specific	Mixed	Idiosyncratic
Occasional	Purchasing standard equipment	Purchasing custom equipment	Constructing a plant
Recurrent	Purchasing standard material	Purchasing customized material	Site-specific transfer of intermediate product across successive stages (or, the provision of patient care by a variety of caregivers in a variety of settings)

Table 3. Matching Governance Structures with Commercial Transactions (adapted from Williamson, 1979, page 253)

	Asset Specificity		
Frequency of Transaction	Non-specific	Mixed	Idiosyncratic
Occasional	Market governance with contract equivalent to a sale	Trilateral (market) governance	
Recurrent		Bilateral (market) governance	Unified (hierarchical) governance

This mapping indicates that there is only one transaction type that naturally lends itself to the hierarchical governance structure (i.e., vertical integration)—the recurrent-idiosyncratic transaction. The market provides non-specific transactions more efficiently, regardless of frequency, because of the lower production costs achievable through economies of scale. This is true because the transaction is homogenous and the buyer

does not need to monitor the vendor, which makes transaction costs minimal. Essentially, this transaction is equivalent to that of a sale, where the specific identity of the buyer and seller are irrelevant. In such a case, the main criterion for the choice of a market or hierarchy is production costs.

The market is also the most efficient strategy for both occasional mixed and idiosyncratic transactions because the production costs of a hierarchy are necessarily less efficient, since the capital and staff acquired for internal production are only used periodically. Transaction costs resulting from monitoring the vendor can be expensive in these types of transactions, according to Williamson. This concern can be managed by the use of third party arbitrators to resolve disputes.

Williamson is less assertive about mixed recurrent transactions, but still maintains that markets are more efficient, primarily due to scale economies that may be attainable through the non-specific aspects of the transaction. Both parties in the transaction have an incentive to maintain the relationship—the buyer through a steady supply and the vendor through a steady revenue—vendor's in particular may be interested in maintaining the relationship, since they are required to learn some specifics about the buyer's business.

Hierarchies are more efficient structures for recurrent idiosyncratic transactions, because (1) the market's economies of scale advantage vanishes, because the frequency of the transaction allows the firm to achieve equivalent economies, and (2) the specific nature of the assets necessary to the transaction makes it less transferable to other users (i.e., the market cannot find enough ready buyers to achieve greater economies of scale). Because in this case production costs are essentially equal between markets and

hierarchies, the main criterion for the decision becomes transaction costs. Williamson maintains that transaction costs inside an organization are less than in the market, since the internal monitoring systems do not need to be as complex as in the market. This type of transaction characterizes the process of patient care delivery, which has already been discussed as highly asset-specific or idiosyncratic, but which is also recurrent, taking place multiple times a day for individual patients, with each episode requiring specific information. Williamson notes that the market can be more efficient in this type of transaction if the buyer is willing to sacrifice some of the customized features of the transaction for a more standardized product.

Williamson adds to this framework the notion of opportunism, which he characterizes as "...self interest seeking with guile..." (Williamson, 1975, p. 26). This is only a problem when there are a small number of suppliers in the market, leaving the buyer with limited choices and little bargaining power. Williamson gave particular attention to the contract renewal stage, since the bargaining situation could then transform to one of small numbers, because the current vendor had firm-specific knowledge that rendered competitors at a disadvantage. Under such circumstances, the vendor may behave opportunistically in order to gain more favorable contract provisions. The result is that the vendor may extract excess fees from the buyer, or not perform as required, leading the buyer to higher costs of monitoring and enforcing the contract. Under such conditions, the scale may tip to favor the hierarchical structure over the market.

Williamson provides prescriptions for the type of contract to be used to reduce the impact of the threat of opportunism, depending again on the type of transaction, as shown in the Table 4. Classical contracting is indicated when buyer and seller exchange discrete homogenous products or services. There is no need to know anything specific about the vendor, and the vendor does not need to know anything specific about the buyer. These are non-specific transactions purchased on the market, and there is no need for special contract provisions.

Table 4. Matching Contracts to Transaction Types (adapted from Williamson, 1979, page 253)

	Asset Specificity		
Frequency of Transaction	Non-specific	Mixed	Idiosyncratic
Occasional	Classical contracting	Neoclassical contracting	
Recurrent		Relational contracting	

Neoclassical contracts include mechanisms for dispute settlement, often including third-party arbitration. This type of contracting is appropriate when the transactions are occasional and mixed or idiosyncratic. Since these transactions are only occasional, not all contingencies can be anticipated in the contract. Under the threat of opportunism, Williamson argues that highly specific occasional transactions may favor hierarchies, unless the contract adequately spells out dispute resolution procedures. Relational contracts are characterized by their frequent adaptation, which results from the close relationship recurrent idiosyncratic transactions require between buyer and vendor.

Uncertainty is the last element of Williamson's framework. Uncertainty as Williamson uses it refers to the inability to gather all of the information necessary to

make an informed decision. Uncertainty increases transaction costs for asset-specific transactions, because the buyer and vendor must spend considerable time and money arranging for contractual mechanisms for adaptations and disputes. In this case, the buyer has three choices: sacrifice customized features to make the transaction less specific, negotiate a more elaborate contract, or internalize the transaction. Uncertainty does not affect the relative advantages of markets versus hierarchies for non-specific transactions, because trading relations in the market are easily arranged, regardless of the degree of uncertainty present. In Williamson's words:

> As indicated earlier, nonspecific transactions are ones for which continuity has little value, since new trading relations can be easily arranged by both parties. Increasing the degree of uncertainty does not alter this. Market governance (classical contracting) thus holds across standardized transactions of all kinds, whatever the degree of uncertainty.
>
> Matters change when asset specificity is introduced. Since continuity now matters, increasing the degree of paramateric uncertainty makes it more imperative to organize transactions within governance structures that have the capacity to "work things out." Failure to support transaction-specific assets with protective governance structures predictably results in costly haggling and maladaptiveness. Efforts to restore a position on the shifting contract curve may be forgone for this reason. The intrusion of behavioral uncertainty, which is associated with

> unique events, compounds the difficulties. (Williamson, 1985, pages 79-80)

In the case of intermediate levels of asset specificity, where hybrid organizational forms are preferred, uncertainty shifts the preferred form away from hybrids and toward either markets or hierarchies. This is because the adaptations required by increasing levels of uncertainty cannot be made unilaterally, as they would be in a market, or by fiat, as they would be in a hierarchy (Williamson, 1991a). In a systematic review of the empirical support for TCE, David and Han (2004) found that of 37 tests of the relationship between uncertainty alone and organization form (market-hierarchy), only nine showed increasing uncertainty led to hierarchy, and six showed the opposite. However, over half of the 21 tests of the interaction between asset specificity and uncertainty on the choice of market or hierarchy were supportive.

Criticisms of TCE

There are many criticisms of TCE, perhaps most notably those of Perrow (1981) and Ghoshal and Moran (1996). Perrow's critique consists of two main points. First, he argues that all of the factors that contribute to increased transaction costs in the market—opportunism, uncertainty, bounded rationality, and so on—also exist within the firm. In fact, Perrow points out that Williamson acknowledges this explicitly in *Markets and Hierarchies*. However, once acknowledged, Williamson does not return to this problem, and essentially leaves the matter of the ability of an organization to mitigate internal transaction costs as a given, primarily through fiat. Second, Perrow argues that the motivation for vertical integration is market power and dominance, not efficiency gains

through reduced transaction costs, an argument similar to that found in the strategy literature.

Ghoshal and Moran's critique focuses on the concept of opportunism. They argue that Williamson's formulation of opportunism does not adequately address its components, specifically the differences between the propensity to behave opportunistically and opportunistic behavior itself. Further, they argue that the ability of organizations to control opportunistic behavior through fiat and other types of rational controls, may actually lead to increased levels of opportunistic behavior within the organization. The result is a self-fulfilling prophecy and an endless feedback loop between the level of opportunistic behavior and the controls instituted to prevent it. Ghoshal and Moran argue that this situation could well result in sapping the competitive ability of the organization.

More recently, Slater and Spencer (2000) have criticized TCE on the basis of the apparent contradiction between the notion of bounded rationality on the one hand, and the elaborate system for efficiently organizing transactions on the other. How is it that managers so constrained by bounded rationality that they cannot determine all of the potential pitfalls of conducting transactions are able to analyze the characteristics of those transactions and determine the most efficient governance structure for organizing those transactions?

Summary

In summary, Williamson proposes that decision makers will choose the most cost efficient governance structure—markets, hybrids, or hierarchies—and that each structure

has inherent cost advantages depending on the transaction type and frequency, the threat of opportunism, and the degree of uncertainty. Markets are more efficient than hierarchies when only production costs are considered, because of economies of scale. Hierarchies are more efficient than markets when only transaction costs are considered, because of internal control mechanisms that prevent opportunism. Markets are more efficient than hierarchies when both production and transaction costs are considered, except for recurrent idiosyncratic transactions, asset-specific transactions under conditions of high uncertainty, or transactions with a small number of suppliers. Markets can be made more efficient than hierarchies for recurrent idiosyncratic transactions by sacrificing custom features (i.e., reducing the specificity of the transaction). Lastly, appropriate contracting can improve the relative efficiency of markets over hierarchies.

Strategic Management Theory

There are a number of theories of strategic management, but the most commonly used are the resource-based view of the firm (RBV) and the knowledge-based view of the firm (KBV). The RBV stems from the work of Penrose and more recently Barney (Barney, 1991; Penrose, 1959). The KBV stems primarily from the work of Grant (Grant, 1996). The RBV is the more common and more developed version of Strategic Management Theory.

Penrose viewed the firm as a collection of resources with productivity potential, bound together by an administrative structure. Barney placed these resources into the physical, human, and organizational categories. A firm's capabilities are determined by its ability to coordinate and direct those resources in a productive activity. Firm capability

is a relative concept. If a firm's capability is better than its competitors, then that capability becomes a firm competence. Bounded rationality is incorporated into the RBV in the sense used by Simon (1960); therefore, bounded rationality has an impact on the capability of the firm through the organization's embedded routines and management's view of the environment.

The RBV assumes that firms will try to maximize long-term profits through the development and use of its resources. This focus on profit and the emphasis on the value side of a firm's activity, rather than the cost side, reflect the entrepreneurial orientation of the strategic framework. In relation to the choice between markets and hierarchies, the RBV uses the firm as the unit of analysis rather than the transaction. This implies that the nature of the firm's resources and capabilities should determine what the firm does internally and what it procures from the market. In this view, the resources considered include all of those affected directly or indirectly by the transaction. Further, the resource is evaluated within the overall organizational context of supporting resources. For example, a highly firm-specific resource will decrease in value when transferred to another firm, because the new environment lacks the supporting resources of the original firm (this is the basis of the position that a custom developed [i.e., in-house or purchased but customized rather than out-of-the-box] IS may generate strategic advantage). Moreover, the ability of the firm to develop innovative applications of its firm-specific resources, which its competitors cannot easily duplicate, provides a distinct competitive advantage.

Lastly, the RBV of the firm views the limits of the existing management as the limiting factor in firm growth. Existing management develops idiosyncratic knowledge that is specific and uniquely valuable to the firm. New members take time to become socialized and integrated into the team, and so management becomes a fixed factor of production. Strictly speaking, this view limits the rate of expansion of the organization rather then the actual size.

Harrigan developed a strategic framework that specified the dimensions of vertical integration (Harrigan, 1983, 1984, 1985a, 1985b). It should be noted from the preceding discussion of the RBV that the focus of strategic perspectives on vertical integration is on developing competitive advantage, rather than minimizing costs. Harrigan also takes this view. Harrigan develops a detailed definition of vertical integration that includes the degree of integration, the breadth of integration, the stages of integrated activity, and the form of ownership. The degree of integration can be either full, tapered, or none, reflecting the degree of the input or output transferred in-house. The breadth of integration can be broad or narrow, reflecting the number of activities along the vertical chain the organization engages in. The stages of integrated activity can be few or many, reflecting the distance along the vertical chain from either supply of raw materials to distribution of finished products that the firm engages in. The form of ownership can be either wholly owned or quasi-integrated, reflecting the degree of ownership and control.

Harrigan proposed five variables that moderate the decision to vertically integrate: demand uncertainty, the volatility of competition, bargaining power, corporate-strategy

needs, and industry evolution. Demand uncertainty will tend to favor markets over hierarchy and stable demand will favor integration. Markets characterized by stable competition favor vertical integration, including greater breadth and more stages of integration than in highly competitive markets. These two concepts reflect the general concept of uncertainty (Mick, 1990). Bargaining power refers to the firm's ability to influence others to supply needed inputs or distribute outputs. Bargaining power is characterized by having a product with no substitutability, having alternative suppliers or distributors, having the existing ability to make the needed good or service, and having dependent suppliers or distributors. Bargaining power tends to reduce the likelihood of vertical integration.

Corporate-strategy needs are the larger strategic decisions of the firm that may argue for integration, even though it may involve risks and even penalize certain business units. Such a strategy could include creating technological leadership or developing organization-wide synergies. In the case of technological leadership, Harrigan maintains that firms may choose to integrate in order to establish such leadership and to position themselves to capitalize on the next technological innovation. Such an approach can also serve to retain strategic capabilities that otherwise might be lost. Harrigan argues that executives should view the integrated businesses as reservoirs of capabilities rather than streams of cash flow. For example, hospital systems might choose to internalize certain service lines and so develop an expertise in those areas, and attract and retain qualified staff to those services (i.e., develop strategic capability). Another example would be the move to integrate physicians into the system. Organizations may integrate to achieve

firm-wide synergies even at the expense of particular business units. For example, hospital systems might integrate into nursing home services to capture patients that would otherwise be discharged, even though these internal nursing home services may not be able to function at the most efficient capacity, as they possibly could if they were not integrated. Therefore, corporate strategy needs can trump the previously discussed factors, as when vertical integration may be part of a larger corporate strategy. In general, Harrigan argues that in the early and late phases of industry evolution, vertical integration is unwise, although the pace of technological change and the decision to be a technological leader or follower can moderate this.

TCE and Strategic Management Theory

Mick (1990) proposed a synthesis of TCE and Harrigan's strategic management approach to vertical integration. In this proposal, Mick emphasizes the differing predictions of each approach with regard to uncertainty and complexity in TCE and demand uncertainty and volatility of competition in strategic management. Taken with Harrigan's other factors, particularly bargaining power and corporate strategy needs, the differences between these approaches becomes apparent.

Mick offers several explanations for the differing predictions of each approach. The first reason is that the two theories are talking about different things, even though they may both refer to vertical integration. For Williamson, the resulting choice of markets versus hierarchies is simply a result of the low cost alternative of managing the transactions that make up the exchange. Organizational structure is not addressed, so the constructs of organization boundary and environment are largely left alone. This is

probably a function of his being an economist rather than an organization theorist. Harrigan, on the other hand, pays a great deal of attention to the phenomenon of integration and the different organizational forms that it can take. As noted earlier, she describes integration along the dimensions of the breadth, stages, degree of internal transfers, and form of ownership. Fundamentally, Mick argues that the two are not describing the same phenomenon.

The second explanation Mick offers mirrors the first. The two approaches view organizations differently. TCE views organizations and their boundaries and environments as secondary to the transactions that give rise to them, while strategic management views them as central to the organizations' management. The strategic orientation sees management as important and having influence, including over what transactions to engage in and how to structure the organization. Again, to be fair, Williamson ascribes importance and influence to management, particular in later writings (Williamson, 1991a, 1991b), but he consistently argues that economizing, specifically first-order economizing,[3] is the most effective strategy.

The third and most striking explanation for the conflicting predictions between these approaches is the differing conceptions of uncertain and complex environments. Again, Mick cites Williamson's brief treatment of the organizational environment and the concepts of uncertainty and complexity. For Williamson, opportunism is the source of

---

[3] First-order economizing is the efficiency gain achieved through the elimination of bureaucracy and waste, while second-order economizing is the increased allocative efficiency gained through the elimination of deadweight loss (Williamson, 1991b).

uncertainty, and opportunism is a feature of the environment. He makes little attempt to characterize the environment itself. As has been described earlier, for Williamson, integrating can control behavioral uncertainty. Harrigan follows the tradition of organization theorists, who have spent a great deal of time and effort describing the environment and environmental complexity and uncertainty. In Harrigan's view, a highly complex and uncertain environment spells danger for integration activities, which impede an organization's ability to respond quickly to changing market conditions.

The last explanation Mick offers is the fundamental perspectives of each approach. Williamson focuses on efficiency, again a reflection of his basic economic orientation. Much like organization structure, Williamson viewed power as a result of economizing. If integration leads to greater efficiency, greater power will be the result. Harrigan does not address the question of efficiency, which is consistent with strategic management perspectives that subordinate efficiency to strategic imperatives. Harrigan assumes firms will engage in integration activities with the explicit purpose of gaining power over competitors.

In his synthesis of these two approaches, Mick proposed a richer conception of the environment along the two dimensions of environmental forces and market actors. His argument is that various combinations of market and environmental characteristics will produce differing pressures towards or away from integration. His proposed view of the environment borrows from the existing literature on the topic and includes the dimensions of munificence, complexity, dynamism (stability or instability), and uncertainty. Mick also argues that integration and de-integration activities occur together

within an organization, which fits nicely with Harrigan's rich definition of vertical integration. In other words, firms may be engaged in differing stages, depths, and breadths of integration and de-integration activity individually and within an industry. An expanded environmental context would allow for influences in both directions.

Mick argues that transaction cost considerations are one aspect of the overall vertical integration decision process, to be taken along with other factors. Tsang makes a similar argument in a discussion and proposed synthesis of TCE and RBV explanations for joint ventures (Tsang, 2000). Tsang conceptualizes the benefit of integration as the value created by integration (V) and the savings in transaction costs (TC) or the benefit of integration = V + TC. The net benefit of integration must account for the costs of management (MC) and production (PC) of the focal firm relative to other firms in the market, so the net benefit of integration = (V + TC) – (MC + PC). Mick also includes production costs in his synthesis. Note that Tsang does not consider the transaction cost of internal transfers as large enough to be included. TCE alone does not recognize either added value from the integration activities or production costs (this is not strictly true, but Williamson considered production costs to be essentially equal in idiosyncratic recurrent transactions), so the net benefit of hierarchies over markets is simply the difference between TC and MC (TC – MC). This conceptualization clearly illustrates how TCE can be thought of as a component of the strategic decision process. Mick states "...transaction cost thinking widens, but does not replace, strategy formulation necessitated by changing environmental circumstances." (Mick, 1990, p. 229)

As noted above, Mick also includes the concept of comparative production costs as a variable in the integration decision, calling economies in production costs "...the most obvious reason an organization would integrate..." (Mick, 1990, p. 230, p. 230). Mick's model also includes the costs of internal transfers and market exchanges. He also includes Harrigan's variables of bargaining power, corporate-strategy needs, and industry evolution. In summary, then, Mick proposes that the interaction between environmental factors and market actors determines the degree of uncertainty and complexity in the environment, which moderates the five variables influencing the integration decision. These five variables are comparative production costs, comparative transaction costs, bargaining power, corporate-strategy needs, and industry evolution.

Conceptual Model

Core IS Capabilities

The IS core capabilities model (Feeny & Willcocks, 1998a, 1998b; Lacity & Willcocks, 2001) introduced in Chapter 2 represents a framework for organizing the IS function. The model is not developed within the context of a theoretical framework, but its roots in both TCE and SMT are evident. First, from the SMT perspective, the model is based on the idea that organizations should focus on their core capabilities and minimize, eliminate, or outsource everything else. Moreover, the authors clearly state their view that the IS function has strategic value when they argue that outsourcing everything except the IS governance function (what they call the minimalist strategy) makes it impossible for the organization to remain informed of its demand-side needs and in control of its IT investments. In this regard, their position amounts to: (1) there are aspects of the IS

function that are core, or of clear strategic value to the organization, and (2) it is unwise from a strategic point of view to outsource those functions.

Second, from a TCE perspective, the model acknowledges that there are certain other aspects of the IS function that are not of strategic value, but are more operational or commodity-like in nature. These specific functions are candidates for outsourcing. Presumably, since there are no strategic reasons for making the determination, this choice will be made based on efficiency considerations, a classic application of TCE. The non-strategic functions that are idiosyncratic, or high in asset specificity, would more likely be retained inside the organization, while the more generic functions would more likely be outsourced.

With this understanding of the TCE and SMT foundation of this model, it becomes possible to delineate which IS functions are of strategic value and which are not. This in turn allows the prediction that strategic considerations will drive the sourcing decisions for the strategic functions, and transaction cost considerations will drive the sourcing decision for the non-strategic functions. The IS Core Capability Domain discussed in Chapter 2 (Feeny & Willcocks, 1998a, 1998b; Lacity & Willcocks, 2001), is reproduced below in Table 5. Non-strategic functions are those that are generic to the provision of IS, like the network infrastructure and hardware installation and support. Strategic functions are those that have the ability to leverage the unique capabilities of the firm for competitive advantage, which for acute care hospitals includes all of the clinical information systems, high-level management support systems, and governance activities. Those IS functions that are of such strategic value to the organization that they should be

Table 5. IS Core Capability Domain (Feeny & Willcocks, 1998a, 1998b)

	Strategy	→	**Enactment**
Information Management (Policy)	Positioning of IT Role**	IS/IT Sourcing Strategy**	IT Management Practices**
Information Systems (Application)	Business/IT Relationship Development**	Business/IT Systems Vision**	Systems Development *
Information Technology (Delivery)	IT Architecture Scope and Design**	IT Platform Construction *	Operational Services *

* Potentially outsourced services and core capability monitoring/facilitation.
** Capabilities retained in-house.

retained in-house fall in the area indicated in the table by the **, and those that are of less strategic value and can be potentially outsourced fall in the area indicated by the *.

Figure 2 depicts a conceptual model that incorporates the theoretical factors driving the sourcing decision. This model, coupled with the core capabilities framework shown in Table 5, allows for the development of a series of hypotheses.

The first set of hypotheses are designed to answer the first research question: what factors are associated with outsourcing of IS functions?

Asset Specificity

The more specific or uniquely customized the IT assets a firm has, the less likely it will be able to replace those assets with those from external service providers. If external service providers do offer an alternative to specific assets, the cost will be higher than for non-specific assets, because of the inability to generate economies of scale. The

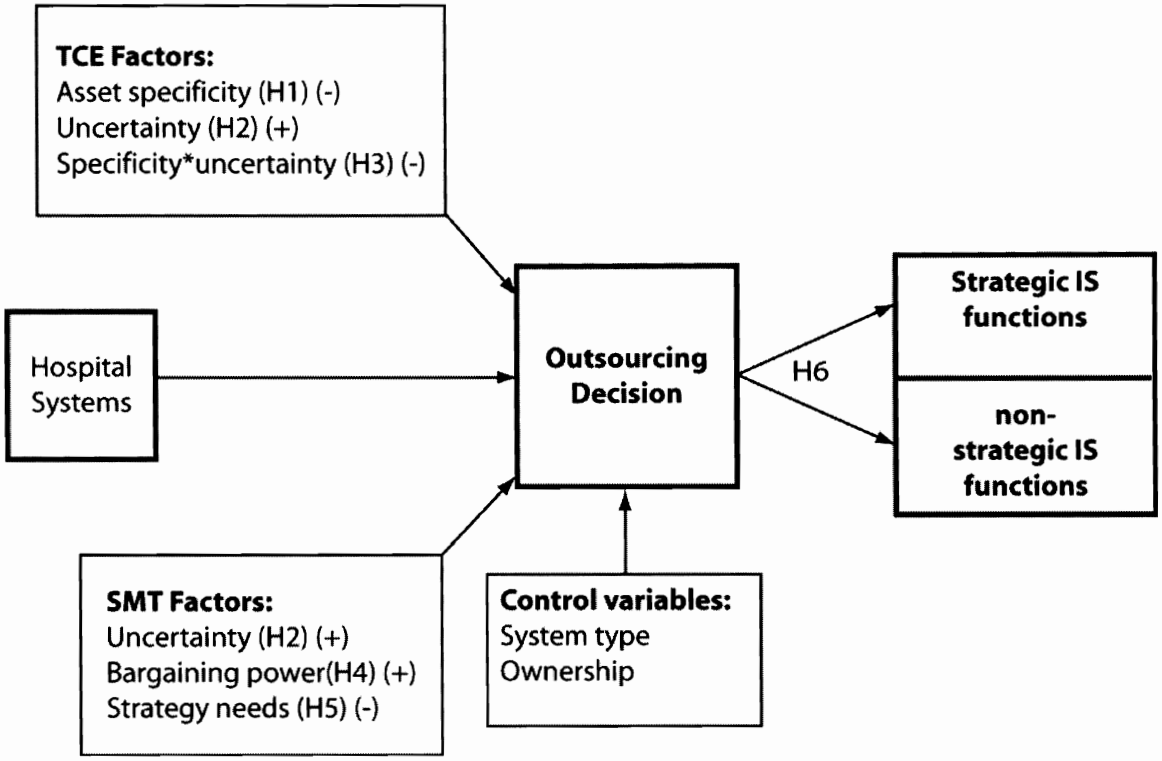

Figure 2. Conceptual Model of the IS Outsourcing Decision in Hospital Systems

degree of specialized skills required is a commonly used measure of asset specificity (David & Han, 2004). In general, the higher the degree of asset specificity, the greater theneed for specialized IT skills to manage those assets, and the less likely the system will be to outsource.

H1: The greater the level of specialized IT skills within the system, the lower the extent of hospital systems outsourcing IS functions, all else being equal.

Uncertainty

Williamson maintains that uncertainty, in the absence of asset specificity, does not affect transaction costs, so there is no advantage to hierarchy over the market. It is only in the presence of asset specificity that uncertainty increases transaction costs

sufficiently to tip the scale toward hierarchy as the most efficient governance structure. Strategic management theory treats uncertainty as a condition requiring maximum flexibility, which also argues for keeping the transaction in the market, because internalizing the transaction leads to bureaucracy that impedes flexibility. This increased bureaucracy could also contribute to increased internal transaction costs, which would also favor market exchange over hierarchy.

Therefore, there is no disagreement between TCE and SMT regarding the effect of uncertainty alone on the sourcing decision. TCE argues that the non-specific transaction in the presence of uncertainty maintains the characteristics of a sale on the spot market, where the identities of the buyer and seller are irrelevant. SMT maintains that the presence of uncertainty demands a maximum amount of flexibility in order to allow rapid responses to changing market conditions. Integration impedes flexibility and so is to be avoided under conditions of uncertainty.

Uncertainty has commonly been operationalized as market conditions, particularly demand and price volatility (David & Han, 2004). Therefore, the greater the level of competition, the greater the uncertainty the hospital system faces, and the more likely it will be to outsource these functions.

H2a: Under conditions of low asset specificity, the greater the degree of competition within the markets in which a system competes, the greater the extent of hospital systems outsourcing IS functions, all else being equal.

Dependence upon sources of payments that may not meet full costs represents another source of uncertainty. Public payers may be viewed as using particularly

constraining payment methods, so the greater the percentage of payment from non-private payers, the greater the level of uncertainty facing the system. Increasing levels of reimbursement from non-private sources has been used by Zinn and colleagues (2003) as a measure of uncertainty in a TCE framework.

H2b: Under conditions of low asset specificity, the greater the percent of patient revenue from non-private payors, the greater the extent of hospital systems outsourcing IS functions, all else being equal.

Hospital systems can have hospitals in one market, or they may have hospitals in multiple markets. Increasing the number of distinctly different markets that the system has a presence in raises the level of complexity they must confront. Therefore, the greater the number of distinct markets the system has a presence in, the greater the degree of uncertainty the system faces.

H2c: Under conditions of low asset specificity, the greater the number of distinct markets a hospital system operates in, the greater the extent of outsourcing IS functions, all else being equal.

Asset Specificity and Uncertainty

SMT does not differentiate the effect of uncertainty based on asset specificity, so the combination of the two would not yield a different hypothesis. However, in the presence of a non-trivial level of asset specificity, TCE predicts that increasing uncertainty favors hierarchy over market governance (David & Han, 2004, p. 41; Williamson, 1979, p. 254; , 1985, pages 59, 79-80). This represents the main area of disagreement between the two frameworks regarding vertical integration. SMT

consistently predicts less vertical integration with increasing uncertainty, while TCE predicts more integration when increasing uncertainty is coupled with high asset specificity.

H3: The greater the level of asset specificity and uncertainty, the lower the extent of hospital systems outsourcing IS functions, all else being equal.

Bargaining Power

Bargaining power is characterized by having a product with no substitutability, having alternative suppliers or distributors, having the existing ability to make the needed good or service, and having dependent suppliers or distributors. Increased bargaining power tends to decrease the likelihood of integration. Hospital systems that are large, specifically with respect to the number of hospitals owned, will have greater bargaining power with suppliers, because the suppliers will be more dependent on them for business. This is because individual hospitals represent distinct installations of the supplier's product, regardless of the size of those individual hospitals. A small hospital will need the same system a large one will, but a hospital system will purchase the needed system for each of its hospitals, representing more potential sales for the vendor.

H4: The more hospitals a system owns, the greater the extent of outsourcing IS functions, all else being equal.

Corporate Strategy Needs

Corporate-strategy needs are the larger strategic decisions of the firm that may argue for integration, even though it may involve risks and even penalize certain business units. Such a strategy could include creating technological leadership or developing

organization wide synergies. Harrigan maintains that large market shares and synergies created by increased levels of forward and backward integration lead to more stages of integration activity and greater degrees of ownership of vertical units (Harrigan, 1985a). Therefore, hospital systems that have integration as a part of their corporate strategy can be expected to have higher levels of integration both in IS and in areas outside of IS. Two cases where this level of integration can be seen in hospital systems is the level of physician integration and the number of integrated services.

H5a: Hospital systems with more physicians on staff as a percentage of total physicians will have a decreased extent of outsourcing IS functions, all else being equal.

H5b: Hospital systems with more integrated services will have a decreased extent of outsourcing IS functions, all else being equal.

Strategic and Non-strategic IS Functions

The next set of hypotheses address the second research question: Is there a difference in outsourcing and integration behavior based on the strategic value of the IS functions? Both strategic management theory and TCE suggest that functions with little or no strategic value will be organized in a discriminating, or transaction-cost economizing way. Therefore, the relationship between outsourcing and integration of IS functions that are non-strategic in nature will be influenced primarily by TCE factors, and strategic factors will not contribute significant explanatory power to the relationship.

H6a: TCE factors will have a greater influence on the decision to outsource or integrate non-strategic IS functions than strategic factors, all else being equal.

Alternatively, the relationship between outsourcing and integration of IS functions that are strategic in nature will be influenced primarily by strategic factors, and TCE factors will not contribute significant explanatory power to the relationship.

H6b: Strategic factors will have a greater influence on the decision to outsource or integrate strategic IS functions than TCE factors, all else being equal.

Table 6 depicts each hypothesis, the construct under examination, the dependent variables, and the hypothesized direction of the relationship.

Table 6. Hypotheses, Constructs, and Predicted Effects

Hypothesis	**Construct**	**IS functions outsourced**
H1	Asset specificity	Decrease
H2a, H2b, H2c	Uncertainty	Increase
H3	Uncertainty & Asset specificity	Decrease
H4	Bargaining power	Increase
H5a, H5b	Corporate strategy needs	Decrease
H6a	Non-strategic IS functions	TCE factors > SMT factors
H6b	Strategic IS functions	SMT factors > TCE factors

Summary

In summary, this chapter has reviewed transaction cost economics and strategic management theory, and a synthesis of the two with regard to their predictions of vertical integration and de-integration activities. This synthesis is then used to create a conceptual model of the current study, which is then used to derive a series of testable hypotheses.

CHAPTER 4: METHODOLOGY

The purposes of this chapter are to identify the research design, sources of data, measurement of variables, and the analytical approach to addressing the research questions and hypotheses. There are two main questions this research is designed to address: (1) what are the factors leading to the decision to integrate or outsource IS functions within hospitals, and (2) is there a difference in outsourcing and integration behavior based on the strategic value of the IS functions?

Study Design

This study is an observational (non-experimental), retrospective, cross-sectional design. The cross-sectional study design is an appropriate design when there is evidence or logical reasoning that one variable preceded another and when there is a strong theoretical framework guiding the analysis (Polit & Hungler, 1999). Both conditions exist in this proposal.

Data Sources

The sample is drawn from three secondary databases. The data sources are the 2004 release of the HIMSS Analytics[sm] database (consisting of data collected in 2003), a proprietary database of information systems for integrated health delivery systems provided by the Health Information Management Systems Society (HIMSS); the 2003 release of the American Hospital Association (AHA) annual survey of hospitals; and the

2004 release of the Area Resource File (ARF). The ARF contains historical data, some of which are updated with each release, so the 2004 release will contain the most accurate data for 2003.

The HIMSS Analytics database contains demographic and IT information on 1,453 integrated healthcare delivery systems (IHDS) encompassing almost 28,000 facilities. The data are collected through a survey process that begins with the demographic data, which are first validated by the interviewee at that system, and ends with the IT data, which are also validated by the system before final release. The data are updated annually. Table 7 shows the types and numbers of facilities present. Table 8 lists the numbers and types of facilities within the acute care category.

Table 7. Facility Types and Frequencies in the HIMSS Database

Facility Type	*Frequency*	*Percent*	*Cum.*
Acute Care	3,989	14.35	14.35
Sub-Acute Care	3,007	10.82	25.17
Ambulatory Care/Physician Office/Clinics	18,008	64.80	89.97
Home Health/Hospices	1,842	6.63	96.60
Affiliated Physician Organizations	749	2.70	99.30
Owned Payor Components	195	0.70	100.00
Total	27,790	100.00	

The AHA data come from an annual survey of member and non-member hospitals that has been conducted every year since 1946. The data collected include variables on organizational structure, personnel, hospital facilities and services, and financial performance. The 2003 data set includes records for over 6000 hospitals and contains over 700 data fields.

Table 8. Acute Care Facility Types and Frequencies in the HIMSS Database

Facility Type	*Frequency*	*Percent*	*Cum.*
Academic	334	8.37	8.37
Cardiology	4	0.10	8.47
Critical Access	91	2.28	10.75
Eye, Ear, Nose & Throat	1	0.03	10.78
General Medical	53	1.33	12.11
General Medical & Surgical	3,250	81.47	93.58
Geriatric	1	0.03	93.61
Long Term Acute	114	2.86	96.47
Neuroscience	1	0.03	96.49
OB/GYN	18	0.45	96.94
OB/GYN, Pediatric	7	0.18	97.12
Oncology	2	0.05	97.17
Ophthalmology	3	0.08	97.24
Orthopedic	5	0.13	97.37
Osteopathic	1	0.03	97.39
Pediatric	96	2.41	99.80
Respiratory & Pulmonary Rehabilitation	5	0.13	99.92
Surgical	2	0.05	99.97
Women's Health	1	0.03	100.00
Total	3,989	100.00	

For comparison with the HIMSS data, Table 9 lists the types and frequencies of facilities contained in the AHA 2003 database, and Table 10 lists the types and frequencies of facilities in the AHA 2003 database for those that are members of systems.

Table 9. Facility Types and Frequencies in the AHA Database

Facility Type	*Frequency*	*Percent*	*Cum.*
General Medical & Surgical	4,881	81.24	81.24
Hospital unit within and institution	26	0.43	81.67
Specialty hospital	790	13.15	94.82
Children's	142	2.36	97.19
Institution for mental retardation	12	0.20	97.39
Acute Long-Term Care	113	1.88	99.27
Alcoholism and other chemical dependency	44	0.73	100.00
Total	6,008	100.00	

Table 10. Facility Types and Frequencies by System Membership in the AHA Database

Facility Type	*Frequency*	*Percent*	*Cum.*
General Medical & Surgical	3,092	83.19	83.19
Hospital unit within and institution	2	0.05	83.24
Specialty hospital	436	11.73	94.97
Children's	79	2.13	97.09
Institution for mental retardation	2	0.05	97.15
Acute Long-Term Care	94	2.53	99.68
Alcoholism and other chemical dependency	12	0.32	100.00
Total	3,717	100.00	

The Bureau of Health Professions assembles the ARF annually from a variety of secondary sources. The data are summarized and reported at the county level. There are over 3000 records (one for every U.S. county, independent city, or territory), and more than 6000 separate data fields. The data include geographic identifiers, health professions data, health facility data, population data, health professions training data, expenditure data, economic data, and environmental data.

Sample

The sample is a non-probability sample consisting of non-federal hospital systems and their general medical and surgical hospitals in the U.S. The unit of analysis is the hospital system. The Veterans Administration (VA) system will be excluded because it has invested heavily in its own internally developed clinical information system. This might be considered a good reason to include them in the sample, but they exhibit certain characteristics that most other hospital systems do not. They are part of a large and centrally controlled system that functions under mandates that private sector hospitals do not face. Figure 3 represents the sampling plan.

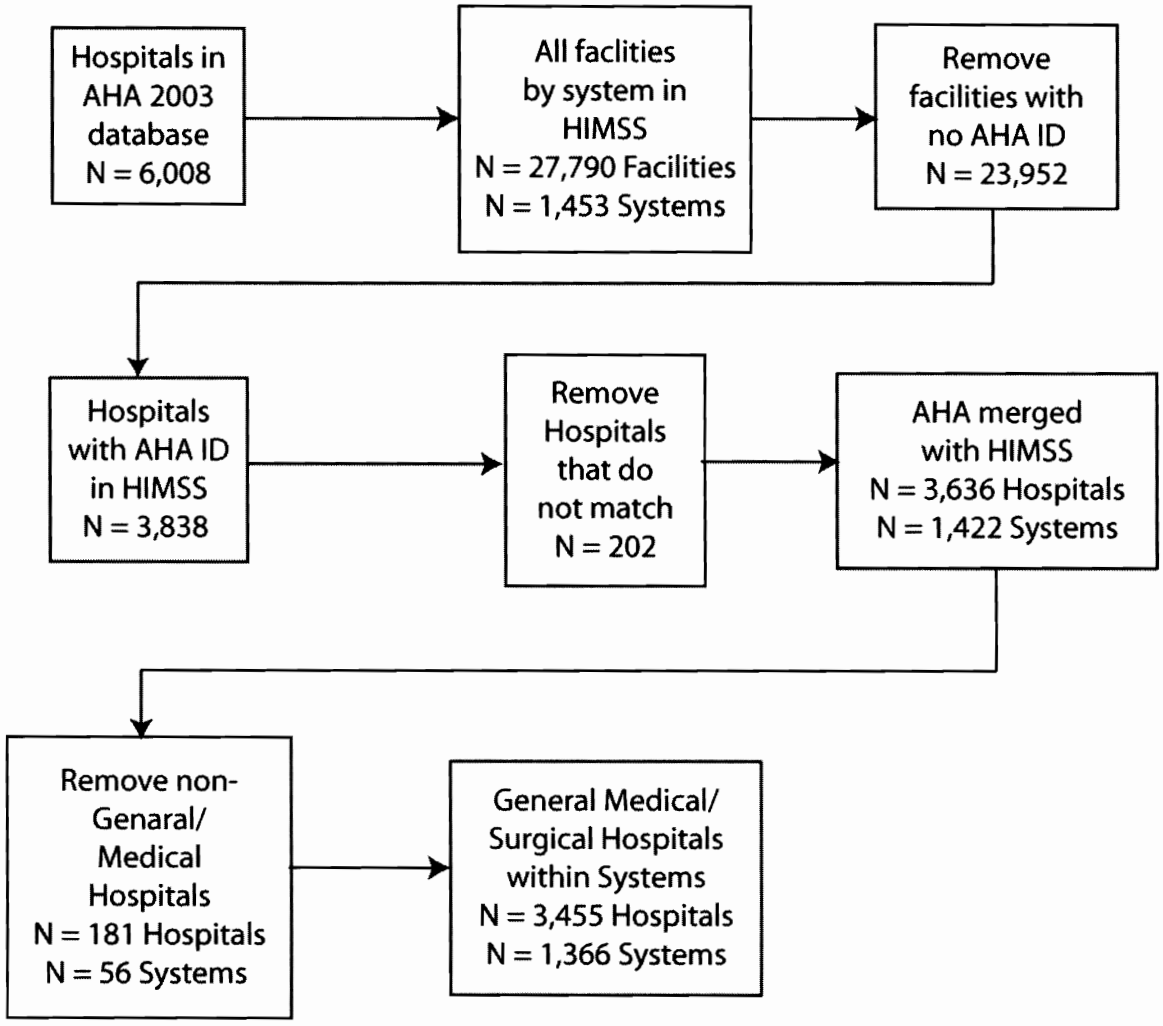

Figure 3. Sampling Plan

Measurement

Independent Variables

The independent variables used, the constructs they measure, and the source of the variable are listed in Table 11. In some cases, the variable may be constructed from several sources, or may be available in more than one source. In the latter case, they will be crosschecked for reliability.

Table 11. Independent Variable Descriptions

Construct	Variable	Description	Source
Asset Specificity (H1)	*SKILLS*	Degree of specialized IT skills in the system measured as the number of differing types of FTEs in IT.	HIMMS
Uncertainty (H2a)	*HHI*	Herfindahl-Hirschman index.	AHA, ARF
Uncertainty (H2b)	*NONPRIV*	Percentage of patient revenue from non-private payers.	HIMSS
Uncertainty (H2c)	*NUMMRKTS*	The number of distinct markets the system operates in.	HIMSS, AHA, ARF
Uncertainty x Asset Specificity (H3)	*UNCxSKILLS*	Combined measure of *HHI* and *SKILLS*	HIMSS, AHA, ARF
Bargaining Power (H4)	*NUMHOSP*	The number of hospitals in the system	HIMSS, AHA
Corporate Strategy Needs (H5a)	*PI*	Physician integration measured as the ratio of staff physicians to total physicians.	HIMSS
Corporate Strategy Needs (H5b)	*INTSRVCS*	Average number of forward and backward integration services provided by hospitals in the system.	AHA
Control	*SYSTYPE*	The type of system indicated by the AHA cluster code.	AHA
Control	*OWN*	Ownership, not-for-profit, for-profit, or catholic-owned	AHA

Asset specificity is measured as the degree of specialized IT skills required within the system. The degree of specialized skills has frequently been used as a measure of human asset specificity (David & Han, 2004; Klein, Frazier, & Roth, 1990; Monteverde, 1995). This variable is measured by a count of the types of FTEs present within the system. The more types of FTEs within the system, the more diverse they are, and the

higher the degree of specialized skills the system requires. The fewer types of FTEs, the lower the degree of specialized skills the system requires. The count for each category may include a cut-off point, depending on the distribution of the FTEs within these categories. For example, if most systems have a minimum level of help desk personnel, a threshold will be set for that category so that a system will only be counted as having that category if its numbers exceed the threshold.

Uncertainty is measured by three variables: the Herfindhal-Hirschman index, a measure of competition derived from the relative market shares of competitors in the market (White & Chirikos, 1988), averaged across markets for multi-market systems; the percentage of revenue from non-private payers, an indicator of uncertainty regarding reimbursement levels; and the number of markets the system operates in, as managing facilities in a variety of markets would present a greater amount of uncertainty. Zinn (2003) has used the proportion of Medicare residents in skilled nursing facilities as a measure of environmental uncertainty regarding reimbursement.

The number of hospitals a system owns measures bargaining power. The number of hospitals owned by the system indicates the advantage a system has in negotiations with suppliers, because IT applications are installed on a facility-by-facility basis. Therefore, a system that owns many hospitals represents increased business to the vendor and thus has more bargaining power with the vendor.

Both the ratio of staff physicians to total physicians (physician integration), and the number of forward and backward services provided by hospitals in the system (service integration) measure corporate strategy needs. The ratio of staff to total

physicians is directly calculated from the HIMSS data. Service integration is calculated as a ratio of the number of services the system is integrated into in relation to the total number of possible services as measured by the AHA data. Control variables include the type of system, classified by the taxonomy developed by Bazzoli and colleagues (1999) and system ownership, including not-for-profit, for-profit, and catholic-owned. Both of these are included as control variables since there may be effects based on the basic structure of the system and the fundamental mission of the system that the model does not otherwise incorporate.

Dependent Variables

The dependent variable is measured at three different levels. The first step in the construction of the dependent variable is to enumerate the outsourced functions. The second step is to position the enumerated functions into the various cells of Feeny, Lacity, and Willcocks' IS core capabilities model (this is done to provide a basis for categorizing the functions based on strategic value). The third step is to cluster the functions that have been positioned in the model into two categories—strategic and non-strategic functions (or what Feeny, Lacity, and Willcocks call core capabilities and non-core capabilities). The fourth step is to create each of the three dependent variable levels as (1) the ratio of total outsourced functions to the number of automated system functions, (2) the ratio of strategic functions outsourced to the number of automated system functions, and (3) the ratio of non-strategic functions outsourced to the number of automated system functions. Each of these steps is now explained in more detail.

Step 1: Enumeration of Outsourced Functions

The IS functions that are outsourced are enumerated in Appendix A. Table A1 lists the outsourced functions present in the HIMSS data, which includes an "other" category. Table A2 enumerates this "other" category.

Step 2: Positioning the Outsourced Functions into the Core Capabilities Framework

The outsourced functions are placed in the cells of the Feeney and Willcocks core capabilities model based on the descriptions of the various IS functions in this model, as described below. The first domain of the model is information management, which is concerned with the role and mission of IS/IT in the business; the responsibilities of business and IS/IT personnel in achieving the mission; the people, processes and principles guiding IS/IT strategy; the evaluation processes for IS/IT investment proposals; and the establishment of common standards. Using this description, the following functions are mapped to this domain: disaster recovery, HIPPA related, IT assessments and reviews, IT contract staffing, IT plans and strategies, IT subject matter expertise, patient safety assistance, quality management support, specialized IT consulting assistance, and workload management.

The second domain is information systems, which focuses on defining systems to be developed and their relationship to the business, their relationships and dependencies with other systems, and the actual development of such systems. Using this description, the following functions are mapped to this domain: (1) IT system selection, PACS evaluation, and PACS selection, cost reduction project, and work process improvement

and re-engineering, and (2) IT application development, other IT project management, and web site development and support.

The third domain is information technology which focuses on ensuring the business has access to the technical capabilities it needs through the definition of the IT architecture that must be in place to support targeted systems, and the implementation, support, and maintenance of this capability. Using this description, the following functions are mapped to this domain: benefits realization, hardware maintenance and support, help desk support, IT application implementation, network management, PACS implementation, PACS storage, remote processing and remote ASP offerings, transcription, and all of the functions in the "other" category except quality management support, specialized IT consulting assistance, and workload management (which are all included in the IM domain). Table 12 depicts the mapping of the outsourced IS functions to the IS core capabilities domain.

There are two outsourcing functions that have not been addressed—interim IT department outsourcing and long term IT department outsourcing. These two responses represent outsourcing of all IS/IT functions, and so will be included in both the strategic and non-strategic dependent variables calculation.

Step 3: Cluster the Outsourced Functions in Strategic and Non-strategic Categories

The Feeny, Lacity, and Willcocks framework categorizes IS functions along three dimensions: (1) the domains of IS functions (along the vertical axis), which are information management, information systems, and information technology, and (2) the level of these functions along the continuum from strategy to enactment (along the

Table 12. Mapping of Outsourced Functions to the IS Core Capabilities Domain

	Strategy	→	**Enactment**
Information Management (Policy)	Positioning of IT Role • IT plans and strategies	IS/IT Sourcing Strategy	IT Management Practices • Disaster recovery • HIPPA related • IT assessments and reviews • IT contract staffing • IT subject matter expertise • Patient safety assistance • Quality management support • Specialized IT consulting assistance • Workload management
Information Systems (Application)	Business/IT Relationship Development	Business/IT Systems Vision • IT system selection • PACS evaluation • PACS selection • Cost reduction project • Work process improvement and re-engineering	Systems Development * • IT application development • Other IT project management contract • Web site development & support
Information Technology (Delivery)	IT Architecture Scope and Design	IT Platform Construction * • IT application implementation • PACS implementation • PACS storage	Operational Services * • Benefits realization • Hardware maintenance and support • Help desk support • Network management • Remote processing and remote ASP offerings • Transcription • All "other" functions**

* Potentially outsourced services and core capability monitoring/facilitation

** Except quality management support, specialized IT consulting assistance, and workload management.

horizontal axis), and (3) overlaid on these two dimensions is the supply domain, or the sourcing strategy. The most critical decision in this last domain is what to in-source and what to outsource. In order to categorize functions as strategic and non-strategic, when the function is placed in one of the cells within the in-sourcing area of the supply domain, it is categorized as strategic, and when the function is placed in one of the cells within the outsourcing area of the supply domain, it is categorized as non-strategic. This reflects the assumption that the functions this model indicates should remain in-house have strategic value to the organization, and those that the model indicates can be safely outsourced have little strategic value to the organization.

The Feeny, Lacity, and Willcocks model proposes that all of the functions in the Information Management domain should remain in-house (i.e., they are considered core capabilities), regardless of the level from strategy to enactment. Therefore, all of the outsourced functions placed in this domain are categorized as strategic.

In the Information Systems domain, the sourcing domain is divided between business and IT relationship development and systems vision at the strategy level, both of which are not considered outsourcing candidates; and systems development at the enactment level, which is considered an outsourcing candidate. Therefore, all of the outsourced functions placed in the business and IT relationship development and systems vision cells are categorized as strategic, and those that are placed in the systems development cell are categorized as non-strategic.

In the Information Technology domain, the sourcing domain function splits across the strategy and enactment dimension between the IT architecture scope and design

function, which is not considered a candidate for outsourcing, and the platform construction and operation functions, which are considered candidates for outsourcing. Therefore, all of the outsourced functions placed in the IT architecture scope and design function are categorized as strategic (there are none of these, however), and those that are placed in the platform construction and operation functions are categorized as non-strategic. This mapping was previously illustrated in Table 12, and the resulting list of outsourced functions categorized as strategic and non-strategic is shown in Table 13.

Table 13. Delineation of Strategic and Non-strategic Outsourced IS Functions

Strategic IS functions outsourced	*Non-strategic IS functions outsourced*
IT plans and strategies	IT application development
Disaster recovery	Other IT project management contract
HIPPA related	Web site development & support
IT assessments and reviews	IT application implementation
IT contract staffing	PACS implementation
IT subject matter expertise	PACS storage
Patient safety assistance	Benefits realization
Quality management support	Hardware maintenance and support
Specialized IT consulting assistance	Help desk support
Workload management	Network management
IT system selection	Remote processing and remote ASP offerings
PACS evaluation	Transcription
PACS selection	All "other" functions (except quality
Cost reduction project	management support, specialized IT consulting
Work process improvement and re-engineering	assistance, and workload management)

Step 4: Create Three Dependent Variable Levels

The three dependent variable levels are created as (1) the ratio of total functions outsourced to the number of automated system functions, (2) the ratio of strategic functions outsourced to the number of automated system functions, and (3) the ratio of non-strategic functions outsourced to the number of automated system functions. The

numerator for each of these ratios has been developed in the preceding steps. This numerator is measured in the HIMSS data at the hospital system level.

The denominator is the average number of automated applications provided by hospitals in the system and is the same for all three ratios. The denominator is measured in the HIMSS data at the individual hospital facility level, so it is summed across all the hospitals in the system and then averaged to produce a hospital system level measure of automation.

The result is three dependent variables. First is the total level of outsourcing, measured by the ratio of all outsourced functions to the average number of automated applications provided by hospitals in the system. Second is the level of strategic functions outsourced, measured by the ratio of strategic functions outsourced to the average number of automated applications provided by hospitals in the system. Third is the level of non-strategic functions outsourced, measured by the ratio of non-strategic functions outsourced to the average number of automated applications provided by hospitals in the system.

Data Evaluation and Transformation

Merging the variables from the different data sources and constructing the necessary variables will construct the data set. Then the data will be analyzed using traditional descriptive techniques to examine the variables for missing values, presence of outliers, normality, linearity, homoscedasticity, and correlation. These techniques include frequencies, means, standard deviations, and normality tests such as skewness and kurtosis. Difficulties with any of these areas will be adjusted as needed (e.g., by dropping

highly correlated independent variables, transforming non-normal variables, or treating missing values by case deletion or imputation).

Analysis

The analyses will be conducted using both a standard and a sequential (or hierarchical) multiple regression analysis. Multiple regression analysis is appropriate to use to assess the relationship between a single dependent variable (DV) and a number of independent variables of interest (Tabachnik & Fidell, 2001). The sequential multiple regression technique is appropriate to compare the relationship of competing sets of IVs to the DV (Tabachnik & Fidell, 2001). Econometricians call this testing exclusion restrictions (Wooldridge, 2000, 2002). Two models are used, the first, called the unrestricted model, contains all of the independent variables. The second, called the restricted model, drops the variables that are hypothesized to have no effect on the DV. The sequential regression technique also uses two models, but starts with the reduced set of independent variables and then adds the remaining ones. In both cases, the change in R^2 is used to test the hypothesis jointly.

Because this is a cross-sectional analysis, there is a significant possibility for endogeneity among the independent variables. This problem arises when the specified model contains an omitted variable that, because of its omission, is a part of the error term. If the omitted variable is correlated with any of the independent predictor variables, the estimates produced by the ordinary least squares (OLS) technique will be biased and inconsistent. Therefore, a Hausman specification test is done to test for the presence of endogeneity (Wooldridge, 2000, 2002) with regard to each of the independent variables.

If endogeneity is found to be present, the instrumental variables estimation, or two-stage least squares (2SLS) technique, will be used. This technique involves identifying an instrumental variable for each independent variable found to have an endogeneity problem. Each instrumental variable must be (1) correlated with the respective independent variable, but (2) not correlated with the error term (or the omitted variable). The first condition can be tested by a simple regression test, while the second cannot be tested and so must be assumed by appealing to logic (Wooldridge, 2000, 2002).

In this study, the first analysis tests the full, unrestricted model, using standard multiple regression analysis, to address the first research question: what factors are associated with outsourcing or integration of information systems in hospitals? This results in individual hypothesis tests for each independent variable. The dependent variable is the ratio of all outsourced functions to automated functions. The independent variable definitions are in Table 11, and the equation is specified as:

$$\begin{aligned} ISOS = {} & \beta_0 + \beta_1 skills + \beta_2 hhi + \beta_3 nonpriv + \beta_4 nummrkts + \\ & \beta_5 unc \times skills + \beta_6 numhosp + \beta_7 pi + \beta_8 srvcs + \beta_9 systype + \beta_{10} own + \mu_X \end{aligned} \quad (1)$$

The subsequent analyses test the second research question: is there a difference in outsourcing and integration behavior based on the strategic value of the IS functions? The model will be tested sequentially, introducing variables in two distinct sets against the dependent variable of interest. Therefore, to examine the factors associated with the outsourcing of non-strategic functions, the dependent variable is the ratio of non-strategic functions outsourced to automated functions, and the IVs are introduced in two blocks, starting with those representing transaction costs, and then those variables representing

strategic management. Appropriate tests for increment in R^2 (F_{inc}) are done to assess the additional level of variance explained by introduction of the strategic variables. The independent variables are defined in Table 11, and the restricted model is specified as:

$$NSISOS = \beta_0 + \beta_1 skills + \beta_2 hhi + \beta_3 nonpriv + \beta_4 nummrkts + \beta_5 unc \times skills + \beta_6 systype + \beta_7 own + \mu_X \quad (2)$$

The unrestricted model is specified as:

$$NSISOS = \beta_0 + \beta_1 skills + \beta_2 hhi + \beta_3 nonpriv + \beta_4 nummrkts + \beta_5 unc \times skills + \beta_6 numhosp + \beta_7 pi + \beta_8 srvcs + \beta_9 systype + \beta_{10} own + \mu_X \quad (3)$$

Next, to examine the factors associated with the outsourcing of strategic functions, the dependent variable is the ratio of strategic functions outsourced to automated functions, and the IVs are introduced in two blocks, starting with those representing strategic management, and then those variables representing transaction costs. Appropriate tests for an increment in R^2 (F_{inc}) are done to assess the additional level of variance explained by introduction of the transaction cost variables. The independent variables are defined in Table 11, and the restricted model is specified as:

$$SISOS = \beta_0 + \beta_1 hhi + \beta_2 nonpriv + \beta_3 nummrkts + \beta_4 numhosp + \beta_5 pi + \beta_6 srvcs + \beta_7 systype + \beta_8 own + \mu_X \quad (4)$$

The unrestricted model is specified as:

$$SISOS = \beta_0 + \beta_1 skills + \beta_2 hhi + \beta_3 nonpriv + \beta_4 nummrkts + \beta_5 unc \times skills + \beta_6 numhosp + \beta_7 pi + \beta_8 srvcs + \beta_9 systype + \beta_{10} own + \mu_X \quad (5)$$

Study Limitations

The cross sectional design has several significant weaknesses or threats to internal validity. The major weakness is the potential for uncontrolled selection bias, which may

affect this study. The major data collection for the dependent variable was done with a survey instrument, leading to the possibility that respondents differ in some important ways than non-respondents. All of the data used in this study comes from secondary databases, which suffer from similar limitations. In this study, the sample will be based on the independent variables, rather than the dependent variable, reducing the likelihood of inconsistent estimators due to selection bias (Wooldridge, 2000, 2002). Nevertheless, a selection bias test using the Heckit method (also known as the Heckman selection model) will be done, and if selection bias is found to be present, the analysis will be conducted using the full Heckit method.

Other weaknesses of the cross-sectional design include the potential for a cross-over effect and implicit mortality. Implicit mortality could also be present in this study, since the decision to outsource may have been adopted or abandoned at differing rates before the data collection point. These weaknesses are inherent in the design and can only be partially controlled through analysis techniques.

The sample is constrained to non-federal hospital systems, and so cannot be generalized to other settings, such as the VA system, independent hospitals, or physicians offices and clinics.

Endogeneity is another significant threat the cross-sectional design cannot control. Endogeneity occurs when the causal order of events cannot be specified. Endogeneity is not likely a major threat with regard to corporate-strategy needs, or environmental and market uncertainty, since it is unlikely the level of IS outsourcing will effect these constructs. There is the potential for endogeneity with regard to bargaining power, as the

level of IS outsourcing could lead to a reduction in the bargaining power a system has in the market place. This problem has been addressed in part by specifying a measure that is less likely to be endogenous (i.e., the percentage of FTEs in the IT unit that are programmers, rather than the overall percentage of IT FTEs), and in part by utilizing the instrumental variables technique as indicated in the analysis.

Summary

This study is conducted using 2003 data from the HIMSS, AHA, and ARF. The sample is based on hospitals present in the 2003 AHA database that are then matched with those in the HIMSS database, which eliminates hospitals that are not members of systems and federally-owned systems. The unit of analysis is the hospital system. The independent variables are defined in Table 11 and include measures for constructs from the hypotheses presented in Chapter 3. The dependent variable is defined as the ratio of outsourced functions at three different levels (total, strategic, and non-strategic) to the level of automation within the hospital system. The analysis is done using standard multiple regression to test the individual hypotheses. Appropriate tests for sample selection and endogeneity are performed and if either are present, the Heckit method is used to adjust for sample selection and the instrumental variables technique is used to adjust for endogeneity. Lastly, a sequential regression technique is used to test the joint hypotheses H6a and H6b. Assigning outsourced functions to one of two categories—strategic and non-strategic—splits the dependent variable. This categorization is done using the Feeny and Willcocks core IS capabilities domain model, presented in Chapter

2. The independent variables are grouped according to the theoretical constructs they measure and an increment in R^2 test is used to test the joint hypotheses.

CHAPTER 5 – RESULTS

This chapter presents the results of the analyses. First, the sample derivation is detailed. Second, descriptive statistics for the sample are presented, along with a comparison of the sample against hospitals and hospital systems in the population. These descriptive statistics include means, standard deviations, ranges, or frequencies and percentages, of characteristics of the sample and the population. Third, once the sample has been derived, similar descriptive statistics are presented for the study variables. A correlation analysis of all the variables in the sample is also presented at this stage. Then the results of the three proposed regression models are presented.

Several key problems arose during the progression of this analysis. Chief among these was the construction and distribution of the dependent variables. These variables included a preponderance of zeroes in the counts of outsourced functions that carried through the construction of the dependent variable as described in Chapter 4. Further, that construction was to produce a continuous ratio that through the denominator accounted for the level of overall information systems activity in which the health care system engaged. The numerator of this ratio, however, was the count of outsourced functions, which did not originate from the denominator, and so the value of this ratio ranged greater than one.

A second problem arose with the system type variable. The system type is a classification of multi-hospital systems, while the HIMSS data are collected for health care delivery systems that have multiple facilities but perhaps only one hospital. Many such systems with one hospital do not have a system type classification, so there are many missing values. A third problem arose with the measurement of uncertainty. There were originally three measures of uncertainty, but one had to be removed because of its high correlations, leaving two. A key question this analysis is designed to investigate is the difference between the effect of uncertainty alone and uncertainty coupled with asset specificity. This complicates the choice of which uncertainty measure to interact with asset specificity. Further, the HHI is, by itself, perhaps not the best measure of uncertainty, but it may contribute to uncertainty when coupled with other market conditions, such as occupancy rates. For all of these reasons, after presenting the analysis as proposed in Chapter 4, an alternative analysis is presented that attempts to address these problems.

Sample Derivation

Merging the 2003 American Hospital Association (AHA) data with the 2003 Area Resource File and with the 2004 Health Information Management Systems Society (HIMSS) data derived the sample. Figure 4 illustrates the sample derivation. This sample derivation is somewhat different than that proposed in Chapter 4, primarily because of the need to merge the AHA data with the ARF data to capture the market level variables needed to calculate the HHI.

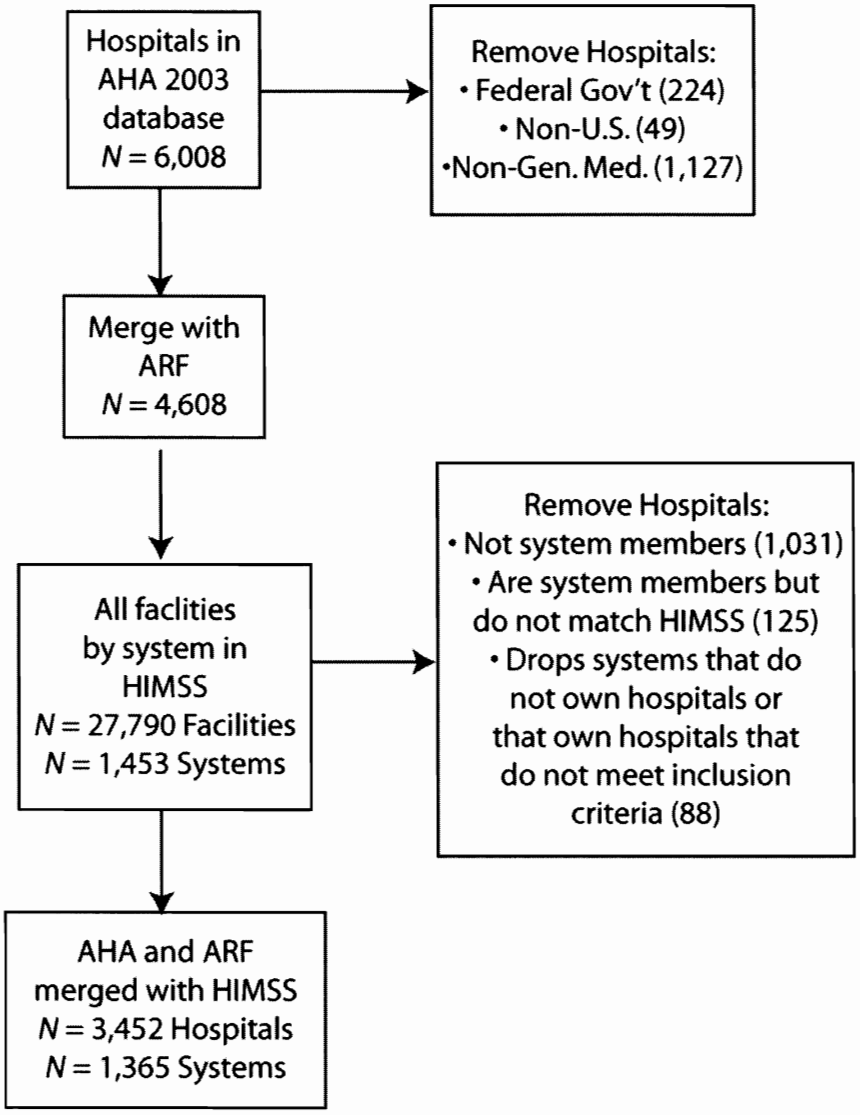

Figure 4. Sample Derivation

The sample begins with 6,008 hospitals in the AHA 2003 data. Federal government hospitals ($n = 224$), non-general/medical hospitals ($n = 1,127$), and hospitals outside of the United States ($n = 49$) are removed, leaving 4,608 hospitals. These hospitals are merged with the ARF data file with no loss. Next, the HIMSS data are merged with the combined AHA and ARF data. The HIMSS data contain 1,453 health

care delivery systems, and these systems own 27,790 facilities. The HIMSS data include systems that own multiple facilities, but may own only one hospital among those facilities, thus these are health care delivery systems, not necessarily multi-hopsital systems. All facilities in the HIMSS data that are not hospitals or that do not meet the sampling criteria are dropped (n = 24,338), resulting in a loss of 88 health care delivery systems that do not own at least one hospital. Combining the HIMSS data with the AHA and ARF data results in a mismatch between hospitals that are not system members (n = 1,031) and hospitals that are system members and are present in the AHA data but not in the HIMSS data (n = 125). Both categories of hospital are removed, resulting in a total of 3,452 hospitals in 1,365 health care systems. Hospitals that are system members that were dropped from the sample are generally larger and in less competitive markets than those that were retained. Mean admissions, staffed beds, and HHI for those that were retained were 9,097, 207, and 0.43, respectively. Mean admissions, staffed beds, and HHI for those that were dropped were 3,229, 94, and 0.54, respectively.

Sample Hospitals vs. Population Hospitals

Table 14 presents a comparison of the hospitals in the sample (N = 3,452) and the population of hospitals (N = 4,608). In general, the sample consists of larger hospitals in terms of admissions and staffed beds, hospitals with a greater number of integrated services, a greater percentage of hospitals that are system or network members as reported to the AHA, and hospitals that are more often located in metropolitan areas with higher levels of competition.

Table 14. Comparison of Sample and Population Hospitals

Variable		Sample (N = 3,452)	Population (N = 4,608)
		M (SD) or f (%)	M (SD) or f (%)
Admissions**		9097.17 (9284.32)	7239.02 (8860.62)
Integrated Services**		4.67 (2.71)	4.35 (2.67)
HHI**		0.42 (0.37)	0.48 (0.38)
Staffed beds**		206.70 (187.91)	169.36 (181.51)
System/Network Member			
	Yes	2,660 (77.1%)	3,032 (65.8%)
	No	792 (22.9%)	1,576 (34.2%)
Metropolitan Area			
	Non-metro	523 (15.15%)	1,164 (25.26%)
	Metro Area	2,294 (66.45%)	2,606 (56.55%)
	Micro Area	635 (18.40%)	838 (18.19%)
Census Region			
	Northeast	527 (15.27%)	617 (13.39%)
	Midwest	946 (27.40%)	1,364 (26.60%)
	South	1,338 (38.76%)	1,760 (38.19%)
	West	641 (18.57%)	867 (18.82%)
Catholic			
	Yes	589 (17.06%)	613 (13.30%)
	No	2,863 (82.94%)	3,995 (86.70%)
Status			
	FP	583 (16.89%)	688 (14.93%)
	NFP	2,869 (83.11%)	3,920 (85.07%)

Note: * $p < .05$, ** $p < .01$

Sample Health Delivery Systems vs. Population Health Delivery Systems

Table 15 presents a comparison of the IHDS's in the sample (N = 1,365) and the population of IHDS's in the HIMSS database (N = 1,453). Overall, the IHDS's in the HIMSS database own mostly acute care, sub-acute care, ambulatory care, physician's offices and clinics (90 percent of all facilities). The systems in the sample are comparable to those in the population in virtually every respect. The types of facilities lost in the sample are predominantly from the sub-acute (366 lost) and the ambulatory care, physician office and clinic (1,236 lost) categories.

Descriptive Statistics of Study Variables

Table 16 presents descriptive statistics for all of the study variables. The skills variable is missing in 666 cases in the 2003 HIMSS data. Because of this, the values for skills in the 2002 data were compared to the 2003 data. The values were consistent across years, so missing values in 2003 were substituted for with the 2002 data when they were present. This procedure reduced the missing values to 472.

A histogram of the HHI shows a large number of values at or near one. Further examination shows these values to be cases where the system has one hospital in a small population area (229 of 271, or 84.5 percent of systems with an HHI of one were located in either a Micropolitan Statistical Area, or outside of a metropolitan area). The percent of revenue from non-private sources (nonpriv) variable was measured as the ratio of Medicare and Medicaid discharges to total discharges, because the proposed measurement of this variable (the ratio of revenue from non-private sources) had 307

Table 15. Comparison of Sample and Population Health Delivery Systems

Variable	Sample (N = 1,365)	Population (N = 1,453)
	M (SD) or f (%)	M (SD) or f (%)
IHDS FTE's in IT	53.82 (179.30)	53.07 (174.15)
IHDS Staffed Beds	680.48 (1,933.19)	679.65 (1,944.82)
IHDS Annual Net Rev (millions of $)	387 (1,210)	381 (1,180)
IHDS IS Budget (% of total operating budget)	3.85 (2.63)	3.84 (2.64)
For-profit		
Yes	53 (3.88%)	61 (4.20%)
No	1,312 (96.12%)	1,392 (95.80%)
IS Steering Committee		
Yes	1,192 (87.33%)	1,266 (87.13%)
No	173 (12.67%)	187 (12.87)
Owned Facility Staffed Beds	141.95 (145.51)	140.18 (143.18)
Owned Hospital IS Budget (% of hospital operating budget)	3.9 (3.05)	3.93 (3.05)
Type of Owned Facility		
Acute Care	3,855 (14.85%)	3,989 (14.35%)
Sub-Acute Care	2,641 (10.18%)	3,007 (10.82%)
Ambulatory Care/Physician Office/Clinic	16,772 (64.62%)	18,008 (64.80%)
Home Health/Hospice	1,793 (6.91%)	1,842 (6.63%)
Affiliated Physician	706 (2.72%)	749 (2.70%)
Organizations	188 (0.72%)	195 (0.70%)
Owned Payor Components		

Note: * $p < .05$, ** $p < .01$

Table 16. Descriptive Statistics of Study Variables

Variable	*N*	*M* (*SD*) or *f* (%)	*Min*	*Max*	*Skewness*	*Kurtosis*
Skills	893	3.62 (1.61)	1	6	- 0.17	1.95
HHI	1,365	0.46 (0.35)	0	1	0.43	1.76
nonpriv	1,305	0.57 (0.13)	0.05	1	-0.03	3.09
skills*nonpriv	851	2.10 (0.97)	0.31	5.58	0.21	2.51
nummrkts	1,365	1.91 (6.44)	1	180	18.71	460.03
numhosp	1,365	2.53 (8.61)	1	198	15.40	300.63
pi	1,315	0.09 (0.19)	0	1	3.03	12.59
intsrvcs	1,365	5.32 (2.40)	0	11	- 0.36	3.07
systype	364	2.95 (1.12)	1	5	- 0.17	2.64
CHS		57 (15.66%)				
CPIHS		34 (9.34%)				
MCHS		177 (48.63%)				
DHS		62 (17.03%)				
HIS		34 (9.34%)				
own	1,365	0.22 (0.59)	0	2	2.46	7.32
NFP		1,188 (87.03%)				
FP		50 (3.66%)				
Catholic		127 (9.30%)				
ISOS	1,365	0.14 (0.22)	0	2.97	4.14	35.31
SISOS	1,365	0.06 (0.11)	0	0.89	2.84	13.78
NSISOS	1,365	0.08 (0.17)	0	2.97	6.36	82.64

missing cases. The interaction of skills and uncertainty was created as the product of skills and the non-private discharge ratio.

The number of markets (nummrkts) and number of hospitals (numhosp) variables show a significant positive skewness, and an analysis of their standardized scores reveals potential outliers. These two variables are not candidates for log transformations because of the predominance of small values. Further analysis indicates large maximum z-scores attributable to the presence of large multi-hospital systems. Moreover, some of these large multi-hospital systems are primarily in the business of hospital contract management, so they do not actually own the hospitals they manage (e.g., Triad

Hospitals, Inc. managed 149 out of 203 hospitals that the HIMSS data assigns to them). This raises the question of whether a primarily contract management company can be considered a health care delivery system, and whether such companies belong in the data set. It was decided to leave these systems in the data.

The ratio of staff to total physicians (pi) has 50 missing values, shows a significant skewness, and has some values that equal one, indicating that all the system's physician's are on staff or salaried. It was not possible to recover any missing values from the previous year. The integrated services variable (intsrvcs) is normally distributed with no missing values. The system type variable is a categorization of multi-hospital systems included in the AHA data based on work done by Bazzoli and colleagues (Bazzoli, Shortell, Dubbs, Chan, & Kralovec, 1999). This categorization only applies to multi-hospital systems, but because the HIMSS data include single-hospital health care delivery systems, there are many cases where there is no system type code for the systems in the HIMSS data, resulting in 1,001 missing values. This unfortunate situation leaves the options of (a) conducting the analysis on only multi-hospital systems that have this indicator, (b) dropping this control variable from the analysis, or (c) both.

The ownership variable, although not dichotomous, is close to the 90/10 percent split level that is sometimes recommended as a cutoff point for inclusion in the analysis (Tabachnik & Fidell, 2001). However, because in this case it is not dichotomous and it does not reach the 90/10 percent level, it is included in the analysis.

The three dependent variables (ISOS, SISOS, and NSISOS) all show a non-normal distribution and a predominance of zero values. Even though these measures are

presented as ratios, they sometimes have values exceeding one. This is because the numerator is not taken as a part of the denominator, and so its value is not limited by the value of the denominator (the numerator is the number of outsourced functions, and the denominator is the average number of automated applications the system has installed across its facilities), i.e., this is not a true ratio. Additionally, in any case where the entire IT department has been outsourced, it is not possible to know how many functions were actually outsourced, or how that number may compare to other systems. Because of this measurement error problem, all instances of the entire IT department being outsourced were dropped from the count of outsourced functions ($n = 78$).

Correlation Analysis

Table 17 shows the intercorrelations between the study variables. The correlation between the number of hospitals and the number of markets (.95, $p < .00$) is large enough to suggest that these two variables may be measuring the same phenomenon and that one of them should be removed from the model before regression analysis is conducted. The logical choice of which to drop is the number of markets, since it is a second measure of uncertainty, while the number of hospitals is the only measure of bargaining power. Other significant correlations appear between skills and uncertainty measures, and between skills and integrated services.

The moderately high correlations between the three outsourcing dependent variables is to be expected and not a concern since they will not be used together in the same model. All three dependent variables also show a consistent pattern of significant

Table 17. Intercorrelations Between Study Variables

	skills	HHI	nonpriv	skills*nonpriv	nummrkts	numhosp	pi
skills	–						
HHI	-.19**	–					
nonpriv	-.27**	.44**	–				
skills*nonpriv	.86**	-.00	.22**	–			
nummrkts	-.05	.06*	.00	-.04	–		
numhosp	-.05	.03	-.04	-.06	.95**	–	
pi	-.02	.01	-.05	-.02	.00	.01	–
intsrvcs	.18**	.02	-.10**	.12**	-.06*	-.07*	.06*
systype	-.17*	.18**	.25**	.01	.16**	.14**	-.15**
own	.04	-.08**	-.02	.00	.12**	.14**	-.01
isos	.09**	-.03	-.06*	.06	.37**	.38**	.01
sisos	.09**	.02	.00	.07*	-.01	.00	.02
nsisos	.06	-.06*	-.08**	.04	.49**	.49**	.00

	intsrvcs	systype	own	isos	sisos	nsisos
intsrvcs	–					
systype	-.29**	–				
own	-.01	.13*	–			
isos	.04	-.02	.00	–		
sisos	.03	-.05	-.02	.66**	–	
nsisos	.03	.00	.02	.87**	.21**	–

*$p < .05$, **$p < .01$

positive correlations with skills and the number of hospitals owned by the system, and negative correlations with uncertainty (HHI or nonpriv).

Endogeneity

Instrumental Variables Estimation

The instrumental variables (IV) or two-stage least squares (2SLS) estimation is indicated when there is a concern that there may be one or more endogenous explanatory variables in the model (Wooldridge, 2000, 2002). The technique involves the identification of one or more instruments for the suspected endogenous indicators that must meet two criteria. If x is the suspected endogenous explanatory variable, z is the instrument, and u is the error term, then (a) $Cov(z,u) = 0$, and (b) $Cov(z,x) \neq 0$. The first

requirement cannot be tested, but the second can be tested through a reduced form regression. If we can reject the null hypothesis $H_0 : \beta_1 = 0$, then we can be confident that condition (a) above holds (Wooldridge, 2000).

After identifying the instruments, the next step is to conduct the Hausman Specification Test to determine the actual presence of endogeneity. This test has the following steps:

1. Estimate the reduced form equation for z by regressing it on all exogenous and instrumental variables, and obtain the residuals from this estimation (this also serves as the test described in the preceding paragraph).
2. Add the residuals to the structural equation and test for significance of the residuals using ordinary least squares (OLS). If the residuals are significant, endogeneity is present and IV estimation is indicated.

This procedure becomes more complicated as the number of potentially endogenous regressors increases.

Instrument Identification

Given the variable screening presented earlier that resulted in the transformation of several variables and the elimination of one, the structural model has become

$$isos = \beta_0 + \beta_1 skills + \beta_2 HHI + \beta_3 nonpriv + \beta_4 skills * nonpriv + \beta_5 numhosp + \beta_6 pi + \beta_7 intsrvcs + \beta_8 systype + \beta_9 own + \mu$$

The skills variable is a measure of the variety of types of FTEs in IT that the health system employs, and it is the most suspect in terms of endogeneity. It is easy to imagine that the decision to outsource IT functions may influence the number and types

of FTEs the system employs, which is a classic example of an endogenous relationship. The per capita income reflects the prevalence of an educated work force, which may also influence the number and types of FTEs a system employs (IT workers generally require college degrees), but it is unlikely to be directly related to the level of IT outsourcing. This is the classic condition for an instrumental variable, that it is related to the suspected endogenous explanatory variable, but not to the dependent variable (or more correctly the error term). Therefore, the instrument for skills is the per capita income for the market the system operates in, or the average per capita income for systems in multiple markets. This variable is available from the ARF.

The HHI is a measure of market concentration, and in this study, it measures the level of environmental uncertainty the health system faces. The HHI itself is measured in various ways, but in this study, it is calculated as the sum of the squared ratio of system admissions to total admissions in the market. It does not seem plausible that the level of IT outsourcing by an individual health system influences the level of concentration in the market measured by admissions, so no instrument is proposed for the HHI.

Similarly, the non-private discharge ratio is a measure of uncertainty, calculated as the sum of the percent revenue from Medicare and Medicaid. It seems unlikely that the level of IT outsourcing influences the percentage of patient revenue from Medicare and Medicaid, so no instrument is proposed for the non-private discharge ratio.

The interaction term formed as the product of the skills variable and the non-private discharge ratio is suspected of endogeneity through its relationship with the skills variable (Wooldridge, 2002). An appropriate instrumental variable in this circumstance

consists of the interaction of the instrument for the endogenous variable and the other variable in the interaction term. In this case, that is the interaction between skills and the per capita income.

The number of hospitals measures bargaining power and is a straight count of hospitals. Once again, it seems unlikely that the decision by a health system to outsource IT functions will influence the system to acquire or sell hospitals. It is possible that IT outsourcing could be used as a means to generate capital dollars that could be used for construction or acquisition, however. Therefore, an instrument may be necessary for this variable. The total population of the system's service area could influence the number of hospitals a system decides to acquire, build, or sell, but it should have no direct relationship to the decision to outsource IT functions. Therefore, the proposed instrument for the number of hospitals is the total population of the system's service area. This variable is available from the HIMSS data.

Physician integration and the number of integrated services are both measures of corporate strategy needs, and so attempt to capture the strategic decisions of health system management. Physician integration is the ratio of salaried physicians to total physicians in the system. The level of IT functions outsourced should not influence the number of salaried physicians on staff, so no instrument is indicated. Neither should the level of IT outsourcing influence the number of integrated services the system is involved in, so no instrument in indicated.

The type of system is a measure of a variety of characteristics of multi-hospital systems that categorizes those systems into five groups. The characteristics used to

classify these systems include the level of centralization, geographic location, involvement in insurance products, and so on. It is highly unlikely that these systems made their choices on how to structure themselves and what types of products and business lines to participate in based on their level of IT outsourcing, so no instrument is proposed for system type.

Ownership status is not-for-profit, for-profit, or catholic-owned. It is difficult to imagine that the level of IT outsourcing determines the ownership status of the system, so no instrument is proposed.

Hausman Specification Test

The endogeneity test is more complicated than earlier described because there are three potentially endogenous regressors. The approach in this situation is to conduct three reduced form regressions—one for each of the suspected endogenous regressors—and include the residuals from each of these regressions in the full model. Then a test of joint restrictions on all three of the included residuals is used to determine the presence of endogeneity. The joint test for the initial analysis indicates the presence of endogeneity: $F(3, 145) = 2.72$, $p = 0.0465$. A separate test is done for each analysis and the results are reported along with each analysis.

Regression Analysis

Given these results, two stage least squares (2SLS) regression is used to analyze the three models. The analysis is first conducted on the full sample, and then on the sub-sample without the system type variable, because so many of the systems in the data set are not multi-hospital systems, as discussed previously.

All IS Functions

Table 18 presents the results of the first regression analysis on all outsourced IS functions. Post-regression diagnostics indicate omitted variables based on the Ramsey RESET, $F(3, 142) = 12.36$, $p = .00$. Adding squared or logarithmic forms does not improve the RESET score significantly, so the model is estimated using level terms (i.e., no logarithmic or quadratic transformations of the variables). There is clear evidence of heteroskedasticity, so the regression is done with robust correction for standard errors. There are no significant predictors of overall IS outsourcing.

Table 18. Summary of Regression Analysis of the TCE and SMT Variables on Total IS Outsourcing ($N = 162$)

Variable	*B*	*Robust SE B*	β
Skills	-0.25	0.81	-1.55
HHI	0.05	0.11	0.06
Nonpriv discharge ratio	-1.79	5.64	-0.92
Skills X Nonrpiv	0.45	1.46	1.57
Number of hospitals	0.01	0.01	0.35
Physician integration	0.44	0.28	0.29
Integrated services	0.00	0.01	-0.03
System Type			
CHS	0.00	0.09	0.01*
CPIHS	0.14	0.13	0.12
DHS	0.01	0.07	0.02
IHS	0.00	0.06	0.01
Own			
FP	-0.04	0.13	-0.04
Catholic	0.03	0.06	0.05
V_hat1 [4]	-0.17	1.22	-0.13
V_hat2	-0.58	2.62	-0.42
V_hat3	0.01	0.01	0.38

Note: $R^2 = .58$; $*p < .05$

[4] The three V_hat variables are the fitted values from the previous stage estimations of the reduced form equations.

Table 19 shows the regression results for the same model excluding the system type variable. This model does not exhibit endogeneity: $F(3, 816) = 1.64$, $p = .18$. The Ramsey RESET again indicates the presence of omitted variables, $F(3, 818)$, $p = .00$, but adding squared or logarithmic forms does not improve the score, so level forms are used. Heteroskedasticity is still present, so robust standard errors are used. The number of hospitals is the only significant predictor of total IS outsourcing behavior in this model.

Table 19. Summary of Regression Analysis of the TCE and SMT Variables on Total IS Outsourcing Excluding System Type ($N = 831$)

Variable	*B*	*Robust SE B*	β
Skills	-0.01	0.02	-0.06
HHI	-0.02	0.02	-0.03
Nonpriv discharge ratio	-0.12	0.12	-0.07
Skills X Nonpriv	0.03	0.03	0.15
Number of hospitals	0.01	0.00	0.43**
Physician integration	0.03	0.05	0.02
Integrated services	0.00	0.00	0.04
Own			
FP	-0.07	0.04	-0.07
Catholic	-0.03	0.03	-0.03

Note: $R^2 = .19$; $*p < .05$, $**p < .01$

Non-strategic IS Functions

The next analysis is a nested model testing the relationship between the TCE set of variables and outsourcing of non-strategic IS functions. This analysis was done by estimating the full model

$$NSISOS = \beta_0 + \beta_1 skills + \beta_2 hhi + \beta_3 nonpriv + \beta_5 skills \times nonpriv + \beta_6 numhosp + \beta_7 pi + \beta_8 srvcs + \beta_9 systype + \beta_{10} own + \mu_X$$

and testing the joint hypothesis that the SMT variables = 0. Table 20 presents the results of the nested-model estimation, and Table 21 presents the results of the nested-model estimation excluding the system type variable. None of the transaction cost economics (TCE) variables are significant in predicting total outsourcing in either model. The strategic management theory (SMT) variables are not significant in the model including the system type, but in the model excluding system type, the null is rejected, suggesting that these variables contribute to the prediction of non-strategic outsourcing. The significance of the v_hat variables suggests that endogeneity arises from both sources.

Table 20. Summary of Nested-model Estimation for TCE Variables Predicting Non-strategic IS Outsourcing (N = 162)

Variable	*B*	*Robust SE B*	β
Skills	-0.06	0.59	-0.38
HHI	-0.01	0.08	-0.01
Nonpriv discharge ratio	-0.45	4.07	-0.26
Skills X Nonpriv	0.10	1.06	0.40
Number of hospitals	0.01	0.01	0.37
Physician integration	0.01	0.19	0.01
Integrated services	0.00	0.01	-0.02
System Type			
CHS	-0.02	0.07	-0.02
CPIHS	0.04	0.09	0.04
DHS	0.01	0.05	0.02
IHS	0.01	0.05	0.01
Own			
FP	-0.03	0.13	-0.03
Catholic	-0.01	0.05	-0.01
V_hat1	0.07	0.88	0.06
V_hat2	0.01	1.89	0.01
V_hat3	0.01	0.01	0.49

Note: R^2 = .71; Joint test for endogeneity $F(3, 145) = 3.36$, p = .02. Joint test of TCE variables = 0 failed to reject the null $F(4, 145) = 0.30$, p = .88. Joint test of SMT variables = 0 failed to reject the null $F(5, 145) = 0.73$, p = .6.

Table 21. Summary of Nested-model Estimation for TCE Variables Predicting Non-strategic IS Outsourcing Excluding System Type ($N = 829$)

Variable	*B*	*Robust SE B*	β
Skills	4.31	2.61	42.58*
HHI	-0.17	0.10	-0.37
Nonpriv discharge ratio	26.26	15.94	21.40*
Skills X Nonpriv	-7.40	4.49	-44.25*
Number of hospitals	0.00	0.01	-0.16
Physician integration	0.00	0.03	0.00
Integrated services	0.04	0.03	0.67
Own			
FP	0.03	0.05	0.04
Catholic	-0.30	0.18	-0.52
V_hat1	6.00	3.63	7.86*
V_hat2	13.34	8.06	15.55*
V_hat3	0.02	0.01	0.83**

Note: $R^2 = .34$; Joint test for endogeneity $F(3, 816) = 3.88$, $p < .01$. Joint test of TCE variables = 0 failed to reject the null $F(4, 816) = 1.62$, $p = .17$. Joint test of SMT variables = 0 rejects the null $F(5, 816) = 2.56$, $p < .05$.
* $p < .1$ ** $p < .05$

Strategic IS Functions

The last analysis is a nested model testing the relationship between the TCE set of variables and outsourcing of strategic IS functions. Table 22 presents the results of the nested-model estimation, and Table 23 presents the results of the nested-model estimation excluding the system type variable. None of the SMT variables are significant in predicting total strategic outsourcing in either model, nor is there any additional explanatory power from adding the TCE variables.

Alternative Analysis

A number of concerns about the limited findings of the planned analysis led to several adjustments in the analytical strategy. There are two main reasons for conducting an alternative analysis. First, the dependent variable as proposed was constructed as a

Table 22. Summary of Nested-model Estimation for SMT Variables Predicting Strategic IS Outsourcing ($N = 163$)

Variable	*B*	*Robust SE B*	β
Skills	-0.01	0.02	-0.9
HHI	0.04	0.03	0.13
Nonpriv discharge ratio	0.00	0.18	0.00
Skills X Nonpriv	0.00	0.04	-0.01
Number of hospitals	0.00	0.00	-0.04
Physician integration	0.08	0.06	0.15
Integrated services	0.00	0.00	-0.03
System Type			
CHS	0.05	0.02	0.15*
CPIHS	0.07	0.05	0.18
DHS	-0.02	0.05	-0.07
IHS	-0.01	0.02	-0.05
Own			
FP	-0.01	0.01	-0.02
Catholic	0.02	0.02	0.09

Note: $R^2 = .11$; Joint test for endogeneity $F(3, 145) = 0.86$, $p = .46$. Joint test of TCE variables = 0 failed to reject the null $F(4, 149) = 1.06$, $p = .38$. Joint test of SMT variables = 0 failed to reject the null $F(5, 149) = 1.18$, $p = .32$.
* $p < .05$

Table 23. Summary of Nested-model Estimation for SMT Variables Predicting Strategic IS Outsourcing Excluding System Type ($N = 831$)

Variable	*B*	*Robust SE B*	β
Skills	0.00	0.01	0.00
HHI	0.00	0.01	0.00
Nonpriv discharge ratio	-0.04	0.07	-0.05
Skills X Nonpriv	0.01	0.02	0.09
Number of hospitals	0.00	0.00	-0.02*
Physician integration	0.02	0.03	0.03
Integrated services	0.00	0.00	0.01
Own			
FP	-0.02	0.01	-0.04
Catholic	0.00	0.02	0.00

Note: $R^2 = .01$; Joint test for endogeneity $F(3, 816) = 0.86$, $p = .46$. Joint test of TCE variables = 0 failed to reject the null $F(4, 821) = 1.29$, $p = .27$. Joint test of SMT variables = 0 failed to reject the null $F(5, 821) = 1.43$, $p = .21$.
* $p < .05$

ratio, but because the numerator of the ratio did not constitute a fraction of the denominator, the values sometimes exceeded one, so this is not a true ratio. The original rationale for this construction was to allow for different levels of IS activity between systems for a given amount of outsourcing activity. To deal with this in the first alternative analysis, the average level of automation is added as a control variable in the regression, and thedependent variable is constructed as a true ratio of the number of IS functions outsourced to the total number of IS functions outsourced by any system.

Second, the dependent variable has a large number of zero values ($n = 523$), whether constructed as a ratio or left as a straight count of outsourced functions. In such cases, a log transformation is problematic, and a linear model may not provide the best fit, since the model can predict negative values of the dependent variable, when in fact the dependent variable is constrained to be positive. In such cases, the Poisson regression model is an appropriate analytical technique (Cameron & Trivedi, 1998; Wooldridge, 2000, 2002). The Poisson regression model also allows for the incorporation of exposure. Exposure typically refers to the length of time during which the occurrence of an event is observed. Generally the longer the length of time, the higher the probability of the event occurring, or the higher the count of the number of events will be. Thus, the count of events is partially dependent on the time over which they are observed. In the current context, the number of functions observed to be outsourced is influenced by the total number of functions that can be outsourced. In other words, a system with higher numbers of automated functions would have a larger exposure, and would be expected to have a higher count of outsourced functions relative to a system with fewer numbers of

outsourced functions. The difference in counts resulting from the difference in exposure is controlled for in a Poisson regression through the specification of exposure, which in this case would be the overall level of IS activity by the system. Therefore, the second alternative analysis is a Poisson regression model where the dependent variable is a straight count of outsourced functions. The exposure is the average number of automated IS functions in the system.

Two additional problems encountered in the original analysis are addressed in the alternative analyses. First, the numbers of variables measuring uncertainty make it difficult to determine which term to interact with the skills variable, and the HHI by itself is probably not a good measure of uncertainty to a system. For example, a system operating in a highly competitive market, but with high occupancy rates may face little uncertainty. Therefore, a new uncertainty variable that is the product of the HHI and hospital occupancy rates in the market was created (these values were averaged for multi-market systems). Imagine a market with a low HHI (i.e., a highly differentiated market) but with high occupancy rates. Even though there are many systems dividing market share, they all have generally high occupancy rates, and the low market share is not a great source of uncertainty. Similarly, a market with a high HHI, but low occupancy rates, would be a source of more uncertainty. This measure then is an index, where high levels of both HHI and occupancy rates represent the largest values, indicating markets where there are few systems and high occupancy rates, and therefore little uncertainty. Conversely, low levels of both HHI and occupancy rates represent the smallest values of this index, indicating markets where there are many systems and low occupancy rates,

and therefore a great deal of uncertainty. Second, the system type variable was dropped from the analyses altogether, because it is a classification of multi-hospital systems, while this analysis includes many single hospital systems (n = 1,020).

Alternative Regression Analysis

Using the new uncertainty variable and dropping the system type variable, the model of total IS outsourcing becomes

$$isos = \beta_0 + \beta_1 skills + \beta_2 uncertainty + \beta_3 skills \times uncertainty + \beta_4 numhosp + \beta_5 pi + \beta_6 srvcs + \beta_7 own + \beta_8 avgautoapps + \mu$$

The sample for the alternative analyses is the same as the original. Table 24 shows descriptive statistics for the alternative study variables.

Table 24. Descriptive Statistics of Alternate Analysis Variables with Refined Uncertainty Measure and Average Automated Applications

Variable	*N*	*M* (*SD*) or *f* (%)	*Min*	*Max*	*Skewness*	*Kurtosis*
skills	893	3.62 (1.61)	1	6	- 0.17	1.95
uncertainty	1,365	0.28 (0.05)	0	0.96	0.76	2.68
skills*uncertainty	893	0.99 (0.89)	0	5.72	1.35	4.80
numhosp	1,365	2.53 (8.61)	1	198	15.40	300.63
pi	1,315	0.09 (0.19)	0	1	3.03	12.59
intsrvcs	1,365	5.32 (2.40)	0	11	- 0.36	3.07
own	1,365	0.22 (0.59)	0	2	2.46	7.32
NFP		1,188 (87.03%)				
FP		50 (3.66%)				
Catholic		127 (9.30%)				
avgautoapps	1,365	13.13 (9.94)	2.11	139	4.31	38.64
ISOS	1,365	0.05 (0.06)	0	1	3.44	37.88
SISOS	1,365	0.13 (0.20)	0	1	1.59	5.28
NSISOS	1,365	0.03 (0.05)	0	1	5.98	93.24

Table 25 is a correlation analysis of the alternative analyses variables. The pattern of correlations is similar to that seen in the original analysis, although there are no perfect

Table 25. Intercorrelations between Alternate Analysis Variables with Refined Uncertainty Measure and Average Automated Applications

	skills	uncertainty	skills*uncer	numhosp	pi	intsrvcs	avgautoapps
skills	–						
uncertainty	-.18**	–					
skills*uncer	.40**	.73**	–				
numhosp	-.05	.01	-.02	–			
pi	-.02	.00	.03	.01	–		
intsrvcs	.18**	.05	.14**	-.07*	.06*	–	
avgautoapps	-.15**	.00	-.08*	.06*	-.08**	-.22**	–
own	.04	-.10**	-.08*	.14**	-.01	-.01	.02
isos	.07*	-.03	.02	.40**	.01	.02	.03
sisos	.07*	.04	.03	.01	.02	.02	.03
nsisos	.04	-.07*	.00	.49**	.00	.02	.03

	own	isos	sisos	nsisos
own	–			
isos	.0.02	–		
sisos	-.01	.61**	–	
nsisos	.03	.87**	.13**	–

*$p < .05$, **$p < .01$

correlations indicating the need to drop any variables. There is again a pattern of significant correlations between the three dependent variables, but they will not be used in the same model, so are not a cause for concern. Two of the dependent variables show a high correlation with the number of hospitals, and the pattern of relationships between the skills variable and the uncertainty and integrated services variable persists. The average number of automated applications shows a number of significant relationships, particularly with the skills and integrated services variables.

A Hausman test using the same instruments as before for the skills, the interaction of skills and uncertainty, and the number of hospitals is conducted for each analysis as before. The test for the initial regression shows the presence of endogeneity, $F(3, 858) = 3.58$, $p = .01$, so a 2SLS estimation is used. Table 26 shows the results of this estimation.

Table 26. Summary of Two Stage Least Squares Regression Analysis of the TCE and SMT Variables on Total IS Outsourcing ($N = 871$)

Variable	*B*	*Robust SE B*	β
Skills	0.02	0.01	0.53
Uncertainty	0.20	0.13	0.70
Skills x Uncertainty	-0.06	0.04	-0.87
Number of hospitals	0.01	0.00	0.18
Physician integration	0.01	0.01	0.01
Integrated services	0.00	0.00	0.03
Average automated apps	0.00	0.00	0.09*
Own			
FP	-0.01	0.01	-0.02
Catholic	0.00	0.01	0.01
V_hat1	0.03	0.00	0.15
V_hat2	0.00	0.00	0.31**
V_hat3	0.09	0.04	0.46

Note: $R^2 = .38$; $*p < .05$ $**p < .01$

The average number of automated applications is the only variable with a significant relationship to IS outsourcing, and it is small.

Table 27 presents the results of the nested model estimation of the full model

$$nsisos = \beta_0 + \beta_1 skills + \beta_2 uncertainty + \beta_3 skills \times uncertainty + \beta_4 numhosp + \beta_5 pi + \beta_6 srvcs + \beta_7 own + \beta_8 avgautoapps + \mu$$

and the joint test that the SMT variables = 0. The results of this nested estimation indicate that skills, uncertainty, and the interaction of skills and uncertainty are significantly related to non-strategic IS outsourcing, although the relationships are small. The joint test that the SMT variables = 0 was not rejected, while a joint test that the TCE variables = 0 was rejected.

Table 28 presents the results of the nested model estimation of the full model

$$sisos = \beta_0 + \beta_1 skills + \beta_2 uncertainty + \beta_3 skills \times uncertainty + \beta_4 numhosp + \beta_5 pi + \beta_6 srvcs + \beta_7 own + \beta_8 avgautoapps + \mu$$

Table 27. Summary of Nested-model Estimation for TCE Variables Predicting Non-strategic IS Outsourcing in Alternative Analysis ($N = 871$)

Variable	*B*	*Robust SE B*	β
Skills	0.02	0.01	0.64*
Uncertainty	0.21	0.10	0.93*
Skills X Uncertainty	-0.07	0.03	-1.17*
Number of hospitals	0.00	0.00	0.27
Physician integration	0.00	0.00	0.00
Integrated services	0.00	0.00	0.03
Average automated apps	0.00	0.00	0.05
Own			
FP	0.01	0.01	0.02
Catholic	0.00	0.01	-0.01
V_hat1	0.04	0.02	0.24
V_hat2	0.00	0.00	0.34*
V_hat3	0.10	0.04	0.65*

Note: $R^2 = .38$; Joint test for endogeneity $F(3, 858) = 4.41$, $p < .01$. Joint test of TCE variables = 0 rejects the null $F(3, 858) = 2.82$, $p < .05$. Joint test of SMT variables = 0 failed to reject the null $F(4, 858) = 2.19$, $p = .07$.

Table 28. Summary of Nested-Model Estimation for SMT Variables Predicting Strategic IS Outsourcing in Alternative Analysis ($N = 873$)

Variable	*B*	*Robust SE B*	β
Skills	0.02	0.01	0.14*
Uncertainty	0.08	0.07	0.09
Skills X Uncertainty	-0.02	0.02	-0.09
Number of hospitals	0.00	0.00	-0.01
Physician integration	0.03	0.04	0.03
Integrated services	0.00	0.00	0.00
Average automated apps	0.00	0.00	0.08
Own			
FP	-0.07	0.02	-0.07**
Catholic	0.02	0.03	0.02

Note: $R^2 = .02$; Joint test for endogeneity $F(3, 858) = 0.50$, $p = .69$. Joint test of TCE variables = 0 rejects the null $F(3, 868) = 2.88$, $p < .05$. Joint test of SMT variables = 0 failed to reject the null $F(4, 863) = 0.50$, $p = .73$. *$p < .05$. **$p < .01$.

and the joint test that the TCE variables = 0. The results of this nested estimation indicate that skills is the only variable significantly related to strategic IS outsourcing, although the relationship is again small. The joint test that the TCE variables = 0 was rejected, while a joint test that the SMT variables = 0 was not rejected.

The results of this analysis, while somewhat better, still appear to be the result of a poor model fit. There are two likely causes of this problem as described by Wooldridge (2000; , 2002). First, in count data such as the number of outsourced functions, the value of the dependent variable is constrained to be positive. If OLS is used to estimate such models, there will be some predicted values of the dependent variable that will be negative. Second, for strictly positive values, natural log transformations can be used, but in count data where there are a large number of zeros, log transformations are problematic. In such cases, where values of the dependent variable are constrained to be positive, and where there are a significant number of zeros, the exponential functional form is preferred, and the Poission regression model is the most common of these. Therefore, the last stage of the alternative analysis is the Poisson regression.

Poisson Regression Analysis

The Poisson regression model, as described earlier, uses the dependent variable in its count form and treats the average number of automated applications as the exposure. One key requirement for the Poisson model is equidispersion, which means that the mean of the dependent variable equals the variance. This assumption is often violated in application, and when equidispersion is not present, a negative binomial estimation is favored over the Poisson (Cameron & Trivedi, 1998; Greene, 2000; Wooldridge, 2000,

2002). Table 29 presents a tabulation of the total IS outsourcing variable, indicating its Poisson nature and large number of zero values.

Table 29. Frequency Tabulation of the Total Number of Outsourced Functions

Total Outsourced Functions	Frequency
0	523
1	376
2	244
3	115
4	56
5	33
6	7
7	8
8	1
11	1
24	1

An initial Poisson regression of the form

$$osfunctions = \exp\left(\begin{array}{l}\beta_0 + \beta_1 skills + \beta_2 uncertainty + \beta_3 skills \times uncertainty + \\ \beta_4 numhosp + \beta_5 pi + \beta_6 srvcs + \beta_7 own + \ln avgautoapps + \mu\end{array}\right)$$

was estimated and tested for endogeneity, which was found to be present ($p < .01$). The test of equidispersion failed ($GOF = 1653.23$, $p < .00$), indicating the use of the negative binomial model. The test for endogeneity in the negative binomial model was not rejected ($p = 0.06$), so no adjustment for endogeneity was made. Table 30 presents the results of the negative binomial model. Skills, the number of hospitals, the number of integrated services are positively related to the count of outsourced functions. For-profit status is negatively related to total IS outsourcing.

Table 31 presents the results of the nested model estimation of the full negative binomial model predicting non-strategic outsourcing, and the joint test that the SMT

Table 30. Summary of Negative Binomial Analysis of the TCE and SMT Variables on Total IS Outsourcing ($N = 873$)

Variable	*B*	*Robust SE B*	*z*
Skills	0.12	0.05	2.48**
Uncertainty	-0.24	0.55	-0.43
Skills x Uncertainty	0.00	0.13	0.01
Number of hospitals	0.01	0.00	6.95**
Physician integration	0.55	0.31	1.81
Integrated services	0.05	0.02	2.34*
Own			
FP	-0.66	0.19	-3.58**
Catholic	0.07	0.16	0.46

Note: *$p < .05$ **$p < .01$

Table 31. Summary of Nested-model Negative Binomial Estimation for TCE Variables Predicting Non-strategic IS Outsourcing ($N = 871$)

Variable	*B*	*Robust SE B*	*z*
Skills	0.82	0.29	2.84**
Uncertainty	7.86	3.40	2.31*
Skills X Uncertainty	-2.53	1.03	-2.46**
Number of hospitals	-0.02	0.03	-0.72
Physician integration	0.49	0.38	1.29
Integrated services	0.07	0.03	2.21*
Own			
FP	0.14	0.29	0.47
Catholic	0.11	0.21	0.51
V_hat1	1.57	0.73	2.15*
V_hat2	0.04	0.03	1.38
V_hat3	3.95	1.48	2.67**

Note: Joint test for endogeneity $p < .01$. Joint test of TCE variables = 0 rejects the null, $p < .01$. Joint test of SMT variables = 0 rejects the null, $p < .01$. *$p < .05$ **$p < .01$

variables = 0. The results of this nested estimation indicate that skills, uncertainty, and the number of integrated services are positively related to the count of non-strategic functions outsourced. The interaction of skills and uncertainty is negatively related to

non-strategic IS outsourcing. The joint test that the TCE variables = 0 was rejected, as was a joint test that the SMT variables = 0.

Table 32 presents the results of the nested model estimation of the full negative binomial model predicting strategic outsourcing, and the joint test that the TCE variables

Table 32. Summary of Nested-model Negative Binomial Estimation for TCE Variables Predicting Strategic IS Outsourcing ($N = 871$)

Variable	*B*	*Robust SE B*	*z*
Skills	0.20	0.06	3.27**
Uncertainty	0.79	0.67	1.18
Skills X Uncertainty	-0.22	0.17	-1.29
Number of hospitals	-0.01	0.01	-0.68
Physician integration	0.57	0.31	1.86
Integrated services	0.05	0.03	1.99*
Own			
FP	-1.08	0.37	-2.94**
Catholic	0.17	0.20	0.84

Note: Joint test for endogeneity $p < .62$. Joint test of TCE variables = 0 rejects the null, $p < .01$. Joint test of SMT variables = 0 rejects the null, $p < .05$. * $p < .05$, ** $p < .01$.

= 0. The results of this nested estimation indicate that skills and the number of integrated services are positively related to the count of strategic functions outsourced. For-profit status is negatively related to strategic IS outsourcing. The joint test that the TCE variables = 0 was rejected, as was a joint test that the SMT variables = 0. The next chapter will discuss the results presented here.

Summary

In summary, the analysis proposed in Chapter 4 was done despite encountering several significant problems. Some of these problems were with the data or the sample itself, but the most important problems revolve around the construction and measurement of the dependent variable. The dependent variable was originally constructed to account

for the differences between health care delivery systems in their individual use of information systems. This was the rationale for constructing a ratio of the number of outsourced functions to the average number of automated applications. The number of automated applications was included to serve as the means of controlling for differing levels of IS activity between systems. However, the number of outsourced functions is not numerically tied to the average number of automated applications, so what was conceptualized as a ratio turned out to be something other than that. Almost as problematic is the preponderance of zeros in the number of outsourced functions, which carried through to the construction of the final dependent variable. Most importantly, the choice of analytical technique was based on the construction of the dependent variable as a continuous variable. As described above, the strictly positive nature of the dependent variable, coupled with the large number of zeros, makes the OLS technique less than ideal for estimating the models.

Because the primary concern revolved around the dependent variable construction, the two alternative analyses used an alternate construction. The first of these addressed the problem of not having a true ratio for the dependent variable, but it did not address the other two main problems, i.e., that the value of the dependent variable is strictly positive and that the value is zero a significant number of times. Therefore, the OLS approach continued to yield a poor fit. The second analytical approach using the Poisson regression allowed the dependent variable to remain in its original count form, and for the control of exposure through the average number of automated applications. The data were found to be overdispersed, which was addressed by using the negative

binomial technique. Given the nature of the data and the problem, this approach has the most to recommend it and it demonstrates the best model fit, therefore it is used to test the hypotheses developed in Chapter 3.

Preliminarily, estimation of this model indicates that skills, the number of hospitals, the number of integrated services, and for-profit status all positively affect the total number of outsourced functions, but there is no significant interactive effect between skills and uncertainty. With respect to non-strategic outsourcing, skills and the number of integrated services are positively related, while the interaction of skills and uncertainty is negatively related. Both the TCE and the SMT variables appear to affect the number of non-strategic functions outsourced. With respect to strategic outsourcing, only skills appears positively related, while for-profit status appears negatively related. Again, both the SMT and the TCE variables appear to jointly affect the number of strategic functions outsourced. These findings and the results of hypothesis testing will be explored more fully in the next chapter.

CHAPTER 6 – DISCUSSION

This chapter presents the results of hypothesis testing along with a discussion of each study variable. A discussion of the implications for theory, policy, management, and methodology follows. Finally, there is a discussion of the contributions to the literature, limitations of the study, and implications for future research.

The two research questions this dissertation has attempted to answer are (a) what factors are associated with outsourcing or integration of information systems in health care delivery systems, and (b) is there a difference in outsourcing and integration behavior based on the strategic value of the IS functions? A synthesis of transaction cost economics (TCE) and strategic management theory (SMT) was applied to these questions because it was judged a suitable combination to derive theoretical constructs and testable hypotheses. Similar combinations have been used in other research (Afuah, 2001; Poppo & Zenger, 1998; Steensma & Corley, 2001).

In this case, however, the synthesis of the two frameworks was based on a theoretical analysis of both TCE and SMT applied specifically to vertical integration in the health care industry (Mick, 1990). Mick's synthesis drew on early TCE work by Williamson (Williamson, 1975) and SMT applied to vertical integration by Harrigan (Harrigan, 1983, 1984, 1985a, 1985b). The application of this framework allowed for the derivation of testable hypotheses of the constructs of asset specificity, uncertainty, the

combination of asset specificity and uncertainty, bargaining power, and corporate strategy needs. The results of the hypothesis testing follows.

Results of Hypothesis Testing

Table 33 summarizes the results of hypothesis testing based on Tables 30, 31 and 32. There were seven total hypotheses, five of which tested the relationship between one or more independent variables and the dependent variable. The two final hypotheses tested the joint effect of the TCE variables on non-strategic functions, and the SMT variables on strategic functions. Overall, there were four significant relationships, but only one was in the hypothesized direction. The relationship between skills, physician integration, and the number of integrated services and the total number of outsourced functions was significant in the opposite direction than hypothesized. The relationship between the number of hospitals and the total number of outsourced functions was significant in the hypothesized direction. The joint tests of TCE and SMT variables on non-strategic and strategic functions, respectively, did not support the hypotheses. A discussion of each of these follows.

Asset Specificity

According to TCE, the more specific or uniquely customized the IT assets a firm has, the less likely it will be able to replace those assets with those from external service providers. If external service providers do offer an alternative to specific assets, the cost will be higher than for non-specific assets, because of their inability to generate economies of scale. The degree of specialized skills required is a commonly used measure of asset specificity (David & Han, 2004). In general, the higher the degree of

Table 33. Summary of Hypothesis Testing Results

Hypothesis	**Construct (Variable)**	**IS functions outsourced**	**Supported?**
H1	Asset specificity (Skills)	Decrease	No (Increase)
H2a, H2b, H2c	Uncertainty (HHI x Occupancy rates)	Increase	No (Not significant)
H3	Uncertainty & Asset specificity (Uncertainty & Skills)	Decrease	No (Not significant)
H4	Bargaining power (Numhosp)	Increase	Yes
H5a, H5b	Corporate strategy needs (PI, Intsrvcs)	Decrease	No (Increase)
H6a	Non-strategic IS functions	TCE factors > SMT factors	No
H6b	Strategic IS functions	SMT factors > TCE factors	No

asset specificity, the greater the need for specialized IT skills to manage those assets, and the less likely the system will be to outsource. Therefore, it was hypothesized that:

H1: The greater the level of specialized IT skills within the system, the lower the extent of hospital systems outsourcing IS functions, all else being equal.

H1 was not supported. The predicted direction of the relationship between asset specificity and the number of outsourced functions is negative, but the results were significant in the opposite direction ($p = .01$). The coefficient on the skills variable of 0.12 indicates that an increase in categories of FTEs employed by the system by one results in an increase in the number of outsourced functions by approximately 12 percent. This finding is consistent across total functions outsourced, and non-strategic and strategic functions.

There was some concern over the potential endogeneity of the relationship between the degree of specialized skills and outsourcing, but this would have caused a negative relationship—as more functions were outsourced, fewer types of IT FTEs would have been necessary. One possible explanation for this finding is that the more complex the IT environment of the system, the more specialized the skill mix needed, as TCE predicts, but further, this high degree of complexity may also present more opportunities for outsourcing arrangements. That is, systems that are engaged in complex IS/IT activities may be seeking more opportunities to exploit their IS/IT capabilities, and offerings from external providers may be one means of doing so. This could also be the result of outsourcing providers offering higher-end services in an effort to increase margins, and of systems with complex IT environments experiencing difficulty finding specific IT workers with the requisite knowledge and capabilities. Further, the systems that have less complex IT environments, and therefore a lower degree of specialized skills, may have little difficulty finding the workers needed to manage a relatively straightforward IT function, resulting in less outsourcing.

Another possible explanation is that the greater the degree of specialized skills, the greater the cost of IS/IT to the system, and outsourcing may be seen as a means of reducing cost (Lacity & Hirschheim, 1993a, 1993b; Lorence & Spink, 2004). Lacity and Hirschheim found a prevailing attitude among executives that engaged in IS outsourcing that views the IS function as a utility service that can be provided more efficiently by external providers through economies of scale, resulting in savings of anywhere from ten

to fifty percent of IS costs. With this perspective the cost of the transaction and the strategic impact of outsourcing would not factor into the decision.

Uncertainty

Both TCE and SMT predict that uncertainty alone favors market exchange. In the language of TCE, uncertainty in the absence of asset specificity does not alter the spot market characteristics of the exchange, where the identity of the buyer and seller are irrelevant. In the language of SMT, uncertainty demands flexibility, and since integration impedes flexibility, market exchanges are preferred. Three measures of uncertainty were originally proposed, leading to the following three hypotheses:

> H2a: Under conditions of low asset specificity, the greater the degree of competition within the markets in which a system competes, the greater the extent of hospital systems outsourcing IS functions, all else being equal.
>
> H2b: Under conditions of low asset specificity, the greater the percent of patient revenue from non-private payors, the greater the extent of hospital systems outsourcing IS functions, all else being equal.
>
> H2c: Under conditions of low asset specificity, the greater the number of distinct markets a hospital system operates in, the greater the extent of outsourcing IS functions, all else being equal.

The number of markets the system operates in had to be removed from the model because of its high degree of correlation with the number of hospitals. The other two measures were replaced with the product of market occupancy rates and the HHI as a single measure of uncertainty. All three of these hypotheses, however, predicted the same

relationship between uncertainty and outsourcing; that is the greater the uncertainty, the greater the amount of outsourcing. This relationship was not supported. There is no significant relationship between uncertainty and the number of functions outsourced (p = .67).

It is possible that these systems are making outsourcing decisions based on other criteria than uncertainty. Such criteria may include cost and the belief that outsourcing is less costly, or a perceived inefficiency in the internal IS function (Lacity & Hirschheim, 1993a, 1993b). Or it could be that outsourcing vendors were not available, which would override uncertainty conerns. External pressures may also be driving outsourcing decisions. Such pressures may include regulatory requirements like HIPAA, or pressures to demonstrate quality improvements like those exerted by the Leapfrog Group. The model tested in this analysis did not include these factors, so they would have been included in the error term and so contributed to an omitted variables problem.

Lastly, the variable chosen to measure uncertainty may not actually be capturing uncertainty, or at least not the type of uncertainty that would influence outsourcing decisions. To examine this possibility, the negative binomial model was run using two of the three original measures of uncertainty (excluding the number of markets variable), to see if there was a significant relationship. This model did not show any significant relationships among these measures of uncertainty and the level of outsourcing.

Uncertainty and Asset Specificity

SMT does not differentiate the effect of uncertainty based on asset specificity. However, in the presence of a non-trivial level of asset specificity, TCE predicts that

increasing uncertainty favors hierarchy over market governance (David & Han, 2004, p. 41; Williamson, 1979, p. 254; , 1985, pages 59, 79-80). This represents the main area of disagreement between the two frameworks regarding vertical integration. SMT consistently predicts less vertical integration with increasing uncertainty, while TCE predicts more integration when increasing uncertainty is coupled with high asset specificity. Therefore, it was hypothesized that:

> H3: The greater the level of asset specificity and uncertainty, the lower the extent of hospital systems outsourcing IS functions, all else being equal.

The coefficient on the interaction of skills and uncertainty is not significant, but a joint test of the significance of skills and the interaction of skills and uncertainty rejected the null that they jointly = 0 ($p < .01$). To test the effect of the interaction, the partial effect of uncertainty on outsourced functions at the mean value of skills ($M = 3.62$) was calculated to be 0.13. This would indicate that the number of outsourced functions increased by 13 percent as uncertainty increased by one unit. To test whether this partial effect is significant, the negative binomial regression was rerun with the interaction term replaced by $(skills - 3.62) \times uncertainty$, which gives a direct test of significance on the uncertainty term at the mean value of skills (see Wooldridge, 2000, pages 190-191.). This test found this term is not significant ($p = .26$), indicating that there is no support for the hypothesis.

It is perhaps not surprising that the interaction test is not significant, given the contradictory results regarding asset specificity, and the lack of significance of uncertainty alone. In other words, it appears that neither asset specificity nor uncertainty

are factors influencing the outsourcing decision, so it is reasonable to assume that their combination would also not influence the decision. Further, Williamson maintains that while uncertainty increases the transaction costs of asset-specific transactions, the buyer has the option of sacrificing customized features to make the transaction less specific. This could well be the case here. Outside service providers presumably need their offerings to be less specific to gain economies of scale, so health systems that decide to outsource may also settle for a less specific transaction, reducing the effect of uncertainty.

Bargaining Power

Bargaining power is characterized by having a product with no substitutability, having alternative suppliers or distributors, having the existing ability to make the needed good or service, and having dependent suppliers or distributors. Increased bargaining power tends to decrease the likelihood of integration. Hospital systems that are large, specifically with respect to the number of hospitals owned, will have greater bargaining power with suppliers, because the suppliers will be more dependent on them for business. This is because individual hospitals represent distinct installations of the supplier's product, regardless of the size of those individual hospitals. Therefore it was hypothesized that:

> H4: The more hospitals a system owns, the greater the extent of outsourcing IS functions, all else being equal.

The coefficient on the number of hospitals is highly significant ($p < .00$) in the hypothesized direction, providing strong support for this hypothesis. The coefficient of

0.015 indicates that an increase of the number of hospitals owned by one increases the number of outsourced functions by approximately 1.5 percent.

The support for this hypothesis appears to support the theoretical prediction that the more bargaining power a system has, the more concessions it can force from its suppliers, enhancing its ability to acquire needed IS functions from the market. However, this interpretation warrants caution, given the general lack of support for the remaining theoretical predictions arising from SMT. It is possible that this measure is capturing a size effect that is unrelated to bargaining power. In other words, it may simply be that the more hospitals a health system owns, the more opportunities there are to outsource. This is because there would presumably be more IS functions as outsourcing candidates across all the hospitals the system owns, unless all of the owned hospitals have exactly the same set of IS functions.

Corporate Strategy Needs

Corporate-strategy needs are the larger strategic decisions of the firm that may argue for integration, even though it may involve risks and even penalize certain business units. Such a strategy could include creating technological leadership or developing organization wide synergies. Harrigan maintains that large market shares and synergies created by increased levels of forward and backward integration lead to more stages of integration activity and greater degrees of ownership of vertical units (Harrigan, 1985a). Therefore, hospital systems that have integration as a part of their corporate strategy can be expected to have higher levels of integration both in IS and in areas outside of IS. Two cases where this level of integration can be seen in hospital systems is the level of

physician integration and the number of integrated services. Therefore, it was hypothesized that:

H5a: Hospital systems with more physicians on staff as a percentage of total physicians will have a decreased extent of outsourcing IS functions, all else being equal.

H5b: Hospital systems with more integrated services will have a decreased extent of outsourcing IS functions, all else being equal.

The coefficient on physician integration was not significant ($p = .07$), while the coefficient on the number of integrated services was significant ($p = .02$). However, like asset specificity, both of these coefficients are in the opposite direction than hypothesized, so the hypotheses are not supported. The coefficient on the number of integrated services of 0.05 indicates that as the number of integrated services increases by one, the number of outsourced functions increases by 5 percent.

These results could also support the interpretation that systems are not making IS outsourcing decisions on strategic grounds or are not pursuing integration in a strategically coherent fashion. The lack of a significant relationship between physician integration and outsourcing supports this interpretation. The opposite effect of the number of integrated services may reflect a size effect, much like the number of hospitals (the more services the system offers the more opportunities there are to outsource). The more integrated services a system has, the more opportunities there are for outsourcing IS functions. If management views IS as a commodity then this is would be the expected result.

Non-strategic IS Functions

Both strategic management theory and TCE suggest that functions with little or no strategic value will be organized in a discriminating or transaction-cost economizing way. Therefore, the relationship between outsourcing and integration of IS functions that are non-strategic in nature will be influenced primarily by TCE factors, and strategic factors will not contribute significant explanatory power to the relationship. Therefore, it was hypothesized that:

H6a: TCE factors will have a greater influence on the decision to outsource or integrate non-strategic IS functions than strategic factors, all else being equal.

A joint test of the hypothesis that TCE variables would predict outsourcing of non-strategic IS functions but SMT variables would not was not supported ($p < .01$). This test was one of the restriction that the SMT variables = 0. Since the null was rejected, the SMT variables have an effect on the outsourcing of non-strategic functions.

This model indicates that skills is again significant in the opposite direction than TCE predicts ($p < .01$). Conversely, the interaction of skills and uncertainty was significantly negatively related to the number of outsourced functions ($p < .01$), as TCE predicts. Lastly, the number of integrated services is positively related to the number of outsourced functions ($p < .05$), which is again opposite of what SMT predicts. Because this model is restricted to non-strategic IS functions, these results do not shed any light on the overall outsourcing decision. However, with regard to the treatment of non-strategic functions, these findings suggest that management does not appear to make soucing decisions for these functions on the basis of their perceived lack of strategic impact.

Further, if the number of integrated services is really not measuring corporate strategy needs, but is rather an indicator of an increased outsourcing potential (i.e., it is not measuring a strategic construct), then it is possible that the SMT variables would not have any additional impact on the outsourcing decision.

Strategic IS Functions

The relationship between outsourcing and integration of IS functions that are strategic in nature will be influenced primarily by strategic factors, and TCE factors will not contribute significant explanatory power to the relationship. Therefore, it was hypothesized that:

H6b: Strategic factors will have a greater influence on the decision to outsource or integrate strategic IS functions than TCE factors, all else being equal.

A joint test of the hypothesis that SMT variables would predict outsourcing of strategic IS functions but TCE variables would not was not supported ($p < .01$). This test was of the restriction that the TCE variables = 0. Since the null was rejected, the TCE variables have an effect on the outsourcing of strategic functions. Specifically, the skills variable is again positively related to the number of strategic functions outsourced ($p < .01$), opposite that predicted by TCE, and the number of integrated services is positively related to the number of outsourced functions ($p < .05$), which is again opposite of what SMT predicts.

These results also suggest that management makes no distinction among the types of IS functions to outsource based on their strategic potential, or that the constructs from SMT and TCE have more predictive power over IS functions based on their strategic

potential. Both of these tests—one on non-strategic and the other on strategic IS functions—suggest that health systems management does not divide IS functions into these two categories. It is possible, and consistent with previous research in this area (Feeny & Willcocks, 1998a, 1998b; Hirschheim & Lacity, 2000; Lacity & Hirschheim, 1993a, 1993b), that management views IS as a whole to be either of strategic value or not. To further evaluate this possibility, the same joint tests of TCE and SMT variables on the total number of outsourced functions was done. The joint test that the TCE variables = 0 was rejected ($p < .01$) as was the joint test that SMT variables = 0 ($p < .01$), which provides no indication that there is a predominant view of IS as strategic or not, at least among the systems in this sample. This issue is an area that bears further investigation, including testing and validation of the classification of IS functions as either strategic or non-strategic.

For-profit Status

The coefficient on for-profit status is highly significant in both the regression on total outsourced functions, and on strategic outsourced functions ($p < .01$). The negative coefficient on for-profit status indicates that for-profit systems are less likely than non-profit systems to outsource IS functions as a whole, or those that are categorized in this study as strategic. This finding contradicts that of Menachemi and colleagues, where for-profit status did not affect outsourcing among Florida hospitals (Menachemi, Burke, Diana, & Brooks, 2005). One possible explanation for this finding is that for-profits are more attuned to cost-saving measures and to the effect that sourcing decisions may have on stock prices, leading them to use outsourcing more than non-profits.

Major Implications of the Study

The two research questions this dissertation has attempted to answer are (a) what factors are associated with outsourcing or integration of information systems in hospitals, and (b) is there a difference in outsourcing and integration behavior based on the strategic value of the IS functions? The results of this study provide some insight into the first question, and provide evidence that suggests there is no difference in outsourcing behavior based on the perceived strategic value of the IS functions. These findings contribute to the research stream in a number of ways.

IS Outsourcing Implications

The results of this study suggest that hospitals and health systems may not be considering many important factors when making IS sourcing decisions. Outside of the health care industry, the literature suggests a movement from outsourcing based primarily on cost grounds, to an increasing consideration of the strategic importance of various types of IS capabilities (Afuah, 2001; Feeny & Willcocks, 1998a, 1998b; Hirschheim, Heinzl, & Dibbern, 2002; Hirschheim & Lacity, 2000; Lacity & Hirschheim, 1993a, 1993b, 1995; Lacity, Willcocks, & Feeny, 1996; Poppo & Zenger, 1998; Steensma & Corley, 2001). The results of this study suggest that this progression may not yet be taking place among hospitals and health systems. In particular, the negative relationship between asset specificity, as measured by the variety of IS skills within the system, and the number of outsourced functions, suggests that cost may be the overriding factor in outsourcing decisions among health systems. The positive relationship between the

number of hospitals owned and outsourcing may provide further support for this conclusion, since the more hospitals a system owns, the greater there is costs will be.

Theoretical Implications

This is the first study to test empirically the combination of strategic management and transaction cost economics predictions on vertical integration proposed by Mick (Mick, 1990). While other studies have used elements of both strategic management and transaction cost frameworks, there was no theoretical basis for the inclusion of certain elements from each framework. This issue of trying to be faithful to both frameworks when they are contradictory on some points, at least, is one difficulty in working with multiple frameworks. In this case, however, Mick did the work in his synthesis. The results of this study did not support his synthesis. It is possible that this is because of measurement and data limitations. An alternative possibility is an apparent lack of attention by health care systems to either the transaction costs or strategic impact of IS capabilities. Mick also suggested that different elements of the environment and market may affect vertical integration differently and simultaneously, a possibility that this study was unable to evaluate.

Further, there is the distinct possibility that the lack of congruency of the findings in this study with Mick's synthesis of TCE and SMT may arise from the conceptualization of IS sourcing as a type of vertical integration. While IS may be viewed as a part of the production process of an organization, particularly in health care, it is also commonly perceived as a support function similar to housekeeping or food service in a hospital. This perception may make IS a candidate for outsourcing, just as

housekeeping and food services are, but it does not give rise to the same concerns about strategic impact that outsourcing a component of the production chain might. This case is clearly related to the broader issue of the perception of IS as either a commodity or a source of strategic advantage. This study's assumptions, drawn from other industries, may simply not yet be relevant in health systems.

This study does not provide any additional support for the application of TCE or SMT to the IS outsourcing phenomenon. This may be the result of data or measurement issues. For example, a main criticism of TCE is the lack of attention to internal transaction costs, and this study did not attempt to measure them because of a lack of data. Measuring internal transaction costs is highly problematic, and the data sets available in the population of health systems have no suitable variables.

The general lack of support for TCE and SMT in these results could also be because they are not the appropriate frameworks for understanding the phenomenon. Lacity and Hirschheim (1993a; , 1993b) have suggested over a decade ago that there may be a strong institutional aspect to IS outsourcing behavior, even though they used TCE and Pfeffer's theories of power (Pfeffer, 1981) as the framework for much of their analysis. The title of their article, *The Information Systems Outsourcing Bandwagon,* clearly suggests the mimetic tendencies they perceived in their analysis of outsourcing behavior. Indeed, one of the two phenomenon they cite as responsible for the IS outsourcing phenomenon is the public pronouncements of outsourcing arrangements that have claimed to attain ten to fifty percent cost savings. While this clearly relates to cost concerns, as previously discussed, it also suggests that there may be a phenomenon

similar to what Westphal described in TQM adoption among hospitals (Westphal, Gulati, & Shortell, 1997), where early adopters seek efficiency gains while late adopters mimic this behavior to achieve legitimacy. This would suggest that the field is ripe for an institutional theory based analysis of IS outsourcing behavior among health systems.

Management and Policy Implications

These findings suggest that management may not be considering the range of factors that are important in making IS outsourcing decisions. It appears that much like the situation in other industries, the initial tendency among health care systems is to focus on overall IS costs as the deciding factor. Outside of health care, however, where the pressure to apply IS to improve efficiency and performance has existed for longer, there appears to be an increasing understanding that the outsourcing decision is more nuanced than a simple cost calculation. For health care managers, the message seems to be to try to learn from the experiences of others outside of health care that have already learned that there are operational and strategic implications to their sourcing decisions that go beyond cost considerations. Perhaps, in the contemporary health care environment, the rewards associated with such foresight may not yet be forthcoming.

Conversely, health policy makers should recognize that cost appears to remain a significant barrier to the adoption and implementation of information systems in health care (this conclusion is based on previous literature on IS outsourcing, since this study did not evaluate cost). Given the high cost of information systems, and the lack of financial incentives or a demonstrable return on investment, it should come as no surprise to policy makers that adoption is slow. Incentives through reimbursement practices that

reward adoption of IS, perhaps linked to pay-for-performance initiatives are one way this problem might be addressed. It seems fair to say that without some type of support from government, adoption of effective IS in health care will continue to be slow. However, until such adoption becomes more widespread, rational models of outsourcing behavior may be hard to document.

Methodological Implications

This is one of the first theoretically-based studies to use the HIMSS Analytics database to analyze IS activity among health delivery systems (see Hillestad et al., 2005 for a non-theoretical use). This database is the most extensive collection of information about IS use among health care delivery systems available and will almost certainly be used more extensively in the future, particularly now that HIMSS has made multiple years available, allowing for longitudinal analysis. Further, linking the HIMSS data to the AHA, ARF, and CMS data provide a richer set of variables to apply organizational analysis to questions surrounding IS in health care.

From an analytical standpoint, this study used a number of variables that were generated for the first time to measure constructs such as IS outsourcing behavior. This is sometimes necessary, as in this case, and may even be desirable to some extent, but it also presents problems since these measures have not been previously validated.

Limitations

A major limitation of this study is its cross-sectional design, which leaves it open to a number of threats to internal validity, including selection bias, implicit mortality, and

cross-over effects. These weaknesses are inherent in the design and cannot be adequately addressed through statistical techniques.

The use of secondary databases also carries with it certain limitations, including the potential for selection bias. However, with the exception of the HIMSS database, the other databases used in this study are commonly used in health services and other organizational level research. The use of the HIMSS data necessitated the development of a number of measures not yet validated by other researchers and required significant exploratory work in this study. Further, issues arose surrounding the unit of analysis. For example, the HIMSS data are primarily collected at the system level, but some elements are collected at the facility level. Much of the other data are also collected at the facility level, requiring aggregation to the system level. This is not necessarily straightforward. For example, what does it mean to compare market concentration across multiple markets?

Endogeneity is another limitation that is difficult to address in a cross-sectional design. The analysis attempted to account for the possible presence of endogeneity through the instrumental variable technique, which is a well-established econometric approach to handling this problem.

The inability to obtain a measure of internal transaction costs is another limitation of this study. This is a major criticism of TCE, and this study would have been strengthened significantly if such a measure were available.

The measurement of several variables presented significant limitations. The dependent variable was not measured in such a way as to allow for the inclusion of the

overall IS activity for health systems. Nor was the dependent variable measured as a subset of the IS functions the health systems identified as having automated, and there was no measurement of the total number of possible outsourced functions, making it impossible to determine the level of outsourcing attributable to those systems that indicated they outsourced everything. This problem arises in part because of definitional problems. How is an IS function defined? For example, HIPAA-preparedness is certainly an IS issue, and it is included in the list of outsourced functions, but in fact being HIPPA-prepared involves a number of distinct IS functions, including security functions, auditing functions, and so on. This problem is inherent in the design of the HIMSS survey.

Another measurement issue is the classification of IS functions as either strategic or non-strategic. The classification in this study was based on a solid stream of research, but that research stream was not focused on the strategic nature of certain IS functions (Feeny & Willcocks, 1998a, 1998b). Instead, it was focused on achieving a high-performance IS function within the organization, albeit through the use of selective sourcing strategies. Further, although the classification used in this study was done with outside expert opinion, that input was limited to two individuals from academia and one from industry.

Lastly, one of the strengths of this study is also a limitation; that is, the use of more than one theoretical framework, even though it was based on a proposed synthesis of the two frameworks. Using two frameworks not only complicates the development of testable hypotheses, but also complicates the interpretation of the findings. Despite the elegance of Mick's synthesis, and the argument by Williamson that economizing is in

fact the best strategy, TCE and SMT are essentially two different and not necessarily competing perspectives on similar phenomenon. This fact pervades the literature on IS outsourcing, where the question of the nature of IS itself as either strategic or commodity-like is always present. Moreover, the conceptualization of IS outsourcing as a case of vertical integration may not reflect the thinking of decision-makers, which could cause the mismatch between the hypotheses and the findings.

Future Research

This study failed to demonstrate a basis for IS outsourcing decisions from either a TCE or SMT framework. Future studies should explore the potential for other frameworks to provide explanatory power to this process. In particular, Institutional Theory offers an intriguing opportunity to examine this process from a different perspective, and one that has not been examined in the IS outsourcing literature. There are a number of potential isomorphic pressures. Pay for performance initiatives, government reports such as those of the IOM on safety and quality, and pressures exerted through institutions like The Leapfrog Group all represent potential sources of regulative isomorphism. Uncertainty surrounding the acquisition and implementation of complex IS investments like EMRs and CPOE may lead to imitation of previously successful implementers, a potential source of cognitive isomorphism. Social pressures to reduce medication errors through IS/IT regardless of the cost; that is, because it is the right thing to do, is a potential source of normative isomorphism. Other frameworks may prove promising as well, including structural contingency or resource dependence approaches.

Regardless of the framework, future research should examine the nature of the apparently contradictory relationship seen in this study between asset specificity on the TCE side, and corporate strategy needs on the SMT side, and the level of integration. Both of these findings suggest that perhaps it is the cost of providing IS that drives the decision to outsource, which in turn argues that a classical economics framework may be appropriate. Further, future studies should also account for the effect of size on the level of outsourcing. For example, a study could examine the relationship between the costs of providing IS/IT, the efficiency of internal IS/IT, and the size of the organization (using various measures such as admissions, beds, or revenues), with the level of IS outsourcing.

Another important question that future research should explore is the relationship between IS outsourcing and organizational performance. These performance measures should be those that are purported to be most improved through the application of IS (e.g., medication errors). This could be accomplished in a number of ways, including an examination of high-performing organizations, but somehow the linkage between performance and outsourcing should be examined. For example, one could examine organizational performance based on financial measures, or quality measures, and relate that to the level of IS outsourcing the organization engages in. Conversely, the level of IS outsourcing could be the dependent variable, as in this study, and a variety of performance measures, including financial, quality, patient satisfaction, perceived effectiveness of the IS function, and so on could be predictors.

Future studies should attempt a longitudinal analysis. The HIMSS data are available to researchers from the inception of the survey by the Dorenfest company in

1986 to the present time. This provides the richest opportunity for a rigorous longitudinal analysis of not only IS outsourcing, but also many other areas of IS use in the health care setting. Examples include a longitudinal analysis of the type and quantity of IS outsourcing in relation to performance on quality or financial measures, or an examination of growth in IS/IT activity and IS outsourcing.

Conclusions

This study is the first to attempt a rigorous theoretically based analysis of IS outsourcing in the health care setting. It is also one of the first to do so using the HIMSS Analytics database, linked to AHA, ARF, and CMS data. The question of IS outsourcing is a critical one in the larger problem of how to address quality and safety needs in health care organizations in a cost-effective manner. This is also the first study to test empirically the synthesis of TCE and SMT proposed by Mick specifically regarding vertical integration in the health care industry.

The findings of the study were generally not supportive of the hypotheses developed out of the synthesized framework, but they do shed some light on the behavior of health care delivery systems regarding IS outsourcing activity. The findings also point to opportunities for future research to further enhance our understanding of this important phenomenon.

LIST OF REFERENCES

List of References

Afuah, A. (2001). Dynamic boundaries of the firm: Are firms better off being vertically integrated in the face of a technological change? *Academy of Management Journal, 44*(6), 1211-1228.

Ang, S., & Straub, D. W. (1998). Production and transaction economies and IS outsourcing: a study of the U.S. banking industry. *MIS Quarterly, 22*(4), 535.

Austin, C. J., & Boxerman, S. B. (2003). *Information systems for healthcare management*. (6th ed.). Chicago: Health Administration Press.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99-120.

Bates, D. W., Cullen, D. J., Laird, N., Peterson, L. A., Small, S. D., Servi, D., et al. (1995). Incidence of adverse drug events and potential adverse drug events: implications for prevention. *Journal of the American Medical Association, 274*(1), 29-34.

Bates, D. W., Leape, L. L., Cullen, D. J., Laird, N., Peterson, L. A., Teich, J., et al. (1998). Effect of computerized physician order entry and a team intervention on prevention of serious medication errors. *The Journal of the American Medical Association, 280*(15), 1311.

Bates, D. W., Spell, N., Cullen, D. J., Burdick, E., Laird, N., Peterson, L. A., et al. (1997). The costs of adverse drug events in hospitalized patients. *The Journal of the American Medical Association, 277*(4), 307.

Bates, D. W., Teich, J. M., Lee, J., Seger, D., Kuperman, G. J., Ma'Luf, N., et al. (1999). The impact of computerized physician order entry on medication error prevention. *Journal of the American Medical Informatics Association, 6*(4), 313-321.

Bazzoli, G. J., Shortell, S. M., Dubbs, N., Chan, C., & Kralovec, P. (1999). A taxonomy of health networks and systems: Bringing order out of chaos. *Health Services Research, 33*(6), 1683-1777.

Beardwood, J., & Alleyne, A. (2004). Preventing the cure from being worse than the disease: Special issues in hospital outsourcing. *Healthcare Quarterly, 7*(2), 54-58.

Boynton, A. C., Jacobs, G. C., & Zmud, R. W. (1992). Whose responsibility is IT management? *Sloan Management Review, 33*(4), 32-38.

Brailer, D. J. (2004). *The Decade of Health Information Technology: Delivering consumer-centric and information-rich health care*. Washington, DC: Department of Health & Human Services.

Brewin, B., & Perez, J. C. (2003). N.Y. hospitals part ways on IT, tap IBM. *Computerworld, 37,* 14-15.

Brown, C. V., & Magill, S. L. (1994). Alignment of the IS functions with the enterprise: Toward a model of antecedents. *MIS Quarterly, 18*(4), 371-403.

Brynjolfsson, E. (1993). The productivity paradox of information technology. *Communications of the ACM, 35*(12), 67-77.

Cameron, A. C., & Trivedi, P. K. (1998). *Regression analysis of count data* (Vol. 30). Cambridge: Cambridge University Press.

Carr, N. G. (2003). IT doesn't matter. *Harvard Business Review*, 41-49.

Casalino, L. P., Devers, K. J., & Brewster, L. R. (2003). Focused factories? Physician-owned specialty facilities. *Health Affairs, 22*(6), 56-67.

Chau, P. Y. K., & Hu, P. J. (2002a). Examining a model of information technology acceptance by individual professional: an exploratory study. *Journal of Management Information Systems, 18*(4), 191-229.

Chau, P. Y. K., & Hu, P. J. (2002b). Investigating healthcare professionals' decision to accept telemedicine technology: an empirical test of competing theories. *Information & Management, 39*(4), 297-311.

Clement, J. P. (1988). Vertical integration and diversification of acute care hospitals: Conceptual definitions. *Hospital and Health Services Administration, 33*(1), 99-110.

David, R. J., & Han, S.-K. (2004). A systematic assessment of the empirical support for transaction cost economics. *Strategic Management Journal, 25*, 39-58.

Devers, K. J., Brewster, L. R., & Casalino, L. P. (2003). Changes in hospital competitive strategy: A new medical arms race? *Health Services Research, 38*(1), 447-469.

Evans, R. S., Pestotnik, S. L., Classen, D. C., Clemmer, T. P., Weaver, L. K., Orme, J. F., et al. (1998). A computer-assisted management program for antibiotics and other anti-infective agents. *The New England Journal of Medicine, 338*(4), 232-238.

Feeny, D. F., & Willcocks, L. P. (1998a). Core IS capabilities for exploiting information technology. *Sloan Management Review, 39*(3), 9-21.

Feeny, D. F., & Willcocks, L. P. (1998b). Re-designing the IS function around core capabilities. *Long Range Planning, 31*(3), 354-367.

Galvin, R. S., Delbanco, S., Milstein, A., & Belden, G. (2005). Has the Leapfrog Group had an impact on the health care market? *Health Affairs, 24*(1), 228-233.

Garg, A., Adhikari, N. K. J., McDonald, H., Rosas-Arellano, M. P., Devereaux, P. J., Beyene, J., et al. (2005). Effects of computerized clinical decision support systems on practitioner performance and patient outcomes. *Journal of the American Medical Association, 293*(10), 1223-1238.

Ghoshal, S., & Moran, P. (1996). Bad for practice: A critique of the transaction cost theory. *Academy of Management Review, 21*(1), 13-47.

Giuse, D. A. (2003). Provider order entry with integrated decision support: from Academia to Industry. *Methods of Information in Medicine, 42*(1), 45-50.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal, 17*(Winter Special Issue), 109-122.

Greene, W. H. (2000). *Econometric analysis* (4th ed.). Upper Saddle River, NJ: Prentice Hall.

Harrigan, K. R. (1983). *Strategies for vertical integration.* Lexington, MA: Lexington Books.

Harrigan, K. R. (1984). Formulating vertical integration strategies. *Academy of Management Review, 9*(4), 638-652.

Harrigan, K. R. (1985a). *Strategic flexibility: A management guide for changing times.* Lexington, MA: Lexington Books.

Harrigan, K. R. (1985b). Vertical integration and corporate strategy. *Academy of Management Journal, 28*, 397-425.

Hayek, F. (1945). The use of knowledge in society. *American Economic Review, 35*(4), 519-530.

Hillestad, R., Bigelow, J., Bower, A., Girosi, F., Meili, R., Scoville, R., et al. (2005). Can electronic medical record systems transform health care? Potential health benefits, savings, and costs. *Health Affairs, 24*(5), 1103-1117.

Hirschheim, R., Heinzl, A., & Dibbern, J. (2002). *Information Systems Outsourcing: Enduring themes, emergent patterns and future directions*: Springer Verlag.

Hirschheim, R., & Lacity, M. C. (2000). The myths and realities of information technology insourcing. *Communications of the ACM, 43*(2), 99-107.

Institute of Medicine. (1999). *To err is human: Building a safer health system.* Washington, D.C.: Institute of Medicine.

Institute of Medicine. (2001). *Crossing the quality chasm: A new health system for the 21st century.* Washington, D.C.: Institute of Medicine.

Kaushal, R., Shojania, K. G., & Bates, D. W. (2003). Effects of computerized physician order entry and clinical decision support systems on medication safety. A systematic review. *Archives of Internal Medicine, 163*(12), 1409-1416.

Klein, S., Frazier, G., & Roth, V. J. (1990). A transaction cost analysis model of channel integration in international markets. *Journal of Marketing Research, 27*, 196-208.

Kleinke, J. D. (1998). Release 0.0: Clinical information technology in the real world. *Health Affairs, 17*(6), 23-38.

Kleinke, J. D. (2000). Vaporware.com: The failed promise of the health care Internet. *Health Affairs, 19*(6), 57-71.

Koppel, R., Metlay, J. P., Cohen, A., Abaluck, B., Localio, A. R., Kimmel, S. E., et al. (2005). Role of computerized physician order entry systems in facilitating medication errors. *Journal of the American Medical Association, 293*(10), 1197-1203.

Lacity, M. C., & Hirschheim, R. (1993a). *Information systems outsourcing: Myths, metaphors, and realities*. Chichester, NY: John Wiley & Sons.

Lacity, M. C., & Hirschheim, R. (1993b). The information systems outsourcing bandwagon. *Sloan Management Review, Fall*, 73-86.

Lacity, M. C., & Hirschheim, R. (1995). *Beyond the information systems outsourcing bandwagon: The insourcing response*. Chichester, NY: John Wiley & Sons.

Lacity, M. C., & Willcocks, L. P. (2001). *Global information technology outsourcing: In search of business advantage*. Chichester, NY: John Wiley & Sons.

Lacity, M. C., Willcocks, L. P., & Feeny, D. F. (1996). The value of selective IT sourcing. *Sloan Management Review, Spring*, 13-25.

Leape, L. L., Bates, D. W., Cullen, D. J., Cooper, J., Demonaco, H. J., Gallivan, T., et al. (1995). Systems analysis of adverse drug events. *The Journal of the American Medical Association, 274*(1), 307-311.

Leape, L. L., Brennan, T. A., Laird, N., Lawthers, A. G., Localio, A. R., Barnes, B. A., et al. (1991). The nature of adverse events in hospitalized patients: results of the Harvard Medical Practice Study II. *The New England Journal of Medicine, 324*(6), 377-385.

Levit, K., Smith, C., Cowan, C., Sensenig, A., & Catlin, A. (2004). Health Spending Rebound Continues in 2002. *Health Affairs, 23*(1), 147-159.

Lorence, D. P., & Spink, A. (2004). Healthcare information systems outsourcing. *International Journal of Information Management, 24*(2), 131-145.

Lowenhaupt, M. (2004). Removing barriers to technology. *The Physician Executive, March/April*, 12-14.

Martin, E. W., Brown, C. V., DeHayes, D. W., Hoffer, J. A., & Perkins, W. C. (2002). *Managing information technology* (Fourth ed.). Upper Saddle River, NJ: Prentice Hall.

McDonald, C. J., Weiner, M., & Hui, S. L. (2000). Deaths due to medical errors are exaggerated in Institute of Medicine report. *Journal of the American Medical Association, 284*, 93-95.

McGlynn, E. A., Asch, S. M., Adams, J., Keesey, J., Hicks, J., DeCristofaro, A., et al. (2003). The quality of health care delivered to adults in the Unites States. *New England Journal of Medicine, 348*(26), 2635-2645.

Medicare Payment Advisory Commission. (2003). *Report to the Congress: Variation and innovation in Medicare*. Washington: MedPAC.

Menachemi, N., Burke, D. E., Diana, M. L., & Brooks, R. (2005). Characteristics of hospitals that outsource information system functions. *Journal of Healhcare Information Management, 19*(1), 63-69.

Mick, S. S. (1990). Explaining vertical integration in health care: An analysis and synthesis of transaction-cost economics and strategic-management theory. In S. S. Mick (Ed.), *Innovation in health care delivery: Insights for organization theory.* (pp. 207-240). San Francisco: Jossey-Bass.

Monteverde, K. (1995). Technical dialog as an incentive for vertical integration in the semi-conductor industry. *Management Science, 41*, 1624-1638.

Moon, S. (2004). Outsiders moving in; Annual survey shows outsourcing remains a growth industry, with more hospitals preferring to buy services by the bundle. *Modern Healthcare, 34,* S1.

Morrissey, J. (2001). Crucial support for major change. *Modern Healthcare, 31.*

Nam, K., Rajagopalan, S., Rao, H. R., & Chaudhury, A. (1996). A two-level investigation of information systems outsourcing. *Communications of the ACM, 39*(7), 36-44.

National Center for Health Statistics. (2004). *Health United States 2004.* Hyattsville, MD: U. S. Department of Health and Human Services, Centers for Disease Control and Prevention.

Peabody, J. W., Luck, J., Glassman, P., Jain, S., Hansen, J., Spell, M., et al. (2004). Measuring the quality of physician practice by using clinical vignettes: a prospective validation study. *Annals of Internal Medicine, 141*(10), 771-780.

Penrose, E. T. (1959). *The theory of the growth of the firm.* Oxford: Blackwell.

Perrow, C. (1981). Markets, hierarchies, and hegemony. In A. H. Van de Ven & W. Joyce (Eds.), *Perspectives on organization design and behavior* (pp. 371-386). New York: Wiley.

Pfeffer, J. (1981). *Power in organizations.* Marshfield, MA: Pitman Publishing.

Polit, D. F., & Hungler, B. P. (1999). *Nursing research: Principles and methods.* Philadelphia: Lippincott Williams & Wilkins.

Poppo, L., & Zenger, T. (1998). Testing alternative theories of the firm: Transaction cost, knowledge-based, and measurement explanations for make-or-buy decisions in information services. *Strategic Management Journal, 19,* 853-877.

Reinhardt, U. (2001). Can efficiency in health care be left to the market? *Journal of Health Politics, Policy and Law, 26*(5), 967-992.

Reinhardt, U. (2003). Does the aging of the population really drive the demand for health care? *Health Affairs, 22*(6), 27-39.

Romano, M. (2004). Outsourcing everything; Accelerating use of outsourcing adds to public policy debate while raising questions about hospitals' 'charitable' status. *Modern Healthcare, 34,* 24.

Shactman, D., Altman, S. H., Eliat, E., Thorpe, K. E., & Michael, D. (2003). The outlook for hospital spending. *Health Affairs, 22*(6), 12-26.

Simon, H. A. (1960). *The new science of management decision.* New York: Harper & Row.

Simon, H. A. (1961). *Administrative behavior* (2nd ed.). New York: The Macmilllan Company.

Slater, G., & Spencer, D. A. (2000). The uncertain foundations of transaction cost economics. *Journal of Economic Issues, 34*(1), 61-87.

Slaughter, S., & Ang, S. (1996). Employment outsourcing in information systems. *Communications of the ACM, 39*(7), 47-55.

Smith, C., Cowan, C., Sensenig, A., & Catlin, A. (2005). Health Spending Growth Slows in 2003. *Health Affairs, 24*(1), 185-194.

Steensma, H. K., & Corley, K. G. (2001). Organizational context as a moderator of theories on firm boundaries for technology sourcing. *Academy of Management Journal, 44*(2), 271-291.

Tabachnik, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Boston: Allyn and Bacon.

Teich, J., Merchia, P. R., Schmiz, J. L., Kuperman, G. J., Spurr, C. D., & Bates, D. W. (2000). Effects of computerized physician order entry on prescribing practices. *Archives of Internal Medicine, 160*(18), 2741.

The Leapfrog Group. (2000). Computer Physician Order Entry Fact Sheet. Retrieved April 15, 2002, 2002, from http://www.leapfroggroup.org/FactSheets/CPOE_FactSheet.pdf

Tsang, E. W. K. (2000). Transaction cost and resource-based explanations of joint ventures: A comparison and synthesis. *Organizational Studies, 21*(1), 215.

United States Government Accountability Office. (2003). *Specialty hospitals: Information on national market share, physician ownership, and patients served* (No. GAO-03-683R). Washington, D. C.: United States General Accounting Office.

Westphal, J. D., Gulati, R., & Shortell, S. M. (1997). Customization or conformity? An institutional and network perspective on the content and consequences of TQM adoption. *Administrative Science Quarterly, 42*, 366-394.

White, S. L., & Chirikos, T. N. (1988). Measuring hospital competition. *Medical Care, 26*(3), 256-262.

Wholey, D. R., Padman, R., Hamer, R., & Schwartz, S. (2001). Determinants of information technology outsourcing among health maintenance organizations. *Health Care Management Science, 4*(3), 229-239.

Williamson, O. E. (1975). *Markets and hierarchies: Analysis and antitrust implications.* Ney York: The Free Press.

Williamson, O. E. (1979). Transaction cost economics: The governance of contractual relations. *Journal of Law and Economics, 22*(2), 233-261.

Williamson, O. E. (1981). The economics of organization: The transaction cost approach. *American Journal of Sociology, 87*(3), 548-577.

Williamson, O. E. (1985). *The economic institutions of capitalism.* New York: Free Press.

Williamson, O. E. (1991a). Comparative economic organization: the analysis of discrete structural alternatives. *Administrative Science Quarterly, 36*(2), 269-297.

Williamson, O. E. (1991b). Strategizing, economizing, and economic organization. *Strategic Management Journal, 12*, 75-94.

Wooldridge, J. M. (2000). *Introductory econometrics: A modern approach*: South-Western College Publishing.

Wooldridge, J. M. (2002). *Econometric analysis of cross section and panel data.* Cambridge, MA: MIT Press.

Yost, J. A., & Harmon, W. K. (2002). Contracting for information system outsourcing with multiple bidders. *Journal of Information Systems, 16*(1), 49-59.

Zinn, J. S., Mor, V., Intrator, O., Feng, Z., Angelelli, J., & Davis, J. A. (2003). The impact of the prospective payment system for skilled nursing facilities on therapy service provision: A transaction cost approach. *Health Services Research, 38*(6), 1467-1485.

APPENDIX A

Table A1. Types and Frequencies of Outsourced IS Functions in HIMSS Data

Service	*Frequency*
Benefits Realization	3
Cost Reduction Project	1
Disaster Recovery	41
HIPAA Related	415
Hardware Maintenance and Support	51
Help Desk Support	18
I.T. Application Development	57
I.T. Application Implementation	89
I.T. Assessments and Reviews	34
I.T. Contract Staffing	25
I.T. Plans and Strategies	49
I.T. Subject Matter Expertise	10
I.T. Systems Selection	28
Interim I.T. Department Outsourcing	10
Long Term I.T. Department Outsourcing	68
Network Management	49
Other	97
Other I.T. Project Management Contract	20
PACS Evaluation	11
PACS Implementation	4
PACS Selection	10
PACS Storage	93
Patient Safety Assistance	112
Remote Processing and Remote ASP Offering	454
Transcription	119
Web Site Development and Support	60
Work Process Improvement and Re-engineer	2
Total	1930

Table A2. Descriptions of "Other" Outsourced IS Functions in Table A1

Description	*Frequency*
Accounts Payable, General Ledger, Materials Management	1
Administrative & Clinical Applications	1
Administrative Services for Ambulatory Care	1
Administrative Services for Owned Payor	1
Audit	1
Benefits Administration	2
Cardiology Image Archiving	1
Computerized Patient Record	1
Credit/Collections	4
Credit/Collections for Ambulatory Care	1
Credit/Collections, Electronic Claims	1
Database Administration	1
Dictation	8
Dictation Product Maintenance	1
Document Management & Workflow	3
Document Storage	1
E-Mail Service	1
Electronic Claims	8
Electronic Claims for Owned Payor Organization	1
Electronic Claims, Eligibility, Premium Billing	1
Exchange Migration	1
Financial Management	2
General I.T. Consulting Assistance	2
Impact Analysis for Bar Coding	1
Interfacing & Custom Reports	1
Laboratory	1
Laboratory, Radiology	1
Human Resources Applications	2
Managed Care	2
Managed Care Contract Management	1
Medical Records Imaging	8
Online Education	1
Online Patient Communication	1
PACS	1
Patient Billing	3
Patient Billing for Ambulatory Care Facilities	1
Patient Scheduling	1
Payroll	1
Payroll, Personnel & Benefits Administration	2
Pharmacy	2

Table A2. Descriptions of "Other" Outsourced IS Functions in Table A1 (continued)

Professional/Physician Billing Services	2
Quality Management Support	1
Radiology	2
Remote Data Storage	3
Report Writing for MEDITECH System	1
Resource Management	1
Software Application Support	7
Specialized I.T. Consulting Assistance	1
Statement Processing	1
Training	2
Workload Management	1
Total	22

VITA

Mark Leonard Diana was born on March 4, 1958 in Tallahassee, Florida. He graduated with a Bachelor of Science in Respiratory Care from Shenandoah University, Winchester, Virginia in 1989. In 1994, he earned a Master of Business Administration, also from Shenandoah University. In 2003, he earned a Master of Science in Information Systems from Virginia Commonwealth University, Richmond, Virginia. He joined the department of Health Administration at Virginia Commonwealth University as a part-time doctoral student in 2001. He has held various positions in Respiratory Care, including as a bedside practitioner, instructor, Director of Clinical Education, and Program Director. During his doctoral studies, he has held the position of Instructor, Local Area Network Manager, and Webmaster in the Department of Health Administration at Virginia Commonwealth University.