THE IMPACT OF IT CAPABILITY ON EMPLOYEE CAPABILITY, CUSTOMER VALUE, CUSTOMER SATISFACTION, AND BUSINESS PERFORMANCE

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This study empirically examines the impact of IT capability on firms' performance and evaluates whether firms' IT capabilities play a role in improving employee capability, customer value, customer satisfaction, and ultimately business performance. The results were based on comparing the business performance of the IT leader companies with that of control companies of similar size and industry. The IT leader companies were selected from the *Information Week* 500 list published annually from 2001 to 2004. For a company to be selected as IT leaders, it needed to be listed at least twice during the period. Furthermore, it had to be listed in the American Customer Satisfaction Index (ACSI) so that its customer satisfaction level could be assessed. Standard & Poor's Compustat and the ACSI scores were used to test for changes in business performance. The study found that the IT leaders had a raw material cost measured by cost-of-goods-sold to sales ratio (COGS/S) than the control companies. However, it found no evidence that firms' IT capability affects employee capability, customer value, customer satisfaction, and profit. An important implication from this study is that IT becomes a commodity and an attempt to gain a competitive advantage by overinvesting in IT may be futile.

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CHAPTER 1

INTRODUCTION

It is important to understand whether and how the investment in information technologies (IT) is related to a firm's performance; IT has become the largest component of capital investment for firms, accounting for 35-50% of invested capital (Carr, 2003; Laudon & Laudon, 2006). Numerous studies have examined how IT influences business performance (Chan, 2000; Dehning & Richardson, 2002; Kohli & Devaraj, 2003; Mahmood & Mann, 2000; Melville, Kraemer, & Gurbaxani, 2004; Wade & Hulland, 2004). Among these, one study is particularly important because of its unique and comprehensive approach to measuring IT capability and its impact on business performance: the Bharadwaj (2000) study. Using the resource-based view of the firm (RBV), Bharadwaj (2000) empirically showed that IT capability indeed matters in business performance. The study chose two groups of companies: one group composed of IT leader companies with superior IT capability selected from *InformationWeek* 500 (IW 500), and the other group composed of corresponding control companies. The control companies and IT leader companies were similar in size and were within the same industry. The Bharadwaj (2000) study compared the financial performance of these two groups and found that IT leaders have higher profits and lower costs than the control companies. Santhanam and Hartono (2003) replicated and extended Bharadwaj's (2000) study to examine any methodological errors and sustainability of the results. They found that Bharadwaj's (2000) findings are reliable and sustainable over time.

In fact, Bharadwaj's study is a turning point for IT value research. Before her study, the dominating view of IT investment was that it increases productivity but does not result in profitability because the benefits of increased productivity are passed on to customers with improved quality and service (Hitt & Brynjolfsson, 1996). After Bharadwaj (2000), IT value researchers argue that IT investment is linked to both improved productivity and business performance.

Although both Bharadwaj (2000) and Santhanam and Hartono (2003) found that IT capability is related to business performance, they fell short of identifying and explaining the underlying processes linking IT to business performance. Many studies in IT have treated these processes as a "black box" (see Figure 1.1) and rarely investigated what is inside the black box (Soh & Markus, 1995).

Figure 1.1. Black Box

Bharadwaj (2000) emphasizes the need for studying the black box as follows:

> Although the analysis indicates that superior IT capability leads to improved firm performance, the underlying mechanisms through which this is achieved are by no means clear. Additional research is needed to identify the full chain of variables connecting IT capabilities to firm performance (Bharadwaj, 2000, p. 188).

This study extends the prior two studies, and the main goal is to discover what constructs should be inside the black box. Examining intermediate processes allows information systems (IS) researchers to better understand the mysterious black box because it enables them to identify and measure IT impacts where they occur (Barua, Kriebel, & Mukhopadhyay, 1995 ; Ray, Muhanna, & Barney, 2005; Tallon, 2008). To

find the constructs inside the black box, I started looking at the theories that explain superior business performance. Among the many theories that aim to explain superior business performance, I became interested in one theory because it appears to explain my observations well: the theory of the value profit chain (Heskett, Sasser, & Schlesinger, 1997; 2003).

Since the 1970s, Heskett et al. (1997, 2003) have attempted to identify common attributes of successful companies. From case studies and other empirical studies, they found that successful companies tend to have high employee satisfaction and capability and focus on offering superior customer value to increase customer satisfaction and loyalty. They suggest that a firm can obtain superior business performance by improving employee capability, customer value, customer satisfaction, and customer loyalty. They coined this concept as the value profit chain and tested it in various business settings along with many other researchers. Companies including Southwest Airline, Vanguard, Enterprise Rent-A-Car, and Harrah's Entertainment have successfully applied this theory in their businesses.

Although IT is an important element in the value profit chain, little attention has been paid to understand its role in the chain. That is, IT can improve employees' capabilities and satisfaction by reducing their time spent in handling tasks and improving their decision-making (Sambamurthy & Zmud, 1994). It also influences customers' values and their satisfaction by allowing employees to meet customer needs more efficiently and effectively (Heskett, Jones, Loveman, Sasser, & Schlesinger, 2008). This study applies the value profit chain to examine whether the firms with superior IT capability, compared to the firms with low IT capability, make a difference in

employee capability, customer value, customer satisfaction, and business performance (Figure 1.2).

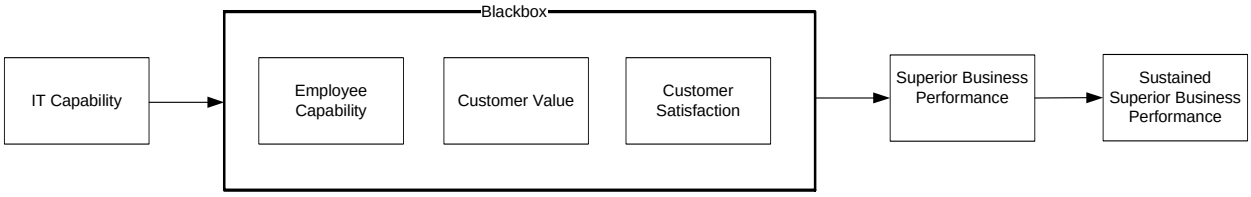


Figure 1.2. Research Model

To test this research model, I replicated and extended Bharadwaj's study (2000). Put another way, this is a replicated study in that it uses the same method to select the IT leaders and control companies as well as measuring the same financial performance. It is an extended study in that it measures new constructs such as employee capability, customer value, and customer satisfaction. In addition, while Bharadwaj (2000) used IT leaders in the 1990s, this study uses recent IT leaders in the 2000s. A good test of a theory's usefulness hinges on replications, extensions, and generalizations (Tsang & Kwan, 1999). Such replications are important to accumulate IS knowledge (Berthon, Pitt, Ewing, & Carr, 2002). Table 1.1 explains how this study is different from the previous two studies.

There are four contributions of this study; the first contribution is to identify the variables that explain the relationship between IT capability and business performance. Little is known as to how IT capability improves business performance, and variables must be found that explain the connection between the two. Drawn from the value profit chain, this study proposes that IT improve business performance through such variables as employee capability, customer value, and customer satisfaction. Examining theses

variables helps us find the underlying mechanism between IT capability and business performance.

Table 1.1. Comparisons with Prior Studies

Studies	Sample	Benchmark (Control Sample)	Measures
Bharadwaj (2000)	IT leaders selected from 1991-1994 IW500	IT leaders versus control company of similar size and industry	- Business performance measured by profit ratios and cost ratios from 1991 to 1994
Santhanam and Hartono (2003)	IT leaders selected from 1991-1994 IW500	IT leaders versus industry average	- Business performance measured by profit ratios and cost ratios from 1991 to 1994 - Sustainability of superior business performance from 1995 to 1997
Chae (2009)	IT leaders selected from 2001-2004 IW500	IT leaders versus control companies of similar size and listed in American Customer Satisfaction Index (ACSI)	- Business performance measured by profit ratios and cost ratios from 2001 to 2004 - Sustainability of superior business performance from 2005 to 2007 - Employee capability - Customer value - Customer satisfaction

In addition, while prior studies tend to look at how IT improves internal business performance, such as productivity, this study examines the impact of IT capability on the external side of business, such as customer satisfaction and customer value. Traditionally, information systems researchers tend to focus on the *internal processes* of business, such as employee productivity or operational efficiency, to explain how IT capability impacts business performance (Barua et al., 1995; Dehning & Stratopoulos, 2002). As the role of IT transforms from back-office utility to a strategic tool, IT plays an active role in enhancing the *external aspects* of business, such as value-added services to customers (Agarwal & Sambamurthy, 2002; El Sawy & Bowles, 1997; El Sawy, Malhotra, Gosain, & Young, 1999; Ray et al., 2005). However, the external aspects of IT

value creation have received relatively little attention compared to the internal aspects. In fact, this study is the first one in the IS discipline that uses the American Customer Satisfaction Index (ACSI) to measure the differences in customer satisfaction.

The third contribution is to examine whether IT capability is still important in improving business performance in the Internet age where IT is more common and homogeneous. As witnessed in Bharadwaj (2000), IT capability improved business performance in the 1990s. However, the rapid adoption of Web technologies and enterprise applications such as enterprise resource planning (ERP) in the 2000s may have removed competitive advantages that proprietary IT systems would provide. By using recent IW500 data from 2001 to 2004, we better understand the impact of new development of IT on business performance.

The fourth contribution is to measure the sustainability of business performance enhanced by IT capability. This study not only looks at the data from 2001 to 2004 when the sample companies were selected, but also examines how business performance changed from 2005 to 2007. This comprehensive data enables us to see the influence of IT capability over this time period.

This study surveys several relevant theories that explain superior business performance. Then, it proposes a research model based on the value profit chain that links IT capability to performance. The proposed model will be empirically tested.

CHAPTER 2

LITERATURE REVIEW

Understanding whether and how information technology (IT) affects business performance has been a major subject of information systems (IS) research, and there is a rich body of literature that addresses the business value of IT investment. Researchers have attempted to understand the business value of IT through the following theoretical lenses:

- The industrial and organization economics (IOE)
- The resource-based view of the firm
- The dynamic capabilities perspective
- The IS success model
- The value profit chain

The Industrial and Organization Economics (IOE)

Many researchers have used the industrial and organization economics (IOE) perspective as a theoretical framework to explain superior business performance. They argue that business performance is dependent on a market structure encompassing customers, suppliers, rivals, and potential new entrants (Porter, 1980). Firms must identify an advantageous market position that allows them to employ their bargaining power over suppliers and customers while effectively competing against new entrants, rivals, and new technologies (Porter, 1980).

That market position can be achieved by creating comparable value at a lower cost (i.e. low cost strategy), delivering greater value to customers (i.e. differentiation strategy) or by doing both (Porter, 1985). Firms can generate comparable value at a lower cost or greater value to customers that demands premium pricing by performing similar activities in different ways or performing different activities from their rivals (Porter, 1996). Obtaining superior business performance boils down to choosing a different set of activities.

However, the IOE view doesn't address how companies can create customer value from different resources and the capability of firms. This view assumes that all firms in an industry are homogeneously endowed with resources and capabilities. It does not address how unique resources and capabilities of firms influence their activities of value creation (Figure 2.1).

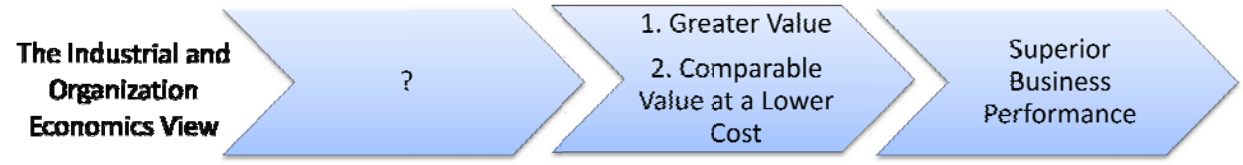


Figure 2.1. The Industrial and Organization Economics Perspective

According to this view, companies can take advantage of IT to differentiate themselves from rivals by offering superior value through personalization, interactive service, convenience, speed, or the loyalty program (Chen & Hitt, 2002; Hitt & Brynjolfsson, 1996; Kim, Nam, & Stimpert, 2004). Superior customer value afforded by IT can make companies unique and shift customer's focus away from price (Porter, 2001). For example, Chen and Hitt (2002) examined how IT can be used to differentiate and sustain competitive advantage by examining the extent of switching

costs and brand loyalty for online service providers. It investigated the impact of systems usage, service design, and individual characteristics on switching and retention for online brokerage firms. The study concluded that online brokerage firms could retain customers with high systems usage and high systems quality. The researchers also found that product line breadth and quality play an important role in reducing switching and in retaining customers.

The Resource-Based View of the Firm

Another school of thought focuses on internal resources and capabilities as the source of superior performance. The resource-based view (RBV) of the firm contends that superior business performance can be attributed to owning valuable, rare, inimitable, and nonsubstituable resources (Barney, 1991). The RBV suggests that resources and capabilities differ among firms (resource heterogeneity) and that these differences may be sustainable (resource immobility); firms can achieve superior business performance by exploiting resource heterogeneity and resource immobility. In addition, firms can sustain superior business performance by minimizing resource imitations, transfers, or substitutions (Wernerfelt, 1984).

However, the RBV doesn't explain how these resources and capabilities create customer value or customer satisfaction that leads to superior business performance. That is, having resources and capabilities does not automatically generate customer value or customer satisfaction (Porter, 1996) (Figure 2.2).

Figure 2.2. The Resource-Based View of the Firm

The RBV has been useful to explain how IT impacts business performance (Melville et al., 2004; Wade & Hulland, 2004). Unlike some resources, such as brand equity or financial assets, IT resources rarely offer long-term impacts on business performance by themselves because of the ease of imitation. Instead, IT resources make differences through the interaction with complementary resources such as organizational structure, culture, and skills to leverage IT assets for business needs (Wade & Hulland, 2004).

IS researchers have used the RBV to explain the business value of IT. Straub and Klein (2001) argue that with proper use of electronic networks, organizations can generate a valuable, rare, inimitable, and nonsubstituable resource such as proprietary customer data. Exploitation of these resources can lead to sustainable competitive advantage for the organizations (Straub & Klein, 2001). Bharadwaj (2000) defines IT as an organizational capability and suggests that firms with superior IT capability outperform a control sample of firms on a variety of profit and cost-based performance measures. Santhanam and Hartono (2003) conducted a follow-up study to examine whether sampling errors may have influenced Bharadwaj's (2000) findings. They found similar results to support the original study. The study also found business performance enabled by superior IT capability is sustained over time.

The Dynamic Capabilities Perspective

A new paradigm, the dynamic capabilities perspective (DCP), emerged as the effectiveness of both the IOE perspective and RBV is being questioned in the current hypercompetitive business environment. As the market changes fast and competition intensifies, some strategy researchers point out that superior performance advantages generated from the market position and resources do not last long (Eisenhardt & Martin, 2000; Teece, Pisano, & Shuen, 1997). The new dynamic and volatile business environment driven by globalization and off-shoring erodes long-term competitive advantages. Thus, DCP proponents argue that only a series of short-term innovations are the way to obtain sustainable competitive business performance. That is, superior business performance depends on firms' ability to integrate their tangible resources, intangible resources, and skills so that they can respond rapidly to competition and market changes (Penrose, 1959). Rapid new product development, business alliance, and strategic decision-making are some examples of these dynamic capabilities (Eisenhardt & Martin, 2000).

However, the DCP does not explain which innovations and actions are important among many innovations and competitive actions from which a firm can choose. Some criticize that continuous innovation without a clear direction would not produce predictable and sustainable results (Porter, 1996).

Figure 2.3.The Dynamic Capabilities Perspective

In the IS field, Sambamurthy, Bharadwaj, and Grover (2003) proposed that IT influences firm performance through organizational capabilities (agility, digital options, and entrepreneurial alertness) and strategic processes (capability building, entrepreneurial action, and co-evolutionary adaptation). These dynamic capabilities and strategic processes, they argue, impact the ability of firms to initiate competitive actions, and these competitive actions are a predecessor of superior business performance. Other researchers proposed the concept of net-enabled organizations (NEO); such organizations are more likely to survive in this competitive environment (Straub & Watson, 2001). For example, Zhu and Kraemer(2002) found that there is a significant association between e-commerce capability and firm performance like inventory turnover. Drawing on the DCP, Wheeler (2002) proposed the net-enabled business innovation cycle (NEBIC). NEBIC describes how emerging IT can influence a firm's ability to achieve growth and to create and sustain competitive advantages. This framework includes four sequenced constructs: (1) choosing new IT, (2) matching economic opportunities with the technology, (3) executing business innovation for growth, and (4) evaluating customer value. Each construct becomes a part of a cycle along with the processes and events. The basic tenet is that firms must develop reliable capabilities for continual IT innovation for competitive necessity and to exploit fleeting competitive advantage (Wheeler, 2002). Zahra and George (2002) extend Wheeler's

work (2002) with a strategic entrepreneurship perspective. They point out that although NEBIC creates new opportunities for firms by creating new markets, firms may have difficulty in recognizing the emerging technology or its impact on the firm's business because they do not have experience or knowledge. Therefore, they argue that NEBIC should consider a strategic entrepreneurial perspective so that a firm's search focus is not limited to the domain in which they are familiar.

DeLone & McLean IS Success Model

Another school of thought uses the IS success model to understand business value of IT investment. IS success model by DeLone and McLean (1992, 2003) explains how information systems create value for organizations. According to the model, system quality, information quality, and service quality determine the system usage and satisfaction and, in turn, system usage and satisfaction influence business performance (Figure 2.4).

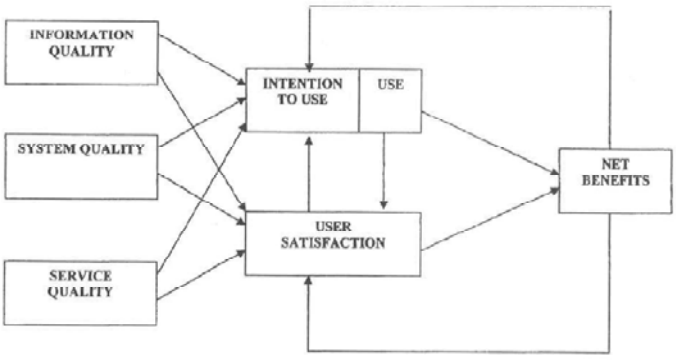


Figure 2.4. DeLone & McLean IS Success Model

However, this premise has limitations. It does not fully address how users perceive the value of an information system. It assumes that the information quality, system quality, and service quality automatically generate user satisfaction. Users will

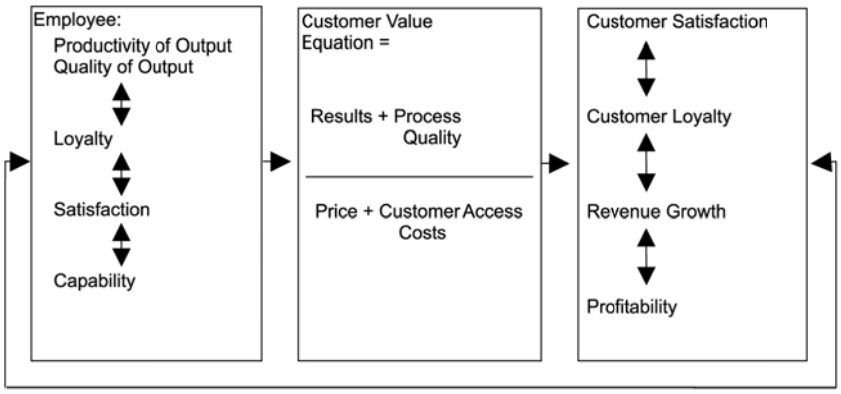
not be satisfied with information systems of high quality when they perceive that the benefits of using a system do not match or exceed the cost (i.e. efforts and time-investment) of learning or using the system. Numerous high-profile IT investment failures due to employee dissatisfaction and customer dissatisfaction illustrate the need for understanding the perceived value of IT.

In addition, the IS success model has mainly been used for understanding internal IT value and does not adequately address how IT can generate value to external customers. As IT becomes pervasive, it is necessary to approach the IS success model from the perspective of all stakeholders, including employees and customers. IT can improve employee productivity, which increases employee satisfaction. It then influences customer satisfaction by enhancing customer value, which in turn increases customer loyalty and firm performance (Heskett et al., 2003).

The Value Profit Chain Model

A group of researchers, especially in the marketing discipline, attempts to explain superior business performance using intermediate processes such as employee satisfaction, customer perceived value, customer satisfaction, and customer loyalty. Traditionally, marketers understand business performance through the “4 Ps”: product, price, promotion, and place or channels (Kotler, 1994). However, as mass marketing wanes its effectiveness in an environment where most products rapidly become a commodity, customer service becomes an important differentiator. Firms also recognize the importance of employee satisfaction and their effective interaction with customers. Employee satisfaction reflects on their attitude, and it in turn influences customer

satisfaction. Southwest Airlines' success attributes to its employee satisfaction and their effective interaction with customers, which impacts customer satisfaction (Heskett et al., 1997). Based on such observations, Heskett et al. (1997, 2003) proposed the value profit chain. It suggests that employee satisfaction and capability, customer value, and customer satisfaction and loyalty are the main constituents of successful business. That is, firms consider employees as internal customers and provide them with suitable training, support, motivation, and rewards to serve external customers (Kotler, 1994). These satisfied and capable employees can provide superior customer value by offering great products or services that meets customer needs. Satisfied customers will reward the firms with referral or repurchase, which influences business performance (Reichheld, 1996). Figure 2.6 summarizes the value profit chain.



Source: Heskett *et al*. (1997, p.12)

Figure 2.5. Heskett, Sasser, and Schlesinger's (1997, 2003) Value Profit Chain

IT plays an increasingly important role in the value profit chain (Parasuraman, 1996). Well-designed support systems, such as information and communication systems, improve employee productivity and increase employee satisfaction. In addition, IT enables employees to provide fast and correct services to their customers (Parasuraman & Grewal, 2000; Sambamurthy & Zmud, 1994). Despite the importance

of IT in the value profit chain, there are few empirical studies that examine the linkage between IT and the value profit chain (Heskett et al., 2003; Ray et al., 2005).

In sum, IS researchers have used multiple theoretical lenses to examine the impact of IT on business performance, yet they have not reached any consensus about how IT affects business performance. It is imperative that we have a theoretical model to explain the processes through which IT empowers firms to achieve improved business performance. In the next chapter, a theoretical model drawing from the value profit chain is proposed, and the reason for selecting the model is justified.

CHAPTER 3

RESEARCH MODEL AND HYPOTHESES

This study applies the value profit chain to explore the linkage between information technology (IT) capability and business performance. It examines whether the firms with superior IT capability are more likely to achieve sustained superior business performance through increased levels of employee capability, customer value, and customer satisfaction, as depicted in the proposed research model (Figure 3.1).

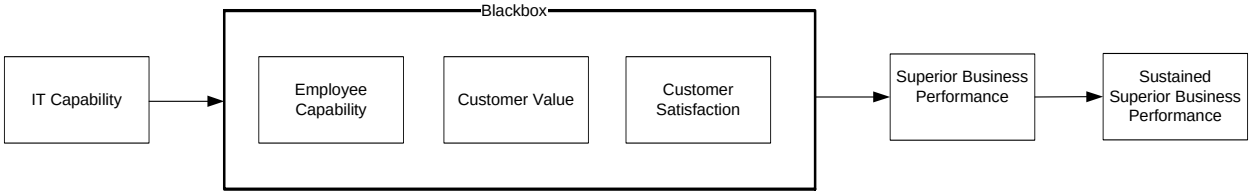


Figure 3.1. Proposed Research Model

There are several advantages of this model over others that attempted to explain IT's influence on business performance. Information system (IS) researchers have relied on the resource-based view (RBV) to explain the business value of IT. While describing the development of resources and capability, the RBV-based model does not provide useful guidance as to what strategic actions firms should take to achieve business performance (Wheeler, 2002). My research model can be useful to explain how IT capability can build superior business performance through improving employee capability, customer value, and customer satisfaction.

Although it is well understood that providing superior customer service is one of the primary priorities of a business and its IS department, previous research models overlook the possible linkage between IT and external customer service (Ray et al., 2005). Thus, the second benefit is that this model fills the gap by explicitly answering how IT influences customer satisfaction and customer value.

Finally, the IS success model assumes that the information quality, system quality, and service quality automatically generate user satisfaction. Users will be satisfied only when the benefits of using a system exceed the investment in time and effort to learn and use the system. That is, superior user (customer) value beats costs that a user incurs is a prerequisite of user satisfaction. Thus, the IS success model should include customer value. By borrowing customer value from marketing, this research model fills the gap that the IS success model fails to answer.

Only an empirical verification will support that the proposed model better explains the phenomenon than competing models. The constructs in the research model and hypotheses are discussed in the following section.

Constructs & Hypotheses

IT Capability and Employee Capability

IT capability refers to a firm's ability to assemble, integrate, and deploy IT-based resources. It is created when a firm combines IT infrastructure, human IT skills, and IT know-how to leverage IT for its business needs[1]. Employee capability is defined as the knowledge, skills, abilities, and motives of each individual employee. A firm's IT capability significantly impacts employees' capabilities. Most of all, information systems can lessen the time managers and employees spend on consuming tasks of analysis

[1] For more discussion about IT resources and capability, refer to Bharadwaj (2000).

and reporting. For instance, when Taco Bell introduced the TACO (Total Automation of Company Operations) information system in 1990, it was able to reduce fifteen hours of managerial administrative work per week as well as improve manager's understanding of their business (Applegate, Austin, & McFarlan, 2007).

In addition, with superior IT capability, customer service personnel can handle their jobs more efficiently and effectively. For example, the United Services Automobile Association (USAA), a financial services company providing banking, investing, and insurance to military members and their families, outspends its competitors on information and communication technology because IT capability is crucial to enable its customer service representatives to meet customer needs. The service representatives can retrieve needed information quickly in order to make rapid recommendations and decisions (Heskett et al., 1997). Superior IT capability enables the sales representative to cross-sell multiple products regardless of whether their products are sold by direct mail, over the telephone, by word-of-mouth, or on the Web site. Another example of a company that benefits from IT capability is Capital One. Its customer support employees pick up a phone call with such information as (1) the reason for the call with a 70% accuracy rate, (2) specific counter offer for customers requesting the cancellation of their credit cards based on customers' loyalty and long-term profitability, and (3) an actual script to use in negotiating the counter terms (Heskett et al., 2003). As IT impacts every aspect of business activities, employee capability is likely to be influenced by IT capability, so I propose the following hypothesis.

H1: Superior IT capability is associated with higher employee capability.

IT Capability and Customer Value

Customer value is an ubiquitous term we easily and frequently encounter. Customer value is the difference (or surplus) between benefits and costs. That is, customer value is made of a "receiving part" – the benefits a user draws from goods and services, and a "giving part"- the customer' monetary and non-monetary costs of acquiring the goods and services (Brynjolfsson, 1996; Heskett et al., 1997; Hitt & Brynjolfsson, 1996; Porter, 1996; Woodruff, 1997). A greater customer value is created when a firm maximizes the difference between benefits and sacrifices that customers incur. Thus, a firm should focus on increasing the benefits that customers consider important and minimizing the costs that do not add value to customers. A firm creates customer value by both providing what customers want (customer-orientation) and reducing what customers do not want (operating focus) (Porter, 1985). Superior IT capability is essential for a firm to be customer-oriented and operating-focused because IT plays a key role in introducing new products or services that customers want, as well as the improving operational efficiency that reduces unnecessary costs (Brynjolfsson and Hitt 1995).

With superior IT capability, a firm can be customer-oriented by identifying customers who are underserved by incumbent providers and offering new products or services. For instance, the success of Progressive, an insurance company, results from penetrating the untapped motorcycle insurance market. Its success is attributed to its IT capability, including the state-of-the art analytic tools, superior IT staff, and insights from unconventional use of information technologies. Most insurance companies ignored motorcycle insurance business because of the high risks associated with it. However,

Progressive collected and analyzed potential applications with sophisticated analytic tools (Heskett et al., 2003). They found that not all motorcycle owners are the same; many riders are professionals, such as medical doctors. The company started selling nonstandard insurance at higher-than-average rates to motorcycle owners while minimizing its exposure to potential risks. Motorcycle owners responded to the new service because they wanted affordable insurance. With superior IT capability, Progressive successfully exploited a new market.

In addition, IT capability enables firms to identify potential customers' needs. For example, Amazon monitors customer-buying patterns and uses customer data for purchase recommendations or cross-selling, illustrating that IT capability is essential for Amazon to spot customers' potential needs.

IT plays a major role in continuous innovation and improvement of products and services for customers (El Sawy & Bowles, 1997). As the business environment changes, a flexible IT infrastructure and a skilled internal IS workforce enable a firm to rapidly develop and deploy a critical IT system (El Sawy et al., 1999). It influences a firm's change-readiness capability (Clark, Cavanaugh, Brown, & Sambamurthy, 1997). In addition, IT capability enables firms to experiment with information-intensive products or services and learn from them. For example, Amazon's sophisticated IT infrastructure allowed it to experiment different pricing schemes for different people without imposing much cost.

IT plays a vital role in reducing operating costs that are not beneficial for customers. For instance, early investment in Internet banking can significantly reduce transaction cost for banks. In 1999, Internet banking transactions cost banks about 1

cent, while tellers cost banks $1.14, phones 55 cents, and ATMs 29 cents (Carmel, Eisenach, & Lenard, 1999). In addition, firms with strong IT capability effectively communicate and work with business units, so customers can benefit from improved business processes that enable them to achieve what they want with minimum interruption or pain. For instance, with the real-time package tracking data provided by shipping companies, customers will not miss an important package that they must receive on time.

In sum, a firm with superior IT capability creates value for a customer through two mechanisms: (1) by offering new products or services or continuous innovation in product features and quality and (2) by lowering customer cost (Porter, 1996). Since IT capability is essential for meeting these two conditions, the following hypothesis is proposed.

H2: Superior IT capability is associated with higher customer value.

Customer Satisfaction

Customer satisfaction depends on his/her realized value of the purchase and his/her expectation of buying value. Customers are satisfied when their realized value of their purchase exceeds their expectation before the purchase. That is, customer satisfaction is the result of a comparison between what is expected and what actually occurs. Customer satisfaction is different from customer value in that customers have different expectations about their purchases. Although companies offer great customer value, they may not satisfy their customer if customers have higher expectations. Customers at Nordstrom have different expectations about their buying experiences

than customers at Wal-Mart. These different expectations impact their satisfaction about the service.

IT impacts customer satisfaction in numerous ways (Mithas, Krishnan, & Fornell, 2005; Parasuraman & Grewal, 2000; Prahalad, Krishnan, & Mithas, 2002). First, IT can enhance customer satisfaction by improving customer service representatives' productivity and reducing their turnover. The frontline personnel who interact with customers directly influence customer satisfaction. By providing up-to-date information for customers, IT enables frontline employees to meet customer needs more efficiently and effectively. For instance, when a customer faces a sold-out item, the sales representative with a good IT system can provide the customer with such information as to other stores have the item, when the item will be restocked, or what other compatible items are available. Such information is vital in exceeding customer expectation.

In addition, IT influences customer-service representatives' job satisfaction and turnover. Traditionally, firms approach the losses incurred by employee turnover from the perspective of the cost of recruiting, hiring, and training replacements. However, in most service jobs, a greater cost of turnover is the loss of customer satisfaction (Heskett et al., 1997). Low turnover of customer-contact personnel not only reduces replacement costs, but also enables the personnel to maintain long-term relationship with customers (Heskett et al., 1997). Customer-contact employee defection, for the most part, results from the lack of managerial systems that support their ability to meet customer needs (Heskett et al., 2003). A good IT system is a key part of managerial system to support frontline personnel.

Second, even if companies offer similar commodity-type products or services, they can increase customer satisfaction by providing superior services in purchase supporting activities. When customers judge satisfaction, they evaluate both the buying activities and other supporting features, such as after-sale technical support. Successful value-added supporting activities such as warranty support and post-purchase support depend on well-coordinated cooperation among business units. Warranty information and previous purchase history, saved on such IT applications as enterprise resource planning (ERP) or customer relationship management (CRM), play a vital role in offering flawless support. Since information systems are a backbone in connecting various business activities, IT capability influences customer service quality, which in turn influences customer satisfaction (Roth & Jackson, 1995). In conclusion, as IT plays a key role in exceeding customer expectations, the following hypothesis is proposed.

H3: Superior IT capability is associated with higher customer satisfaction.

Superior Business Performance

IT capability may influence firms' business performance by increasing revenues, reducing costs, or both (Porter, 2001). First, IT capability can increase product differentiation, which supports higher profits (Hitt & Brynjolfsson, 1996). For instance, some banks have created information and financial services to create a Web site that allows the banks to differentiate their products and service (Tan & Teo, 2000). They can generate new revenue from advertising, referrals, and commissions from their Web partners. Additionally, firms with superior IT capability increase their revenue by obtaining valuable resources such as patents (Fahy & Hooley, 2002). For example,

Amazon's patented 1-Click payment system and Priceline's "Name-Your-Price" are additional revenue sources because competitors must pay them to use such features.

Firms with superior IT can increase switching costs for customers and thus enhance customer loyalty. This, in turn, reduces their marketing and sales cost. For instance, banks may increase switching costs and customer loyalty with a feature-rich Internet banking system. With such system, a customer is likely to use the increasing number of integrated products and services offered on the Internet banking system and become more reluctant and find it difficult to switch to other banks. Approximately, one-fourth of all retail banking customers switch banks each year, but Internet banking has managed to reduce those attribution rates by 30 percent (Langhoff, 2005).

Furthermore, superior IT capability may allow a firm to gain exclusive access to custom information and their preferences, which reduces the companies' search costs for future business (Straub & Watson, 2001). This proprietary information can be a valuable resource for a firm to expand its business into a new industry without incurring heavy toll. For example, AT&T entered the credit card business relatively easily, and its success, in part, attributes to its tremendous amount of customer data that it amassed over a long period of time (Sampler, 1998). These are just a few examples of how IT capability impacts a firm's business performance by either increasing revenues or reducing costs. Therefore, the following hypothesis is proposed:

H4: Superior IT capability is associated with better business performance.

Sustainability of Superior Business Performance in the Internet Age

It is important to answer whether superior IT capability provides a long-term impact on business performance in the 2000s. Unlike the 1990s where proprietary information systems prevailed, the 2000s is characterized with more standard and homogeneous information systems because of the rapid adoption of ERP and Web technologies. It is easier for companies to imitate their competitors' IT capabilities because they can collect the information about the competitors' IT through their IT vendors, customers, or Web sites. Also, firms can significantly reduce development time due to outsourcing, off shoring, or search engines (Porter, 2001). Therefore, firms with low IT capability can easily catch up to IT leaders (Carr, 2003).

Although some critics argue that IT no longer provides long-term impact on performance, a firm's superior IT capability can still offer sustainable benefits due to the significant learning curve, time, and effort that competitors should overcome. Superior IT capability in the Internet age can lead to two types of learning effects: (1) learning in the IT department from doing, first-order learning, and (2) learning that adapts organizations to take advantage of new innovations, second-order learning (Dos Santos & Peffers, 1995). The emergence of Web technologies in the late 1990s involved significant learning in both the internal IT workforce and organization itself. The benefits from learning effects may outweigh the initial higher costs associated with a new technology, and they can be a source of a sustainable competitive advantage.

Companies can benefit from learning through first-order learning. Internet technologies require a new technological architecture; they are what we call

architectural innovations (Henderson & Clark, 1990). Developing Internet applications demands new sets of technological infrastructure and skills. That is, traditional information systems are mainly based on procedural programming languages, like COBOL, and mainframe computers. Internet applications are, however, based on such technologies as client-server architecture including databases, middleware using object-oriented programming like JAVA, and Web browsers. When Internet applications were first introduced in 1995, there were not many system developers that understood Internet technologies. The firms with superior IT capability in the late 1990s and early 2000s may enjoy first mover benefits because developing capable Web programmers and system administrators takes a long time and a great deal of effort. In addition, they may gain valuable experience in the Internet technologies including efficient programming, server maintenance, and security. The early acquisition of valuable human resources and experience is likely to reinforce IT competence and capabilities, which, in turn, positively impact subsequent projects such as e-commerce or the Internet portal site for mobile phone or PDA users.

Superior IT capability in the Internet age creates second-order learning, an organizational change that IT creates. Internet technologies allow firms to electronically connect customers and suppliers, so organizations must change their operations and management to reflect new technologies. Those changes will accelerate innovations of firms. The impact of Internet banking on banks is a good example of second-order learning. With relatively simple and standard products, banks are vulnerable to price transparency caused by information available on the Web (Clemons & Hitt 2001). Banks find pressures on their margins as customers can now easily access and compare

interest rates(Porter 2001). Banks have historically avoided this problem by differentiating quality of services and providing conveniences with more branch offices and ATMs. Another tactic for banks is to create switching costs by making a customer use a number of products through cross-selling.

However, the Internet undermines such strategies. The advantage of combining many accounts into one institution has declined because of the ease of online money management and interoperation across institutions by personal financial management software like Quicken or Microsoft Money (Clemons & Hitt 2001). Also, the attempt to increase the sale of alternative financial products, such as mutual funds or brokerage accounts through the branch office, often fails because customers can easily find the best available offering in the market through an Internet search.

As more customers embrace Internet banking, banks need to reconfigure their branch offices. Early adoption of Internet banking can enable banks to better recognize the changes in the industry structure and the demands for new service and branch management. The banks with superior IT capability are more likely to be adaptive in a new challenge of the bank industry, the commoditization of banking services.

Because of these two learning effects, a firm's IT capability is likely to be related to the sustained business performance, so the following hypothesis is proposed. Figure 3.2 summarizes all research hypotheses.

H5: The impact of superior IT capability on business performance is sustained over the time.

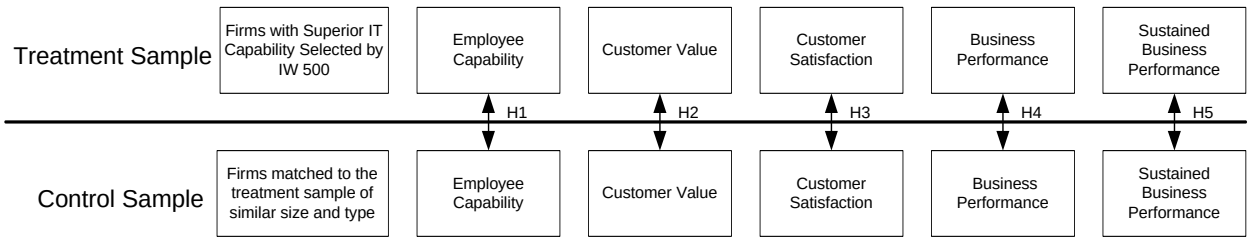


Figure 3.2. Research Framework and Hypotheses

CHAPTER 4

METHODOLOGY

This study aims to replicate, extend, and generalize the Bharadwaj (2000) and Santhanam and Hartono (2003) studies. Replications are important because they solidify tentative beliefs to accepted knowledge. Despite the importance of replications, there are few practices in the information system (IS) field (Berthon et al., 2002). Like Bharadwaj (2000), the "matched sample comparison group" method was used to empirically test the proposed hypotheses. This method selects a treatment sample and a control sample and compares the levels of interest variables across two groups. In this study, the treatment sample is the firms with superior information technology (IT) capability, and the control sample is the firms matched to the treatment sample of similar size and industry.

Constructs and Their Measurement

IT Capability

The firms with superior IT capability are defined as those that were listed in the annual *InformationWeek* (IW) 500 list for at least two years between 2001 and 2004. This process simply replicates the original Bharadwaj (2000) study, which used the rankings of IW 500 from 1991 to 1994. Each year since 1989, IW selects 500 companies as leaders in business technology innovation. The ranking of the list is based on how effectively firms use IT rather than how much they spend. To rank the list in 2002, for example, IW conducted a quantitative analysis as well as a qualitative assessment using essay responses. The quantitative analysis examined such

information as the IT spending plan and budget. It also looked at how the companies use technology to innovate, to make their business processes more efficient, and to use IT for productivity improvement. Additionally, participating firms completed two essays, one on overall technology innovation and the other on six technology initiatives including information security, productivity, wireless, supply chain, customer intimacy, and emerging technology. The responses to all parts of the survey were evaluated, weighted, and combined into a total score by the magazine's editors. The score was the basis for the ranking. The IW is regarded as a reliable barometer for firms' IT capabilities and has been used in prior academic studies (Bharadwaj, 2000; Hitt & Brynjolfsson, 1996; Santhanam & Hartono, 2003).

Employee Capability

Employee capability refers to knowledge, skills, and abilities of each individual employee. Superior IT capability will impact the ability or knowledge of the employees to perform their jobs more efficiently and effectively. Therefore, the impact of IT capability on employees will be reflected on improved employee productivity as measured by sales per employees (Heskett et al., 2003; Kaplan & Norton, 1996; Zhu, 2004;).

Customer Value

Customer value is defined as the benefits that exceed the costs customers incur. That is, customer value means offering great benefits at the lowest cost possible. High customer value means maximizing the difference between benefits and sacrifices. Customer value is measured with sales growth relative to competitors. A firm's sales will not increase faster than its competitors unless it generates more value for customers than competitors (Appiah-Adu & Singh, 1998). Customer-oriented firms tend to have

high growth rates in sales because their new products or services accommodate their customer's needs (Joshi & Sharma, 2004). Slater and Narver (2000) argue that relative sales growth is the best indicator of whether superior customer value is created.

Customer Satisfaction

Customer satisfaction is the result of a comparison between what is expected and what actually occurs. Customer satisfaction data is obtained from the American Customer Satisfaction Index (ACSI) that has been tracked by the National Quality Research Center (NQRC) at the University of Michigan since 1994. Each year the NQRC surveys 65,000 customers who purchase products from over 200 companies in 43 industries and asks them to score these on a 0-100 scale for overall customer satisfaction. The ACSI is considered a reliable indicator of a company's customer satisfaction (Anderson, Fornell, & Mazvancheryl, 2004; Fornell, Johnson, Anderson, Cha, & Bryant, 1996).

Business Performance

This study uses the same variables as Bharadwaj (2000) to measure business performance. Bharadwaj (2000) defined superior business performance by higher profit ratios and lower cost ratios measured by eight variables. As for the profit ratios, the following five variables are measured: (1) return on assets (ROA), (2) return on sales (ROS), (3) operating income to assets (OI/A), (4) operating income to sales (OI/S), and (5) operating income to employees (OI/E). The operating income was not clearly defined in Bharadwaj's (2000) study, so I used earnings before interest payment and taxes (EBIT) as the operating income. Three cost related ratios were also compared: (1) total operating expenses to sales (OEXP/S), (2) cost of goods sold to sales (COGS/S),

and (3) selling and general administrative expenses to sales (SG&A/S). As Bharadwaj (2000) used, operating expenses are defined as the sum of COGS and SG&A.

In addition to the eight variables that Bharadwaj (2000) measured, return on investment (ROI) was added. Companies can achieve superior customer value and satisfaction at the expense of profit. Firms can temporarily increase customer value and satisfaction by offering deep discounts on their products while sacrificing profits. Thus, I examined whether a firm creates economic value or if the ability to command prices is greater than the full costs of producing its goods/services (Porter, 1980, 1985). A reliable test of economic value is sustained profitability, measured by superiority in long-term return on investment (Kaplan & Norton, 1996; Rappaport & Mauboussin, 2001). Other goals and metrics (e.g. eps growth; market share; return on sales; pro-forma earnings; cash flow) may obscure true economic performance (Porter, 1996). ROI is defined as income before extraordinary items divided by total invested capital, which is the sum of the following items: total long-term debt; preferred stock; minority interest; and total common equity. This is then multiplied by 100. The financial data was obtained from the Compustat database. In conclusion, this study examines whether IT leaders show higher profit and lower cost than control companies during the same period between 2001 and 2004.

Sustained Superior Business Performance

Sustainability of superior business performance is measured by whether higher profit and lower cost is maintained over time. To measure sustainability, I measured the profit and cost ratios of both IT leaders and control firms from 2005 to 2007. Table 4.1 summarizes the constructs and their measurement in this research.

Table 4.1. Summary of Constructs and Measurement

Constructs	Definition	Measurement	Sources
IT Capability	A firm's ability to assemble, integrate, and deploy IT-based resources	The firms ranked *InformationWeek* 500 more than twice from 2001 to 2004	Bharadwaj (2000); Rai, Patnayakuni, & Patnayakuni (1997)
Employee Capability	The knowledge, skills, abilities, and motives of each individual employee	Sales/Employee from 2001 to 2004	Heskett et al. (2003); Huselid (1995); Poston & Grabski(2001); Rai et al. (1997); Strassman (1997); Zhu (2004)
Customer Value	The results and service process quality that far exceeds the price and acquisition costs they incur for a service	Relative sales growth rate from 2001 to 2004	Heskett et al. (2003); Porter (1996); Prahalad et al. (2002); Rai et al. (1997); Slater & Narver (2000)
Customer Satisfaction	The result of a comparison between what is expected and what actually occurs	American Satisfaction Index (ACSI) from 2001 to 2004	Mithas et al. (2005); Praharad et al. (2002)
Superior Business Performance	1. Higher profit and lower cost than the control group 2. Generated economic value	1. ROA, ROS, OI/A, OI/S, OI/E, COG/S, SGA/S, OPEXP/S from 2001 to 2004 2. ROI from 2001 to 2004	Bharadwaj (2000); Porter (1985); Rappaport (1998); Rappaport & Mauboussin (2001)
Sustained Superior Business Performance	Sustained superior business performance	1. Sales/Employee from 2005 to 2007 2. Relative sales growth rate from 2005 to 2007 3. ACSI scores from 2005 to 2007 4. ROA, ROS, OI/A, OI/S, OI/E, COG/S, SGA/S, OPEXP/S from 2005 to 2007 5. ROI from 2005 to 2007	Bharadwaj (2000); Porter (1985); Rappaport (1998)

Sample Selection

The firms with superior IT capability are those listed in IW 500 from 2001 to 2004[2]. To select the firms with enduring IT capability, the IT leader sample was restricted to firms listed in IW 500 at least two of the four years. This yielded a list of 561 firms. The sample was further restricted to the firms listed in the ACSI, which reduced the sample to 77 firms. Despite the significant reduction in the sample, this was necessary to examine the relationship between IT capability and customer satisfaction. This step allows the avoidance of common method bias because I use different data for independent and dependent variables.

Once IT leaders listed both in IW 500 and ACSI were selected, a matching set of control firms was selected from ACSI to make sure that control companies have customer satisfaction scores to be compared to those of the IT leader companies. From the set of potential control firms in the same industry as the IT leaders, the matching control companies were chosen with the closest five-year average sales level to the IT leaders. As Bharadwaj (2000) suggested, the average sales of the control firm must be within 70 to 130% of the leader firm. That is, the control companies should be in the same industry as the IT leaders, and their average sales from 1996 to 2000 must be 70% -130% of IT leaders' average sales from 1996 to 2000. The process yielded 19 pairs of IT leaders and comparable firms.

Using the control firm with the same industry and similar size offers several benefits. First, operating performance varies widely by industry and firm size. By using the matching samples, the variance of performance influenced by the difference in

[2] Bharadwaj (2000) used 56 IT leader companies ranked more than twice in IW 500 from 1991 to 1994.

industry and firm size can be minimized. In addition, the literature in accounting suggests that firm size and industry type are strong predictors of the choice of accounting methods and process used to compute costs such as depreciation and amortization (Bharadwaj, 2000). Therefore, the impact of variance in accounting methods can be controlled, and the direct comparison of profitability and cost ratios becomes more reliable.

Table 4.2. Steps of Sample Selection

Step	Procedure	Number of Companies
1	Identify companies listed in IW 500 from 2001 to 2004	2,000
2	Restrict the IT leader sample to those that were listed at least twice in the IW 500 from 2001 to 2004	561
3	Further restrict the IT leader sample to those also listed in ACSI	77
4	Select IT leaders with comparable companies also listed in the ACSI	19

Descriptions of the Sample

Table 4.3 lists the IT leaders and the corresponding control companies. As Table 4.3 shows, many of the 19 IT leaders are in the utility or retail industry where a firm's IT capability varies widely (Zhu, 2004). Not surprisingly, there are few companies from IT intensive industries such as finance, banking, and telecommunication because many firms in such industries are selected in IW 500 and it is difficult to identify control companies not listed in IW 500. Since a firm size can significantly influence the firm's IT budget, the two groups were compared to ensure that there are no significant differences in firm size (Bharadwaj, 2000). Commonly used measures such as sales, total assets, and the number of employees were deployed. Table 4.4 provides the

information of average sales, assets, and the number of employees of these two groups. The means test (t-test) indicates that the IT leader group and the control group do not have significant difference in average sales, assets, and the number of employees.

Table 4.3. IT Leaders and Control Companies

Leader Sample	**Control Sample**	**Industry**
Ameren Corp.	Allegheny Energy Inc.	Energy Utilities
E*Trade Group Inc.	The Charles Schwab Corp.	Internet Brokerage
Colgate-Palmolive Co.	Clorox	Personal Care & Cleaning Products
Kraft Foods Inc.	Conagra Foods Inc.	Food Manufacturing
Edison International	Consolidated Edison Inc.	Energy Utilities
Home Depot Inc.	Costco	Specialty Retail Stores
Hershey Foods Corp.	Dole Food Company, Inc.	Food Manufacturing
Xcel Energy	Firstenergy Corp.	Energy Utilities
CMS Energy	FPL Group Inc.	Energy Utilities
Jones Apparel Group, Inc.	Hanes Brands Inc.	Apparel
Sears, Roebuck & Co.	JC Penny	Department & Discount Stores
Nordstrom Inc.	Kohl's Corp	Department & Discount Stores
Pacific Corp	Northeast Utilities	Energy Utilities
Dial Corp.	P&G	Personal Care & Cleaning Products
Domino's Pizza Inc.	Papa John's	Limited Service Restaurants
Duke Energy Corp.	PG&E Corp.	Energy Utilities
Progress Energy	PPL Corp.	Energy Utilities
Entergy Corp.	Public Service Entrp Grp Inc.	Energy Utilities
Exelon Corp.	Sempra Energy	Energy Utilities

Table 4.4. Comparison Between the IT Leader Group and the Control Group

Descriptive Variables	IT Leader Sample		Control Sample		T-test for Difference of Means
	Mean	Median	Mean	Median	t
Sales (billion $)	13.08	8.36	12.27	9.27	.175
Assets (billion $)	21.9	23.57	18.09	15.76	.758
Number of Employees (thousand)	49.94	15.55	41.30	15.89	.368

Testing for Financial Performance Halo Effects

Prior studies found that popular industry rankings such as *Fortune*'s Most Admired Companies are highly influenced by prior financial performance (Brown & Perry, 1994). Thus, I conducted a test to examine whether the prior financial performance of firms influenced firm's selection in IW 500. The impact of past financial performance on reputation survey is called a financial halo effect. Based on Bharadwaj's (2000) study, the test of a financial halo effect was conducted using the following five independent variables: average return on assets, relative market to book value, sales, growth rate, and risk. The dependent variable was a binary code (Y = 1 for IT leader and Y= 0 for control firm). The logistic regression indicated that the past financial performance did not influence firm's selection in the IT leaders and in the control group (Table 4.5).

Table 4.5. Financial Performance Halo Effects

Variable	IT Leader Sample	Control Sample	T-Value	Standardized Estimate
Average Growth	0.19	0.16	0.31 (p=0.76)	0.21 (p=0.64)
Mean Natural Log Sale	8.81	8.88	-0.20 (p=0.84)	0.21 (p = 0.65)
Mean Risk	2.63	2.88	-0.35 (p=0.73)	0.09 (p= 0.77)
Mean ROA	5.05	4.58	0.39 (p = 0.70)	0.16 (p=0.69)
Mean Relative Market to Book Value	106.02	93.55	0.69 (p=0.49)	0.50 (p=0.48)
Number of Firms	19	19		
p value for model	0.97			

Hypotheses Tests

This study examines whether firms with high IT capability show superior employee satisfaction, employee capability, customer value, customer satisfaction, and financial performance than the matching control firms. One way to test the hypotheses is to compare the mean value of variables for the IT leaders and the control sample using a standard t-test. However, since the sample is not normally distributed, a non-parametric test, such as the Wilcoxon signed rank test, was used.

While the Bharadwaj (2000) study used the Wilcoxon rank sum test, I used the Wilcoxon signed rank test because it is better suited for this study (Dehning and Stratopoulos 2002). The Wilcoxon rank sum test combines the IT leaders into one group and the control companies into the other group; then, it compares the differences of these two groups. However, Wilcoxon signed rank test categorizes one IT leader

company and the corresponding control company into one pair, and it measures the differences between these pairs. Since this study is interested in the performance differences between the IT leader company and the corresponding control company, the Wilcoxon signed rank test is more appropriate.

CHAPTER 5

RESULTS

The results of a statistical test are displayed in Table 5.1. Both the mean and median of the performance measures are reported. The results of the Wilcoxon signed rank test are reported as p-value.

The first hypothesis examines the difference between the information technology (IT) leader group and the control group in employee capability. Although IT leaders showed higher employee capability than the control group, the difference was not strong enough to support the hypothesis (Table 5.1). The second hypothesis that the IT leaders would generate higher customer value than the control group was not supported either. IT leader companies did not show higher customer satisfaction than the control companies, so the third hypothesis was not supported. The fourth hypothesis that IT leaders are associated with higher business performance was partially supported. While the IT leader group didn't show any better performance in terms of profit ratios including return on assets (ROA), return on sales (ROS), operating income to assets (OI/A), operating income to employees (OI/E), and return on investment (ROI), they showed lower cost-of-goods-sold to sales (COG/S) than the control group all four years. Operating expenses to sales (OPEXP/S) were also lower for the IT leaders in two of the four years. The fifth hypothesis tests whether superior business performance driven by IT capability sustains over the time. Table 5.2 displays the result of the hypotheses test. Although IT leaders showed higher profit ratio and lower cost ratio in 2005, superior business performance did not last until 2007. Operating expenses to sales (OPEXP/S)

is the only performance variable that continues to show significance from 2005 to 2007. Table 5.3 summarizes the findings of the hypotheses test.

Table 5.1. Results of Hypotheses Tests

Hypotheses	Measurement	Category	2001			2002			2003			2004		
			Mean	Median	P Value	Mean	Median	P Value	Mean	Median	P Value	Mean	Median	P Value
H1: IT -> Employee Capability	Sales/ Employees	IT Leaders	449.527	504.994	0.38	441.328	491.248	0.34	465.217	537.943	0.40	469.043	500.592	0.48
		Control	481.101	404.617		420.663	428.239		480.513	449.587		502.093	482.831	
H2: IT-> Customer Value	Sales Growth	IT Leaders	18.900	6.657	0.26	-12.253	-9.482	0.64	4.167	5.442	0.48	3.017	5.137	0.86
		Control	14.690	2.148		-8.821	-5.170		2.432	5.443		6.699	4.344	
H3: IT-> Customer Satisfaction	ACSI Score	IT Leaders	74.842	76.000	0.85	75.667	75.500	0.91	76.278	75.500	0.93	76.125	74.000	0.76
		Control	74.611	76.000		76.842	77.000		77.526	77.000		76.111	76.500	
H4: IT-> Business Performance	ROA	IT Leaders	0.046	0.037	0.24	0.049	0.033	0.20	0.053	0.031	0.40	0.056	0.031	0.52
		Control	0.043	0.037		0.041	0.034		0.043	0.031		0.054	0.039	
	ROS	IT Leaders	0.042	0.064	0.58	0.054	0.065	0.29	0.073	0.079	0.21	0.082	0.083	0.21
		Control	0.058	0.057		0.029	0.048		0.050	0.056		0.076	0.064	
	OI/A	IT Leaders	0.105	0.086	0.16	0.100	0.074	0.41	0.117	0.077	0.14	0.113	0.062	0.20
		Control	0.096	0.078		0.093	0.079		0.087	0.074		0.086	0.070	
	OI/S	IT Leaders	0.159	0.154	0.23	0.154	0.162	0.27	0.154	0.161	0.16	0.160	0.167	**0.06** [b]
		Control	0.130	0.134		0.129	0.155		0.125	0.142		0.135	0.142	
	OI/E	IT Leaders	80.334	50.112	0.47	69.225	69.598	0.26	74.289	89.804	0.21	81.205	76.387	0.20
		Control	66.969	66.198		57.794	72.994		67.055	79.710		73.889	90.250	
	COG/S	IT Leaders	0.650	0.636	**0.01** [b]	0.656	0.667	**0.05** [c]	0.675	0.672	**0.08** [c]	0.673	0.688	**0.03** [b]
		Control	0.740	0.774		0.733	0.749		0.730	0.736		0.720	0.739	
	SGA/S	IT Leaders	0.251	0.253	0.97	0.244	0.244	0.95	0.230	0.212	0.93	0.228	0.219	0.96
		Control	0.184	0.208		0.175	0.175		0.185	0.166		0.189	0.183	
	OPEXP/S	IT Leaders	0.850	0.868	0.15	0.829	0.828	**0.07** [c]	0.826	0.822	**0.04** [b]	0.841	0.859	0.23
		Control	0.885	0.917		0.876	0.891		0.871	0.889		0.862	0.902	
	ROI	IT Leaders	7.053	5.849	0.41	7.922	5.646	**0.07** [c]	9.653	5.850	0.42	10.527	6.238	0.45
		Control	6.801	7.229		5.829	5.506		7.993	6.722		9.807	7.873	

S/E-sales to employees; ROA- return on assets; ROS- return on sales; OI/A- operating income to assets; OI/S-operating income to sales; OPEXP/S- operating expense to sales; COG/S- cost of goods sold to sales; SGA/S- selling and general administration expense to sales; ROI- return on investment; ROE- return on equity

[a] 1% level

b 5% level

[c] 10% level

Table 5.2. Results of Performance Sustainability Tests

Hypotheses	Measurement	Category	2005			2006			2007		
			Mean	Median	P Value	Mean	Median	P Value	Mean	Median	P Value
H5: IT-> Sustained Business Performance	S/E	IT Leaders	561.923	551.323	0.47	582.453	679.295	0.47	4.778	3.022	0.55
		Control	564.039	546.598		642.891	612.855		4.726	3.911	
	Sales Growth	IT Leaders	9.877	9.130	0.22	3.612	2.232	0.90	0.158	1.874	0.89
		Control	7.861	10.223		4.951	3.824		3.722	5.804	
	ACSI Score	IT Leaders	75.941	75.000	0.84	76.529	75.000	0.91	75.647	75.000	0.93
		Control	77.158	78.000		77.737	80.000		78.941	80.000	
	ROA	IT Leaders	0.065	0.035	**0.04** [b]	0.062	0.030	0.49	0.048	0.031	0.55
		Control	0.050	0.032		0.059	0.040		0.047	0.041	
	ROS	IT Leaders	0.082	0.077	**0.09** [c]	0.080	0.087	0.85			
		Control	0.070	0.063		0.092	0.079				
	OI/A	IT Leaders	0.121	0.071	**0.08** [c]	0.136	0.082	0.17	0.116	0.064	0.37
		Control	0.090	0.066		0.106	0.085		0.092	0.085	
	OI/S	IT Leaders	0.158	0.177	**0.09** [c]	0.163	0.159	0.47	0.123	0.173	0.55
		Control	0.128	0.127		0.143	0.147		0.155	0.148	
	OI/E	IT Leaders	91.969	105.172	0.14	99.511	97.753	0.66	78.846	102.992	0.70
		Control	74.206	93.586		99.824	103.333		110.625	114.803	
	COG/S	IT Leaders	0.684	0.682	**0.07** [c]	0.674	0.686	0.19	0.720	0.694	0.26
		Control	0.729	0.723		0.705	0.687		0.725	0.707	
	SGA/S	IT Leaders	0.227	0.208	1.00	0.227	0.209	1.00	0.236	0.239	1.00
		Control	0.187	0.189		0.163	0.155		0.163	0.165	
	OPEXP/S	IT Leaders	0.826	0.848	**0.01** [b]	0.802	0.826	**0.01** [b]	0.842	0.840	0.08 [c]
		Control	0.885	0.890		0.861	0.869		0.894	0.898	
	ROI	IT Leaders	12.598	6.460	0.19	12.295	6.460	0.45	7.778	5.411	0.57
		Control	9.697	7.638		9.522	7.248		9.441	7.635	

S/E-sales to employees; ROA- return on assets; ROS- return on sales; OI/A- operating income to assets; OI/S-operating income to sales; OPEXP/S- operating expense to sales; COG/S- cost of goods sold to sales; SGA/S- selling and general administration expense to sales; ROI- return on investment; ROE- return on equity

[a] 1% level

b 5% level

[c] 10% level

Table 5.3. Summary of Hypotheses Tests

Hypotheses	Results
H1: Superior IT capability is associated with higher employee capability	Not supported
H2: Superior IT capability is associated with higher customer value	Not supported
H3: Superior IT capability is associated with higher customer satisfaction	Not supported
H4: Superior IT capability is associated with higher business performance	Partially supported
H5: Superior IT capability is sustained over the time	Not supported

CHAPTER 6

DISCUSSION

The results from this study raise a question regarding the value of information technology (IT) investment. Contrary to the common notion that IT has a significant impact on business performance as proposed in the hypotheses, the IT leader group did not exhibit superior performance in any of the criteria as employee capability, customer value, and customer satisfaction. IT professionals have believed that IT provides these intangible benefits, however, the results do not support such beliefs.

No Profit Advantages

In terms of business performance, this study found different results from Bharadwaj's (2000) study. In the Bharadwaj (2000) study, when compared to the control group, the IT leader group had higher profit ratios measured by the return on assets (ROA), return on sales (ROS), operating income to assets (OI/A), operating income to sales (OI/S), and operating income to employees (OI/E). In addition, the IT leader group showed cost advantages evidenced by lower operating expenses to sales (OEXP/S) and the cost-of-goods to sales (COG/S). Although IT leaders in her study had both profit and cost advantages, the benefits of IT capability were most obvious in the profit categories. The cost advantages of the IT leader group were not as strong as profit advantages.

This study, contrary to Bharadwaj (2000), found that the IT leader group didn't show any higher profit ratios than the control companies. IT leaders did not show better performance on ROA, ROS, OI/S, OI/A, OI/E, and return on invested capital (ROI).

Rather, the most obvious differences were found in cost advantages. The cost-of-goods-sold to sales (COG/S) was the only performance measure that showed significant difference between the IT leader group and the control group in all four years. Operating expense to sales (OEXP/S) was lower for the IT leaders in two of the four years. We need to understand why IT capability is only associated with lower cost-of-goods sold to sales (COG/S) but not with any profit ratios. There are several studies that found that IT does not impact profitability (Hitt & Bryjolfsson, 1997; Rai et al., 1997). Hitt and Brynjolfsson (1996) found that IT spending increases productivity but does not result in increased profits because the profits generated from increased productivity are passed on to the customers.

Inconsistent Results in Overhead Costs (SGA/S)

Contrary to expectation, the IT leaders had higher selling and administrative expenses to sales ratio (SGA/S) than the control group. SGA/S is commonly used to measure overhead costs. This result means that IT leaders incur higher overhead expenses, which is consistent with the finding in the studies from Bharadwaj (2000) and Mitra and Chaya (1996). It is understandable that IT leaders in the Bharadwaj (2000) study had higher overhead costs because IT was more expensive and difficult to acquire in the early 1990s. However, it is puzzling that IT leaders continue to have higher selling and administrative expenses in the 2000s. Intuitively, the IT leaders should have had lower overhead expenses because superior IT capability improves business operation. The improved efficiency by superior IT capability must result in lower overhead costs. In addition, as IT in the 2000s becomes cheaper and more

available than in the 1990s, the impact of IT expenditure on a firm's overhead should be less burdensome. The improved efficiency and affordability of IT should be reflected with lower overhead for IT leaders.

There are two possible explanations for higher overhead costs of the IT leaders: (1) increased knowledge workers and their coordinating costs and (2) careless IT spending. The first explanation is that as products and services become more knowledge intensive, companies need more knowledge workers, and these increased knowledge workers increase overall overhead costs, despite lower IT costs in the 2000s (Strassmann, 2002). Strassmann (2002) suggests that spending on IT would not reduce overhead costs but increase them. He points out that overhead expenses increased from 19.5% to 29% from 1982 to 1999. Also, he argues that the costs of coordinating a workforce have been increasing despite heavy spending on automating information work. Incresed coordinating costs are the result of the nature of businesses that are increasingly knowledge-intensive and complex. The more knowledge firms need for new products or service, the more coordinations they need. Mitra and Chaya (1996) made a similar point that IT has nothing to do with reducing labor costs in organzations. They suggest that higher spenders on IT incur higher overhead expenses than lower spenders because high IT spenders have more information workers.

Another possible explanatioin for higher overheads of the IT leaders is their careless spending on IT. Although IW 500 did not consider IT budget in its selection process, I believe that the IT leaders are likely to be higher IT spenders. The increased IT expenditure may have an impact on the overhead costs. More than half of many companies' IT expenditures are spent on data storage (Carr, 2003). The bulk of their

storage capacity is wasted on saving unnecessary files such as employee's saved emails, files, spam emails, or MP3s. Such data has nothing to do with making new products or serving customers. The problem with high overheads for the IT leaders is that if higher IT expenditure cannot result in higher profits, the costs cannot be justified (Strassmann, 2002). Overhead costs appear to grow faster than revenues or pofits. Table 6.1 summarizes the findings of prior studies that measured the impact of IT on overhead costs.

Table 6.1. Prior Studies about Overhead Costs

Study	Method	Results
Bharadwaj (2000)	IT leader versus control company	Contrary to the expectation, the IT leaders had higher overhead costs than control companies
Santhanam and Hartono (2003)	IT leader versus industry average	Aligned with the expectation, the IT leaders had lower overhead than the industry average. The difference of overhead was more significant when the IT leader group was compared with the industry average in the same two-digit SIC code than the four-digit SIC code
Mitra and Chaya (1996)	Higher IT spender versus lower IT spender	The higher IT spenders had higher average overhead costs than low IT spenders
Feng et al. (2004)	Knowledge management system (KMS) adopters versus non adopters	The KMS adopters had lower overhead after the second year of the adoption
Poston and Grabski (2001)	Enterprise resource planning (ERP) adopter	Overhead was increased the year after ERP implementation. However, the overhead decreased three years after implementation
This Study	IT leader versus control company	The IT leaders had higher overhead than the control companies

Did Bharadwaj (2000) Make Mistakes?

Careful review of Bharadwaj's (2000) study raised several concerns such as the inclusion of foreign companies in the control sample and an inappropriate statistical test. First, the study includes 14 foreign companies in the control sample, accounting for the 25% of the 56 control sample. For example, the performance of AT & T was compared with that of a Japanese telephone company, Nippon Telegraph and Telephone. Monsanto was compared with German Bayer AG. Performance differences may be related to cultural differences or different competitiveness in the market. The inclusion of these foreign companies may have impacted the test results.

In addition, the study appears to use an incorrect statistical test. Although it intends to use Wilcoxon signed rank test, the study reported that it used the Wilcoxon rank sum test. Wilcoxon signed rank test is regarded as better suited for this study than Wilcoxon rank sum test, as explained in the hypotheses tests. Therefore, I replicated her study to examine how these flaws may have influenced the findings.

The first step was to recollect the financial data to measure business performance of both IT leader companies and control companies. I collected the data from Standard & Poor's Compustat ("Research Insight"). I was able to collect 45 pairs of IT leaders and control samples, and 11 pairs were discarded because of missing data due to various reasons such as M&A, renaming, or foreign ownerships. Out of 45 pairs, 10 pairs include foreign control companies, so only 35 pairs are U.S. only companies.

In the next step, I conducted four statistical tests. The first test was to replicate Bharadwaj (2000), so I compared 45 pairs of IT leaders and control groups using the Wilcoxon rank sum test. Next, I investigated whether the foreign companies in the

control group may have influenced the results. Thus, I excluded the foreign companies from the samples and tested the remaining 35 pairs of U.S. only companies using the Wilcoxon rank sum test. In third test, I examined all 45 pairs of IT leaders and control companies using Wilcoxon signed rank test. The fourth test was conducted on the U.S. companies using Wilcoxon signed rank test. Table 6.2 summarizes these steps.

Table 6.2. Summary of Replication of Bharadwaj (2000)

	Sample	Statistical Test	Results
1	45 pairs of IT leaders and control companies	Wilcoxon rank sum test	Supported hypotheses. IT capability was related to higher profit ratios and lower cost ratios
2	35 pairs of the IT leaders and the control companies, excluding foreign control companies	Wilcoxon rank sum test	Z value became lower, so the significance was reduced. Overall, the IT leaders had higher profit ratios, but less support for cost ratios
3	45 pairs of the IT leaders and the control companies	Wilcoxon signed rank test	P value was weaker than Bharadwaj (2000), but still supported the hypotheses
4	35 IT leaders and control companies excluding foreign, control companies	Wilcoxon signed rank test	P value was weaker than Bharadwaj (2000), but still supported the hypotheses

The Results of Duplication of Bharadwaj (2000)

The first test replicated the original study as reported in Bharadwaj's (2000) study. Because of missing data, I was only able to collect 45 pairs of IT leaders and control companies instead of 56 pairs used in the original study. The results in Table 4.6 indicate that the Z value in this study was lower than the Z value in the Bharadwaj (2000) study, so it has a less significant P value. Although Z and P values were less

significant, the results overall are in line with the findings of the Bharadwaj (2000) study. IT capability is related to higher profit ratio and lower cost ratio. The results of Bharadwaj (2000) are reprinted in Table 6.4 to make it easier to compare the results of the confirmation tests to the original study.

Next, I investigated the potential influence of the foreign companies included in the control sample. The same Wilcoxon rank sum test was conducted. The findings in Table 6.5 show less significant results than Bharadwaj's (2000) study. The impact of removing foreign companies in the sample was most obvious in the cost side. The findings show that although IT leaders tended to generate higher profit, they did not have much cost advantage than the control group.

The third and fourth tests investigate the impact of using an incorrect statistical test. I ran Wilcoxon signed rank test instead of Wilcoxon rank sum test that was used in the original study. The pairwise comparison using Wilcoxon signed rank test was conducted on the same 45 pairs of IT leaders and control companies first. Although the findings in Table 6.6 suggest the similar results to Bharadwaj (2000), it is noteworthy that the IT leaders did not show any lower cost-of-goods to sales (COGS/S) ratio.

In the fourth test, the pairwise comparison was conducted on the 35 pairs of the U.S. based companies. The results in Table 6.7 support that the IT leaders showed higher profit ratios. Similar to the third test, the cost-of-goods to sales (COGS/S) ratio was not lower for the IT leaders.

The Lessons from the Duplication of Bharadwaj (2000)

Pure replication of her study revealed several issues. First, Bharadwaj (2000) mentioned that the control company selection criteria is based on Barber and Lyon's

(1996) specifications, so she used the average sales of the control company that lie in 70% to 130% of the leader company. However, Barber and Lyon (1996), the reference paper, argue that the selection criterion of the control company is asset size, not sales. That is, Bharadwaj used average sales instead of average asset size when selecting control companies. It is uncertain how it impacted the results of the study.

Second, the selection of IT leaders did not follow the exact step that the study described. For example,

Out of the 45 pairs, 11 pairs do not seem to meet the selection criteria. In other words, there is too large of a difference in sales between IT leaders and the control companies. The average sales of the control firm must lie within 70% to 130% of the leader firm, but the range of those 11 pairs is between 2,000% and 20%. Further investigation is desired.

Third, when she tested the financial performance halo effect, she did not follow the step the reference paper describes. Brown and Perry (1994) used three-year past data, but Bharadwaj used five-year past data without explaining the reason. Three-year data appears to be more reasonable.

Finally, according to the Table 2 Financial Performance Halo Effects in her study, the average five-year sales growth of the IT leader company is 44%, and the average sales growth of control companies during the same period is 33%. However, such growth rate appears impossible given moderate financial leverage (1-2 times of equity) and low ROA of sample companies. In sum, another replication study is desired. The replicated study should address the issues described above.

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Table 6.3. Replication of Bharadwaj (2000) Using Wilcoxon Rank Sum Test

Measurement	Category	1991				1992				1993				1994			
		Mean	Median	Z Value	P Value	Mean	Median	Z Value	P Value	Mean	Median	Z Value	P Value	Mean	Median	Z Value	P Value
ROA	IT Leaders	0.047	0.039	-1.73	0.04[b]	0.046	0.042	-1.61	0.05[c]	0.044	0.038	-1.56	0.06[c]	0.058	0.056	-2.12	0.02[b]
	Control	0.027	0.02			0.024	0.022			0.031	0.026			0.037	0.033		
ROS	IT Leaders	0.054	0.049	-2.23	0.01[b]	0.037	0.048	-1.83	0.03[b]	0.05	0.047	-1.36	0.09[c]	0.073	0.065	-1.98	0.02[b]
	Control	0.028	0.031			0.009	0.013			0.033	0.032			0.052	0.046		
OI/A	IT Leaders	0.096	0.092	-1.92	0.03[b]	0.095	0.092	-1.93	0.03[b]	0.097	0.094	-2.33	0.01[b]	0.105	0.098	-2.63	0.00[a]
	Control	0.073	0.068			0.068	0.063			0.072	0.064			0.073	0.071		
OI/S	IT Leaders	0.138	0.099	-1.73	0.04[b]	0.138	0.098	-1.53	0.06[c]	0.150	0.103	-2.18	0.01[b]	0.158	0.119	-2.25	0.01[b]
	Control	0.103	0.080			0.100	0.073			0.103	0.071			0.109	0.089		
OI/E	IT Leaders	29.099	20.064	-1.56	0.06[c]	29.625	20.325	-1.66	0.05[c]	34.381	23.315	-1.79	0.04[b]	40.489	32.414	-2.58	0.00[a]
	Control	24.477	13.568			22.512	13.399			25.945	14.419			29.459	18.598		
COG/S	IT Leaders	0.646	0.627	0.67	0.25	0.641	0.636	0.62	0.27	0.616	0.622	1.39	0.08[c]	0.619	0.657	1.00	0.16
	Control	0.665	0.707			0.665	0.710			0.662	0.714			0.653	0.698		
SGA/S	IT Leaders	0.223	0.216	-0.15	0.44	0.227	0.232	-0.03	0.49	0.224	0.233	-0.06	0.48	0.219	0.232	-0.21	0.42
	Control	0.234	0.213			0.235	0.211			0.235	0.213			0.238	0.230		
OPEXP/S	IT Leaders	0.81	0.84	1.67	0.05[c]	0.80	0.83	1.66	0.05[c]	0.79	0.83	2.09	0.02[b]	0.78	0.81	2.02	0.02[b]
	Control	0.84	0.88			0.84	0.87			0.84	0.87			0.83	0.87		

ROA- return on assets; ROS- return on sales; OI/A- operating income to assets; OI/S-operating income to sales; COG/S- cost of goods sold to sales; SGA/S- selling and general administration expense to sales; OPEXP/S- operating expense to sales.

[a] 1% level

b 5% level

[c] 10% level

Table 6.4. The Results of Bharadwaj (2000)

	1991			1992			1993			1994		
	Mean	Median	Z Value	Mean	Median	Z Value	Mean	Median	Z Value	Mean	Median	Z Value
ROA-IT Leaders ROA-control	0.044 0.018	0.038 0.015	-2.35[a]	0.027 0.003	0.036 0.008	-2.19[b]	0.037 0 020	0.035 0.018	-1.87[b]	0.053 0.035	0.048 0.028	-2.38[a]
ROS-IT Leaders ROS-control	0.052 0.022	0.054 0.22	-2.76[a]	0.036 0.008	0.035 0.016	-2.10[b]	0.054 0.029	0.048 0.024	-2 11[b]	0.07 0.051	0.06 0.034	-2.54[a]
OI/A-IT Leaders OI/A-control	0.137 0.107	0.148 0.107	-2.20[b]	0.140 0.104	0.150 0.099	-2.47[a]	0.145 0.109	0.148 0.149	-2.79[a]	0.147 0.117	0.147 0.115	-2 53[a]
OI/S-IT Leaders OI/S-control	0.175 0.138	0.153 0.110	-2.21[b]	0.182 0.143	0.142 0.107	-2.21[b]	0.20 0.151	0.16 0.109	-2.81[a]	0.20 0.163	0.17 0.130	-2.09[b]
OI/E-IT Leaders OI/E-control	37.18 33.51	27.17 19.83	-1.31[c]	39.62 33.41	31.79 19.82	-1.32[c]	47.18 30.19	35.05 21.98	-1.41[c]	53.94 46.44	43.14 28.43	1.45[c]
COG/S-IT Leaders COG/S-control	0.67 0.70	0.67 0.72	1.37[c]	0.66 0.70	0.67 0.72	1.16	0.64 0.69	0.63 0.72	1.77[c]	0.64 0.67	0.66 0.71	1.14
SGA/S-IT Leaders SGA/S-control	0.22 0 21	0.22 0.21	-0.75	0.23 0.21	0.23 0.21	-0.85	0.22 0.211	0.23 0.19	-0.88[c]	0.22 0.44	0.22 0.21	0.60
OPEXP/S-IT Leaders OPEXP/S-control	0.84 0.874	0.85 0.89	2.16[b]	0.83 0.86	0.86 0.897	2.15[b]	0.814 0.865	0.840 0.897	2.73[a]	0.81 0.855	0.840 0.887	-2.49[a]

ROA- return on assets; ROS- return on sales; OI/A- operating income to assets; OI/S-operating income to sales; COG/S- cost of goods sold to sales; SGA/S- selling and general administration expense to sales; OPEXP/S- operating expense to sales.

[a] 1% level

b 5% level

[c] 10% level

Table 6.5. Replication of Bharadwaj (2000) Without Foreign Companies Using Wilcoxon Rank Sum Test

Measurement	Category	1991				1992				1993				1994			
		Mean	Median	Z Value	P Value	Mean	Median	Z Value	P Value	Mean	Median	Z Value	P Value	Mean	Median	Z Value	P Value
ROA	IT Leaders	0.041	0.038	-1.39	0.08 [c]	0.045	0.045	-1.37	0.09 [c]	0.043	0.039	-1.67	0.05 [c]	0.057	0.055	-1.84	0.03 [b]
	Control	0.025	0.02			0.024	0.027			0.028	0.025			0.035	0.033		
ROS	IT Leaders	0.043	0.044	-1.51	0.07 [c]	0.034	0.039	-1.50	0.07 [c]	0.05	0.049	-1.33	0.09 [c]	0.066	0.061	-1.33	0.09 [c]
	Control	0.026	0.024			0.075	0.013			0.027	0.031			0.05	0.048		
OI/A	IT Leaders	0.09	0.095	-1.37	0.09 [c]	0.091	0.095	-1.53	0.06 [c]	0.095	0.100	-2.02	0.02 [b]	0.104	0.100	-2.38	0.01 [b]
	Control	0.073	0.070			0.069	0.070			0.072	0.055			0.073	0.070		
OI/S	IT Leaders	0.125	0.100	-0.80	0.21	0.129	0.100	-0.70	0.24	0.144	0.100	-1.33	0.09 [c]	0.152	0.120	-1.39	0.08 [c]
	Control	0.107	0.080			0.107	0.080			0.108	0.075			0.114	0.090		
OI/E	IT Leaders	26.018	15.000	-0.68	0.25	27.253	16.310	-0.80	0.21	32.311	19.590	-0.92	0.18	39.055	26.430	-1.67	0.05 [c]
	Control	26.100	14.370			24.260	13.470			25.166	15.620			27.576	19.050		
COG/S	IT Leaders	0.679	0.700	-0.23	0.41	0.671	0.700	-0.19	0.42	0.641	0.690	-1.19	0.12	0.644	0.690	-0.90	0.18
	Control	0.678	0.720			0.675	0.730			0.681	0.725			0.673	0.720		
SGA/S	IT Leaders	0.207	0.200	-0.14	0.45	0.208	0.195	-0.21	0.42	0.206	0.200	-0.35	0.36	0.201	0.210	-0.23	0.41
	Control	0.222	0.200			0.225	0.205			0.210	0.180			0.212	0.170		
OPEXP/S	IT Leaders	0.825	0.868	-0.91	0.18	0.818	0.861	-1.06	0.14	0.798	0.840	-1.57	0.06 [c]	0.790	0.831	-1.38	0.08 [c]
	Control	0.843	0.878			0.842	0.868			0.836	0.876			0.829	0.870		

ROA- return on assets; ROS- return on sales; OI/A- operating income to assets; OI/S-operating income to sales; COG/S- cost of goods sold to sales; SGA/S- selling and general administration expense to sales; OPEXP/S- operating expense to sales.

[a] 1% level

b 5% level

[c] 10% level

Table 6.6. The Replication of Bharadwaj (2000) Using Wilcoxon Signed Rank Test

Measurement	Category	1991			1992			1993			1994		
		Mean	Median	P Value	Mean	Median	P Value	Mean	Median	P Value	Mean	Median	P Value
ROA	IT Leaders	4.426	3.856	0.02 [b]	4.398	4.544	0.03 [b]	4.553	4.233	0.04 [b]	5.871	5.638	0.00 [a]
	Control	2.895	2.104		2.781	2.437		3.328	2.628		3.851	3.606	
ROS	IT Leaders	4.940	4.756	0.07 [c]	3.117	3.892	0.04 [b]	4.908	4.546	0.14	7.281	6.532	0.05 [c]
	Control	2.943	3.226		1.282	1.607		3.429	3.196		5.458	5.013	
OI/A	IT Leaders	0.093	0.093	0.02 [b]	0.092	0.092	0.01 [b]	0.099	0.097	0.00 [a]	0.105	0.098	0.00 [a]
	Control	0.076	0.070		0.071	0.069		0.074	0.067		0.074	0.071	
OI/S	IT Leaders	0.129	0.097	0.05 [c]	0.130	0.094	0.03 [b]	0.139	0.102	0.01 [b]	0.148	0.117	0.01 [b]
	Control	0.106	0.080		0.104	0.076		0.106	0.075		0.114	0.089	
OI/E	IT Leaders	26.706	17.102	0.11	27.262	16.820	0.02 [b]	29.418	21.376	0.01 [b]	35.486	31.898	0.01 [b]
	Control	25.514	14.369		23.533	13.399		26.24	14.419		31.786	18.660	
COG/S	IT Leaders	0.651	0.663	0.29	0.646	0.665	0.25	0.617	0.622	0.11	0.626	0.675	0.16
	Control	0.657	0.704		0.657	0.704		0.655	0.714		0.643	0.684	
SGA/S	IT Leaders	0.228	0.217	0.51	0.233	0.232	0.54	0.230	0.233	0.34	0.219	0.225	0.21
	Control	0.236	0.211		0.237	0.209		0.248	0.215		0.253	0.235	
OPEXP/S	IT Leaders	0.835	0.861	0.01 [b]	0.801	0.842	0.01 [b]	0.810	0.853	0.00 [a]	0.802	0.838	0.00 [a]
	Control	0.873	0.887		0.866	0.882		0.860	0.886		0.851	0.874	

ROA- return on assets; ROS- return on sales; OI/A- operating income to assets; OI/S-operating income to sales; COG/S- cost of goods sold to sales; SGA/S- selling and general administration expense to sales; OPEXP/S- operating expense to sale.

[a] 1% level

b 5% level

[c] 10% level

Table 6.7. The Replication of Bharadwaj (2000) Without Foreign Companies Using Wilcoxon Signed Rank Test

Measurement	Category	1991			1992			1993			1994		
		Mean	Median	P Value	Mean	Median	P Value	Mean	Median	P Value	Mean	Median	P Value
ROA	IT Leaders	4.103	3.794	0.03 [b]	4.484	4.54	0.02 [b]	4.365	4.233	0.03 [b]	5.749	5.500	0.01 [b]
	Control	2.762	2.104		2.915	3.004		3.053	2.628		3.676	3.729	
ROS	IT Leaders	4.335	4.424	0.07 [c]	3.396	3.892	0.02 [b]	4.885	4.718	0.12	6.569	6.080	0.09 [c]
	Control	2.799	2.765		1.168	1.607		2.824	3.196		5.308	5.156	
OI/A	IT Leaders	0.089	0.095	0.05 [c]	0.091	0.095	0.01 [b]	0.096	0.099	0.01 [b]	0.104	0.098	0.00 [a]
	Control	0.076	0.070		0.073	0.075		0.076	0.068		0.075	0.074	
OI/S	IT Leaders	0.125	0.097	0.14	0.130	0.097	0.07 [c]	0.133	0.102	0.06 [c]	0.140	0.115	0.05 [c]
	Control	0.111	0.082		0.111	0.089		0.111	0.083		0.121	0.091	
OI/E	IT Leaders	26.018	15.000	0.34	27.252	16.307	0.06 [c]	26.778	19.571	0.03 [b]	32.504	26.393	0.04 [b]
	Control	27.424	14.603		25.583	13.985		24.964	14.419		29.972	20.592	
COG/S	IT Leaders	0.679	0.702	0.40	0.671	0.704	0.25	0.647	0.694	0.21	0.655	0.695	0.23
	Control	0.670	0.724		0.666	0.719		0.669	0.715		0.657	0.716	
SGA/S	IT Leaders	0.216	0.211	0.49	0.220	0.225	0.51	0.212	0.216	0.37	0.201	0.209	0.27
	Control	0.221	0.191		0.224	0.200		0.227	0.203		0.230	0.217	
OPEXP/S	IT Leaders	0.844	0.870	0.05 [c]	0.802	0.844	0.02 [b]	0.814	0.865	0.01 [b]	0.808	0.841	0.00 [a]
	Control	0.873	0.890		0.854	0.872		0.859	0.883		0.850	0.874	

ROA- return on assets; ROS- return on sales; OI/A- operating income to assets; OI/S-operating income to sales; COG/S- cost of goods sold to sales; SGA/S- selling and general administration expense to sales; OPEXP/S- operating expense to sales.

[a] 1% level

b 5% level

[c] 10% level

Why Are the Results Different?

The different results can be explained by the following four reasons: (1) incorrect prior study, (2) benchmark problems, (3) IW 500 selection issues, and (4) IT as a competitive necessity.

First, I examined whether Bharadwaj (2000) made any mistakes. Bharadwaj (2000) may have been incorrect because her study included foreign companies and used an incorrect statistical test. The replication of her study showed her results are credible.

Another possibility is that the selection of inappropriate control companies may play a role in the results. Both Bharadwaj (2000) and Santhanam and Hartono (2003) used the Standard Industrial Classification (SIC) code to select their benchmarks. However, studies found that the SIC code is outdated and does not properly categorize the contemporary industries (Bhojraj, Lee, & Oler, 2003). They suggest that researchers use Global Industry Classification System (GICS) developed by Standard and Poor's and Morgan Stanley. It is Santhanam and Hartono (2003) that highlight how SIC code can impact the findings. Santhanam and Hartono (2003)'s results were stronger when they used two-digit (industry) rather than four-digit (the strategic group) SIC codes as their benchmark. That is, the impact of IT capability on business performance was more evident when the IT leaders were compared with the industry overall rather than with competitors in the same strategic group in the industry. For instance, in the retail industry, there are discount retailers and premium retailers because both have the same two-digit SIC code. Thus, the performance difference of these two companies may be the result of differences in the industry structure rather than the performance differences

of each company. The discount retailers grow faster than the premium retailers, and the difference in growth rate impacts profit margin and operation efficiency. In addition, Santhanam and Hartono (2003) did not exclude foreign companies when they came up with the industry average because Compustat data automatically includes foreign companies. Therefore, the inclusion of foreign companies may influence the industry average.

The third possibility is that the IW 500 selection may relate to the different results. IW 500 from 1991 to 1994 used industry experts to select IT leaders in IW 500, so the process may have been more rigorous and objective. To be in IW 500 from 2001 and 2004, participants had to submit quantitative data such as IT budget and qualitative essay describing innovation usage of IT. The rankings were selected by *InformationWeek* editors. Since they did not use outside experts, the process may have been more subjective and loose. Thus, there is a possibility that poor processes in IW 500 may have influence unqualified IT leaders in IW 500 between 2001 to 2004.

The last explanation is that IT no longer offers a competitive advantage. IT may become a commodity and a competitive necessity. The results indicate that the advantages from superior IT capability were not strong enough to beat their competitors because IT leaders did not show any higher profits than control companies. That is, competitive advantages drawn from IT may have been eroded due to rapid response from competitors and the homogenization and affordability of IT functions.

In order for IT to offer competitive advantages, competitors' response matters. When competitors do not respond or slowly respond to IT innovations, competitive advantages can be sustained. However, with buzz about Y2K, the new economy, or

Internet revolutions, CEOs or the Board of Directors in the companies were more likely aware of the importance of IT. The high profile dot com bubble made companies rush to invest in IT and to build IT capability.

In addition, IT systems that were proprietary and expensive in the 1990s became standardized, homogeneous, and affordable in the 2000s. As more companies replace customized applications with generic ones, the homogenization of IT capabilities has accelerated. Companies adopt enterprise applications because of the best practices built into the application. Enterprise application such as enterprise resource planning (ERP) embeds best business activities and processes. However, the best practices from same applications become replicable. What makes a resource strategic is not ubiquity but scarcity. For example, 70% of Fortune 1000 firms had or were in the process of installing ERP systems in 1998 (Hoffman, 1998). Thus, most of the Fortune 1000 companies would have similar best practices.

In addition to great standardization and homogenization of IT's functions, cheaper price lowers barriers of entry to competitors. Companies buy an off-the-shelf, state-of-the-art application for a fraction of the development cost. The cutting-edge IT capability is readily available to all. As long as access to the technology is limited through a lack of standards, high costs, physical limitations, or patents, a company can use the technology to gain advantages over competitors (Carr, 2003). As the availability of products increases and the costs decreases, IT becomes ubiquitous and a competitive necessity.

As such, a question arises. Why did other studies find that IT investment is related to increased business performance? I believe the reason is that they

investigated with a binary approach, such as IT adopter versus non-IT adopter. Since IT is a strategic necessity, non-adopters would be disadvantageous. However, if they compare IT adopter with other IT adopters, I doubt IT adopter would have any advantages over other adopters. For example, Hitt, Wu, and Zhou (2002) investigated the impact of ERP investment on business performance. They found that ERP adopters showed greater business performance measured by sales per employee, profit margins, ROA, inventory turnover, and asset utilization. However, the finding may have been influenced by the binary approach and a halo effect. First, we do not know whether ERP adopters perform better than other ERP adopters. There were no pairwise comparisons between ERP adopters in same industry and size. What if they compared both ERP adopters in the same industry and size? I believe there would be no differences. In addition, the study did not appear to control a financial performance halo effect. As Hitt, Wu, and Zhou mentioned in their paper, “higher performing firms tend to adoption ERP” (Hitt et al. 2002, p. 84). Prior studies found that high performing firms tend to continue to perform well. That is, it is questionable whether the better performance of ERP adopters was caused by prior business performance or the adoption of ERP. In sum, superior IT capability may improve business performance, but it does not mean that it leads to competitive advantages to beat competitors.

CHAPTER 7

LIMITATIONS AND FUTURE RESEARCH

This study has several limitations. As it looks for the sample companies listed in both *InformationWeek* 500 (IW 500) and the American Customer Satisfaction Index (ACSI), the number of sample is 19 pairs. Although this small number is not necessarily troublesome, a larger sample is desired. Researchers need a creative way to come up with a larger sample. Instead of using publicly available secondary data, researchers may directly collect data for employee capability, customer satisfaction, and customer value to create a larger sample.

Further Research on Intermediate Variables

Although I did not find that information technology (IT) capability of a firm is related to such constructs as customer satisfaction, customer value, and employee capability, I need to continue identifying other variables to explain the linkage. It is essential for information system (IS) researchers to understand the underlying processes through which IT capability impacts business performance. In lieu of finding such variables, it may be worthy to revisit other theories of which other IS researchers rely.

The Resource Based View (RBV) argues that IT resources indirectly improve business performance through the interaction with complementary resources such as organizational structure, culture, and skills to leverage IT assets for business needs (Acemoglu, Aghion, Lelarge, Van Reenen, & Zilibotti, 2007; Bartel, Ichniowski, & Shaw, 2007; Melville et al., 2004; Wade & Hulland, 2004). That is, the benefits of IT

investment depend on business process redesign to maximize IT investment (Brynjolfsson & Hitt, 1995). For example, decentralized and team-based organizational structures increase the value of IT investments (Brynjolfsson et al., 2002). The companies need to change organizational structure to improve information flow (El Sawy et al., 1999).

If the results of IT investment are influenced by complementary resources such as business process redesign and organizational structure, we may ask the following questions: do IT leaders have different organizational structure, culture, or IT employee capability than control companies? We speculate that IT leaders may have flatter and slimmer organizational structure than the control groups because superior IT capability will reduce bureaucracy and middle managers (Brynjolfsson & Hitt, 2000). Firms with superior IT capability have less need for middle managers because people in the firms should have better access to information. Additionally, superior IT capability may be reflected in more efficient organizational structure. Interdisciplinary research with organizational theorists will be desired to understand the impact of IT capability on organizational structure.

Along the line with organizational structure, IS researchers may ask how IT capability impacts organizational culture. Do IT leader companies have different cultures than the control group? Does high digitization inside IT leaders influence the formation of a different culture?

Superior IT capability should accompany IT investment and skilled workforce leverage IT assets (Bresnahan, Brynjolfsson, & Hitt, 2002). Do IT leader companies have better IT personnel than other companies? What are the characteristics of IT

people in the firms with superior IT capability? I believe that IT personnel in IT leader companies would be more entrepreneurial because they should have better ideas for the innovative use of IT on business to take advantage of IT assets. Entrepreneurs are distinguished in terms of exploiting opportunities that new products or services provide. Innovative IT personnel may have common ground with entrepreneurs. By examining the differences of IT leaders and control groups on organizational structure, culture, and IT personnel, IS researchers may come up with general patterns that make firms IT superior.

The dynamic capabilities perspectives (DCP) is another good theory to look for variables that explains the relationship between IT capability and firm performance. DCP proposes that IT influences firm performance through organizational capabilities (agility, digital options, and entrepreneurial alertness) and strategic processes (capability building, entrepreneurial action, and coevolutionary adaptation) (Sambamurthy et al., 2003). These dynamic capabilities and strategic processes impact the ability of firms to initiate competitive actions, and these competitive actions are a predecessor of superior business performance. The examples of a firm's dynamic capabilities are rapid new product development, alliancing, and strategic decision making. Since IT is essential in collecting, storing, and diffusing information, the firm's superior IT capability may be related to the increase of the number of new products, innovations, or patents. It is interesting to examine whether the IT leaders have more patents, innovations, or blockbuster new products than the control companies.

Further Research on Employee Satisfaction and Employee Capability

Although this study did not measure employee satisfaction, it is essential to examine how IT impacts employee satisfaction. Every year, *Fortune* magazine lists the best 100 companies to work for. If a firm's IT capability is associated with improving employee satisfaction, IT leaders may have higher rankings in the *Fortune*'s list. Vice versa, if IT is important in employee satisfaction, the companies in the *Fortune'*s list may have higher IT capability than the ones not on the list.

Identification of IT Leaders

This study relies on IW 500 to identify IT leaders. Using this list offers several benefits. *InformationWeek* 500 (IW) has years of experience, reputation, and higher response rate. However, using IW 500 raises important issues. IW often changes the procedure for ranking IT leaders, so it makes difficulty to conduct longitudinal studies. In addition, the procedure for the selection of IT leaders is not rigorous. The measurement and selection is binary with some firms being identified with leaders and others not. It cannot evaluate the impact of incremental improvements in IT capability on firm performance (Santanam & Hartnono, 2003). Thus, the IS discipline needs to come up with a standard rule that identifies IT leaders (Santhanam & Hartono, 2003). How can we define IT leaders? What qualification do we look at? How do we collect the information? By answering these questions, the IT community may be able to come up with a theory that defines IT leaders. Such effort is critical in terms of addressing IT identity issues because it helps narrow our discourses on a specific issue and create a

theory that distinguish the IS field from other disciplines (Benbasat & Zmud, 1999; Sambamurthy, 2001).

Longitudinal Studies

A longitudinal study is desired to examine the sustained impact of IT capability on business performance (Santhanam & Hartono, 2003). To examine the sustained effects of IT capability, it would be interesting to study whether Bharadwaj's (2000) IT leaders continue to perform better than the control groups in the 2000s using recent data. The IT leaders in her study were selected from 1991 to 1994 in the IW 500, so it is questionable whether the IT leaders in the 1990s maintain their advantages in the 2000s when IT becomes more available. For that reason, it would be desired to replicate Dehning and Stratopoulos (2002), who conducted a similar study with Bharadwaj (2000). Using a matched pair comparision, they selected IT leaders from the Computerworld Permier 100 (CWP 100). The CWP 100 identifies the companies that have sucessfully used IT for their competitive advantages. They compared the profitability and efficiency of the CWP 100 with that of the control companies in the same industry and with similar size from year 1989 to 1995. The control companies were the top performers in each industry. They found that the CWP 100 outperformed the control group in terms of the return on assets (ROA), profitability, and efficiency. Their study indicates that IT is related to improved profitability and efficiency. However, it is questionable if CWP 100 companies continue to perform better than the control companies in the 2000s.

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