STRATEGIC VALUE ANALYSIS OF INFORMATION TECHNOLOGY INVESTMENTS

BİRGÜL ARSLAN

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STRATEGIC VALUE ANALYSIS OF INFORMATION TECHNOLOGY INVESTMENTS

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Birgül Arslan

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Thesis Abstract

Birgül Arslan, "Strategic Value Analysis of Information Technology Investments"

This thesis seeks to shed light upon the strategic value of information technology (IT) investments. Previous literature suggests that IT investments *per se* are not sufficient for improving firm performance. Drawing from the resource-based view, it is hypothesized in this study that IT investments can deliver higher firm performance if they are (a) combined with complementary assets, (b) leveraged to build capabilities and (c) used to support organizational core competencies. Based on the data collected through a survey of thirty four companies, the findings show that IT support for core competencies has a significant positive effect on firm performance and the research model explains more than fifty percent variation of this performance. Furthermore, the relationship between IT infrastructure and IT-based capabilities as well as the relationship between IT-based capabilities and IT support for core competencies are found to be positive and significant. No support has been found for the business value of complementary assets. The study contributes to the literature by proposing a new measurement for IT infrastructure, improving the measurement for IT department human resources and including an extended set of other complementary resources. Furthermore, the study provides evidence from Turkey, a developing country.

Tez Özeti

Birgül Arslan, “Bilgi Teknolojileri Yatırımlarının Stratejik Değer Analizi”

Bu tez, bilgi teknolojilerinin (BT) stratejik değeri konusuna ışık tutmayı hedeflemektedir. Konuyla ilgili literatür bu yatırımların şirket performansını arttırmada tek başına yeterli olmadığını göstermektedir. Kaynak bazlı yaklaşımdan faydalanılarak hazırlanan bu tez, BT yatırımlarının ancak üç şart sağlandığında performans üzerinde olumlu etki yaratacağını önermektedir. Buna göre, BT yatırımları (a) tamamlayıcı kaynaklarla birlikte hayata geçirildiğinde, (b) BT bazlı yetenekler geliştirmek için kullanıldığında ve (c) çekirdek organizasyonel becerileri desteklemek için kullanıldığında şirket performansını arttıracaktır. Otuz dört şirketten anket yöntemi ile toplanan verilere göre, bilgi teknolojilerinin önemli organizasyonel becerileri desteklemede kullanımının şirket performansı üzerinde olumlu etkisi bulunmuştur. Önerilen araştırma modeli, şirket performansındaki varyasyonun yüzde ellisinden fazlasını açıklamaktadır. Ayrıca sonuçlar, BT bazlı organizasyonel yeteneklerin çekirdek organizasyonel becerileri pozitif yönde etkilediğini, BT altyapısının da BT bazlı organizasyonel yetenekleri arttırdığını göstermiştir. Tamamlayıcı kaynakların BT bazlı yeteneklerin gelişimi ile ilişkisine dair kanıt bulunamamıştır. Bu çalışma, teknoloji altyapısını ölçecek yeni bir yaklaşım sunarak, BT departmanları insan kaynağı ölçümünü geliştirerek ve geniş bir tamamlayıcı kaynak seti kullanarak literatüre katkıda bulunmaktadır.

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The unconditional support of Arda Anıl, Acar Arslan, and Barış Özkök made the thesis writing much more enjoyable.

Finally, I dedicate my thesis to my family, for they provided me with the vision.

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CHAPTER I

INTRODUCTION

Information technologies (IT) have come to play a key part in the strategic agenda of companies. This is especially true starting with 1970s when the U.S. economy witnessed a sharp increase in the levels of IT investment. Investments in IT continue to increase taking a progressively larger part of the total investment pie. Hence, IT has become one of the most important decision variables for the top management of companies of any kind.

The benefits of IT investments include productivity, administrative, informational and innovational gains. On the other hand, implementation costs continue to increase with the complexity of the technology and the breadth of the project in question. Hence, IT investments can be characterized as both beneficial and risky. Furthermore, academics as well as managers raise concerns about the strategic value of IT investments. This follows from the fact that information technologies become commodities equally available to every actor. It is claimed that IT has, therefore, lost its power as a differentiating factor. Then, what could one conclude about the business value of IT investments? Do the benefits of possession exceed the costs at the end? Are the resulting advantages long-lived or competed-away?

This study presents the issues covered in the literature of business value of IT and the conditions under which IT is more likely to contribute to firm performance. The resource based view is chosen as the theoretical lens of this study, because it allows the researchers to model the complex process through which IT delivers business value. A model is proposed in which IT is hypothesized to have a

positive effect on firm performance if implemented in combination with complementary assets, leveraged to build capabilities and support core competencies. The process starts when IT infrastructure is combined with human resource skills and intangible complementary assets such as top management commitment, teamwork and benchmarking. This combination of resources is then leveraged to acquire IT-based capabilities. Next, IT-based capabilities are required to provide support for firm's core competencies, in other words, the IT strategy is aligned with the firm's overall strategy. Finally, the core competencies, supported by IT capabilities, improve firm performance.

The model was tested using the survey methodology. A questionnaire was sent to IT executives of the leading companies in Turkey. The results provided support for the hypothesis that, IT resources deliver value if they are leveraged to support business strategy. No support was found for the complementarity hypothesis which holds that IT will more likely to improve firm performance if combined with complementary resources. The findings implied for the managers that the acquisition and implementation of IT resources require careful consideration of the business strategy of the firm and detailed planning to transform these resources into necessary capabilities.

The thesis is organized as follows:

Chapter II reviews the literature on IT productivity. Chapter III introduces the resource-based view, develops resource-based arguments for IT business value, and suggests a model to investigate value creation process. Chapter IV lays out the methodology followed as well as the results. Chapter V discusses the results of the study and provides avenues for future research.

CHAPTER II

LITERATURE REVIEW

Productivity Paradox

Academics' interest on the productivity effects of information technology rose parallel to an increase in the levels of information technology investment during 1970's (Figure 1). The period was particularly interesting because productivity was falling at the same time (Brynjolfsson, 1993). As a Nobel Prize-winning economist, Robert Solow (1987) stated, "we see the computers everywhere except in the productivity statistics"; quoted many times by IT researchers. The issue has come to be known as the 'Solow Paradox' or 'Productivity Paradox' and unveiled a prolific stream of research. The research on productivity paradox can be grouped in three categories.

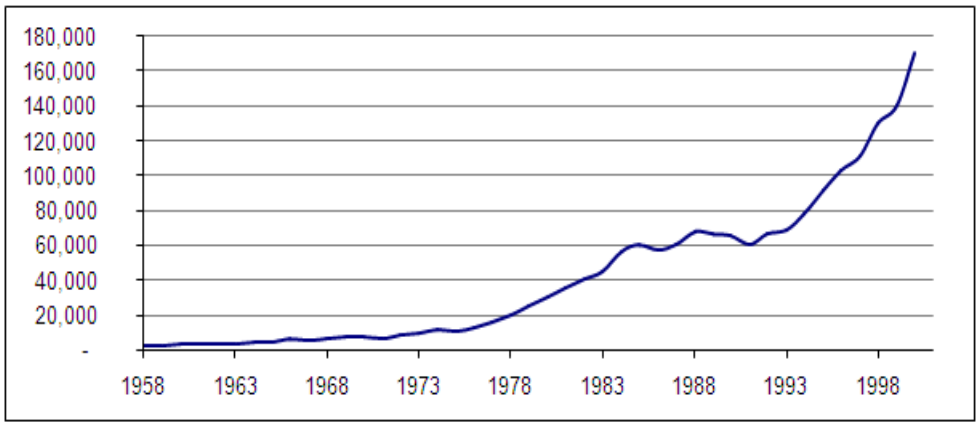

Figure 1. The increase in IT investment as proxied by computer and office equipment shipments in the United States (1958-2000). Source: U.S. Census Bureau. (2007, July 26). *Manufacturers' shipments, inventories, and orders survey (M3).* Retrieved August 14, 2007.

The first category sought to shed light upon the relationship between IT investment and economy-wide productivity. Baily (1986) reported that labor productivity fell down to 0.7% per year between 1973 and 1979 as compared to 2.75% between 1953 and 1968. A more recent study conducted by Jorgenson and Stiroh (1995) confirmed the findings: the average multifactor productivity growth was measured as 0.5 percent per year in the period between 1973 and 1992 whereas the figure was estimated to be 1.7 percent per year for the period between 1947 and 1973. Roach (1991) summarized the paradox in terms of information worker productivity between mid-1970s and 1986: while the level of IT capital per information worker came close to the level of production capital per production worker, the output per information worker fell down by 6.6% as opposed to a 16.9% increase in that of production worker. In their review of literature, Brynjolfsson and Yang (1996) interpreted these findings as premature, and therefore, inconclusive. The authors suggested that even if one assumes 50% of marginal product for IT, the IT stock accumulating over years could have contributed to aggregate GNP growth by 0.15% over the period of 1960-1990. Such an effect on GNP growth is impossible to isolate because many other factors determine the GNP growth. Now that IT stock has reached a significant portion of the whole economy (e.g. 10% of GNP in 1992), research can reveal its effect in a more reliable manner.

The second stream of research focused on industry-level effects of information technology. Earlier studies found that IT did not increase productivity either in service or in manufacturing sectors (Roach, 1987, 1991; Morrison and Berndt, 1991). Service sector was particularly interesting because the sector's contribution to the economy-wide output increased in a much lower rate than its share of total employment. Another interesting finding by Morrison and Berndt

(1991) indicated overinvestment on IT because each dollar spent on IT returned $0.80 of value. However, Siegel (1994) reported that industry-level data was subject to possible biases. The first resulted from inconsistent industry definition and aggregations. Second bias might be due to incorrect computer price and quantity data. Finally, traditional statistics did not account for the quality improvements achieved with IT investments. Indeed, studies focusing on product quality did find a positive correlation (Siegel, 1994; Brynjolfsson, 1994; Berndt and Morrison, 1995).

In the third category, authors turned to firm-level data in an effort to overcome the biases present in industry-level aggregations. Brynjolfsson and Yang (1996) reported a detailed list of articles and their results (Tables 1 and 2). The authors also suggested that studies involving larger and more recent data sets showed a positive relationship between IT and firm performance. Also, studies in the manufacturing sector reported stronger relationships than those in the service sector, attributed to better measurement and higher competitive pressures on the manufacturing sector.

The review of literature above supports Brynjolfsson's (1993) conclusion that 'a paradox remains in the difficulty of unequivocally documenting any contribution, even after so much effort.' The possible explanations for the indecisiveness include (a) mismeasurement of outputs and inputs, (b) lags due to learning and adjustment, (c) redistribution and dissipation of profits, and (d) mismanagement of information and technology.

Table 1: Firm-level Studies in the Service Sector

Study	Findings
Pulley & Braunstein (1984)	Significant economies of scope
Clarke (1985)	Major business process redesign needed to reap benefits in investment firm
Strassmann (1985, 1990)	No correlation between various IT ratios and performance measures
Bender (1986)	Weak relationship between IT and various performance ratios
Franke (1987)	IT was associated with a sharp drop in capital productivity and stagnant labor productivity
Noyelle (1990)	Severe measurement problems in services
Parsons et al. (1990)	IT coefficient in translog production function small and often negative
Alpar and Kim (1991)	IT is cost saving, labor saving, and capital using
Harris & Katz (1991)	Weak positive relationship between IT and various performance ratios
Weitzendorf & Wigand (1991)	Interactive model of information use
Diewert & Smith (1994)	Multi-factor productivity grows 9.4% per quarter over 6 quarters
Brynjolfsson & Hitt (1995)	Marginal products of IT do not differ much in services and in the manufacturing; Firm effects account for 50% of the marginal product differential

Note: The table is reproduced from Brynjolfsson and Yang (1996)

Table 2: Firm-level Studies in the Manufacturing and Cross-Sector Firms

Study	Findings
Dudley & Lasserre (1989)	IT and communication reduces inventories
Barua, Kriebel & Mukhopadhyay (1991)	IT improved intermediate outputs, if not necessarily final output
Weill (1992)	Contextual variables affect IT performance Transaction processing IT produce positive results
Loveman (1994)	IT investments added nothing to output
Brynjolfsson & Hitt (1995)	Firm effects account for half of the productivity benefits of earlier study
Lichtenberg (1995)	IT has excess return; IT staff's substitution effect is large
Kwon & Stoneman (1995)	New technology adoption especially computer use has a positive impact on output and productivity
Brynjolfsson & Hitt (1996)	The gross marginal product of IT capital is over 50% per year in manufacturing

Note: The table is reproduced from Brynjolfsson and Yang (1996)

Although later in 1996, Brynjolfsson and Hitt (1996) found that marginal productivity of computer capital had reached the levels of the marginal productivity of other types of capital in a more recent and larger sample, they concluded in 1998 that half of the benefit derived from IT investments stemmed from unique characteristics of firms and the other half from investment levels (Brynjolfsson and Hitt, 1998). Therefore, according to the authors (Brynjolfsson and Hitt, 1998), "what goes on inside the "black box" of the firm has a substantial influence on the productivity of IT investments" (p.52). To conclude, it has been realized that the relationship between IT investment and productivity is of a complex, indirect nature.

Theories Applied to IT Business Value Research

1990s presented an enriched platform for researchers to explore performance effects of information technology. New techniques and theories allowed them to use data, especially firm-level data, more effectively. Departing from previous literature reviews (Barua and Mukhopadhyay, 2000; Brynjolfsson, 1993; Brynjolfsson and Hitt, 2000; Brynjolfsson and Yang, 1996; Chan, 2000; Cronk and Fitzgerald, 1999; Dedrick et al., 2003; Dehning and Richardson, 2002; Kauffman and Weill, 1989; Soh and Markus, 1995; Triplett, 1999; Wilson, 1995), Melville et al. (2004) identifies four main research paradigms applied to IT business value research: microeconomic theory, industrial organization theory, sociology and socio-political perspectives, and resource-based view. An extended review of literature is presented below following Mellville's (2004) classification.

Microeconomic Theory

Microeconomic theory is originally a branch of economics, which studies economic agents' decisions on how to allocate limited resources (Marchant and Snell, 1991). It has been extensively adopted in IT literature because it is equipped with 'a rich set of well-defined constructs interrelated via theoretical models and mathematical specifications' (Melville et al., 2004).

More specifically, six approaches under the microeconomic theory have been followed in IT literature (Table 3).

Table 3. Microeconomic Approaches to IT Business Value

Theoretical Approach	Studies
Theory of production	Alpar and Kim (1990) Morrison and Berndt (1991) Loveman (1994) Brynjolfsson and Hitt (1995) Lichtenberg (1995) Brynjolfsson and Hitt (1996) Dewan and Min (1997)
Growth Accounting	Jorgenson and Stiroh (1999) Jorgenson and Stiroh (2000) Oliner and Sichel (2000) Brynjolfsson and Hitt (2003)
Consumer Theory	Bresnahan (1986) Brynjolfsson (1996) Hitt and Brynjolfsson (1996)
Data Envelopment Analysis	Wang et al. (1997) Lee and Barua (1999) Shafer and Byrd (2000) Chen and Zhu (2004) Chen et al. (2006)
Tobin's Q	Brynjolfsson and Yang (1997) Berk et al. (1998) Bharadwaj et al. (1999)
Option Pricing	Kumar (1996) Benaroch and Kauffman (1999) Benaroch and Kauffman (2000) Benaroch (2002) Kim and Sanders (2002)

Theory of production holds that the output of a firm is determined by a production function. The production function represents the firm's method of transforming inputs into outputs where all inputs are predicted to have a positive contribution. The analysis results in estimations of gross marginal product of each input, defined as the marginal output delivered by the last dollar invested in that input. Alpar and Kim (1990) suggested that production function approach provided better results than other, less constrained, statistical analyses. Brynjolfsson and Hitt (1996) estimated a gross marginal product of 81% for computer capital in a sample of 1121 observations.

Second, growth accounting approach relates the growth in output to the growth in inputs, IT stock in this case. Basically, it follows a production function approach but adds a time dimension. The approach yielded more consistent results, supporting the contribution of IT investments to the US economy growth. Jorgenson and Stiroh (1999) suggested that computers were the most important investment goods during the period of 1990 to 1996, with a contribution of 0.26 percentage points to growth.

The next theory applied is consumer theory which aims at estimating the total benefit conveyed to the consumer. This is done by estimating a demand curve and summing up the benefits accrued to the consumers who purchased at market price but would be willing to pay more if it was the case, hence consumer surplus (Hitt and Brynjolfsson, 1996). The total surplus is illustrated in Figure 2.

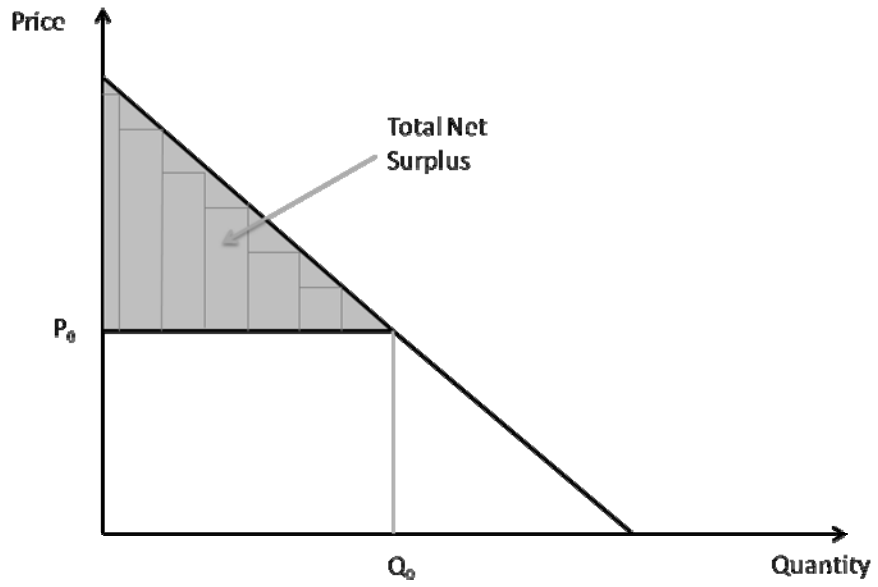

Figure 2: Illustration of consumer surplus as an area between price and demand

Hitt and Brynjolfsson (1996) reported that, in the case of IT investment, the demand curve had been estimated in a relatively more accurate manner because the price of IT had been decreasing by several orders of magnitude. They identified two sources of surplus that arose as the price of IT declined: (a) decreased cost for investments that would have been paid for at the old price, and (b) additional IT investments due to decreased price. The findings of consumer theory, in general, support the hypothesis that IT generates consumer surplus. For instance, Brynjolfsson (1996) estimated a consumer surplus of $50 billion generated by IT in 1987. Hitt and Brynjolsson (1996) also found a surplus of $14.5 billion ($3.6 billion per year) was created by the reduced price of IT, a surplus generated over the cost of investment between 1988 and 1992.

Data envelopment analysis (DEA), also known as frontier analysis, is a linear programming technique which measures the relative efficiency of Decision Making Units (DMU) of a company which utilize multiple inputs and produce

multiple outputs (Boussofiane et al., 1991). DEA assesses the efficiency of each DMU to see how many inputs each unit uses to produce their level of output. The analysis produces piecewise linear combinations of most efficient DMUs as illustrated in Figure 3, and provides a measure of the relative efficiency of each DMU compared to all other DMUs.

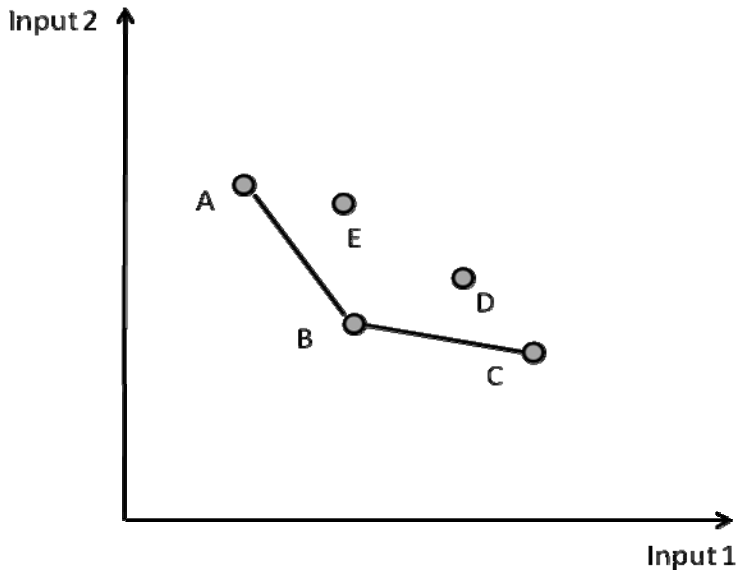

Figure 3: Developing efficient frontier with DEA

DEA is applied to IT literature by replacing DMUs with individual firms, determining common IT inputs (IT budget, personnel, processing power, etc.). The analysis finds most efficient users of IT and compares them to each other. Shafer and Byrd (2000) used a DEA model with three inputs and two outputs where 14 of the 208 organizations were found to be efficient, five of which belonged to the banking industry. Chen et al. (2006) applied the DEA logic to a multi-stage business process DEA model (e.g. deposit generation and loan provision) and found that, in a sample of 27 banks, only three were operating efficiently.

Furthermore, Tobin's q ratio (commonly referred as *q*) is defined as the capital market value of the firm divided by the replacement value of its assets. Tobin's q is characterized as forward-looking, risk-adjusted, and less susceptible to changes in accounting practices (Montgomery and Wernerfelt 1988, Bharadwaj et al. 1999;) It was used extensively to measure the value of a firm's technological assets. (Cockburn and Griliches 1988, Griliches 1981, Hall 1993). Tobin's q is a strong performance indicator in IT literature because IT can only contribute to long-run firm performance and intangible value, which, theoretically, can be objectively represented with a firm market value (Bharadwaj et al. 1999).

Finally, real options are 'investment opportunities to confer the right, but not the obligation, to take some specific operating action in the future' (Leiblein and Miller, 2003). They provide preferential access to future opportunities (Bowman and Hurry, 1993) by creating asymmetry in the distribution of returns: downside exposure is eliminated while upside potential is kept. In IT literature, IT investment was theorized to confer production (Kogut and Kulatilaka, 1994) and rapid deployment flexibilities (Baldwin and Clark, 1994) to managers. Therefore, option pricing models, originally applied in finance, are used to estimate the real value of IT investments, real in the sense that the estimation takes the flexibility and risk-reduction advantages into account. Main criticism of this technique implies that the assumptions of the option pricing models do not hold in IT investment cases.

The main criticism to microeconomic theory is the restrictive assumptions underlying the theory. The specific context of the research has to be analyzed within the boundaries of the assumptions and the results must be interpreted accordingly. The major drawback is that, often, the results cannot be generalized.

Industrial Organization Theory

Industrial organization scholars put much effort to uncovering the potential of information technology to convey competitive advantage. They emphasized the joint interaction of firms in IT investment decisions, and the resulting distribution of benefits. Theoretical contexts under industrial organization are listed in Table 4 and include (a) game theory in which the role of strategic interaction among competitors played a key role in IT business value generation and capture; (b) agency theory and the incomplete contracts where the relationship between parties of the transaction is characterized by information assymmety and moral hazard, which in turn, poses an unequal distribution of benefits; and lastly (c) transaction cost theory where IT is tested as a potential means for reducing transaction costs.

Table 4. Industrial Organization Approaches to IT Business Value

Theoretical Approach	Studies
Game Theory	Barua et al. (1991) Belleflamme (2001) Thatcher and Oliver (2001) Quan et al. (2003) Zhu and Weyant (2003)
Agency Theory and Incomplete Contracts	Clemons and Kleindorfer (1992) Bakos, and Brynjolfsson (1993) Bakos and Nault (1997) Kling et al. (2001)
TCE	Clemons and Row (1991) Gurbaxani and Whang (1991) Argyres (1999)

Looking at the role of competitive environment, e.g. oligopolistic competition, the game theoretic approach was especially useful in the identification of market contingencies under which IT investments were more likely to prove useful (Melville et al., 2004).

Second, Williamson (1975, 1985) stressed the incompleteness of contracts resulting from bounded rationality. Because economic agents are “intendedly rational, but only limitedly so" (Simon, 1961, p. xxiv), it is impossible to foresee all future contingencies. Therefore, all contracts are subject to revision as contingencies arise. Grossman and Hart (1986) defined ownership as the purchase of residual rights, the rights not given away by a contractual assignment. Ownership of residual rights confers the owner the right to exclude any other agent from using the asset and is, therefore, the principal source of economic rents. At the same time, allocation of residual rights determines the propensity to invest in a given asset.

Agency theory links IT investment to efficiency and performance through ownership structure. For example, Bakos and Nault (1997) proposed that efficiency required that the economic agent should own the electronic network if it was idiosyncratic to him. In the framework of agency theory, self-interested agents do not necessarily behave to maximize the principal’s interests. Anticipating this, the principal incurs monitoring and enforcement costs, also called agency costs (Jensen and Meckling, 1976). From an IT investment perspective, agency costs reduce the efficiency of the investment. For instance, Kling et al. (2001) discussed the role of IT in reducing the coordination costs, thus improving performance.

Lastly, Transaction Cost Economics (TCE) holds that markets do not operate frictionlessly and economic transactions are costly (Coase, 1937). Williamson (1991) predicted that the level of transaction costs depended on the level of asset specificity, uncertainty and frequency of the transaction. Economic agents, in turn, select the governance mechanism for a given transaction which minimizes the costs of the particular transaction. These governance mechanisms are market,

hierarchy, and hybrid, each of which differ in their incentive mechanisms, law and adaptation aspects, therefore responding differently to different transactions.

In IT literature, information technologies are theorized to reduce transaction costs and provide higher levels of coordination. Effectively coordinated resources, in turn, increase in value, and the firm achieves higher levels of performance. (Clemons and Row, 1991)

Sociology and Socio-Political Perspectives

The theory of embeddedness helped academics to understand how inter-organizational relationships impact IT business value. Granovetter (1985) pointed out that the economic activity was embedded in social networks in the sense that inter-firm social relations played a key role in determining economic decisions and outcomes. Uzzi (1997) enhanced the framework by dimensionalizing the social network: the structure and the quality of social ties between firms determined economic activity. Chatfield and Yetton (2000) theorized that the strategic payoff from IT investment depended on the embeddedness of the inter-firm IT investment which was defined as its centrality in managing firm interdependencies.

As opposed to rational perspectives in previous research, the socio-political perspective stresses relationships and trust within and across organizations and their interaction with rational economic analyses. In a case study of the implementation of an interorganizational information system in the textile industry, Kumar et al. (1998) proposed that economic theories traditionally applied in IT business value research might not be applicable to the empirical contexts outside its geographical areas of origin where trust replaced the universal assumption of opportunism. In such

contexts, IT implementations may require additional considerations other than economic ones such as power, politics, trust and long-lived relationships. Hoogeveen and Oppelland (2002) found evidence that destructive conflict and low level of trust among managers reduced the quality of IT assets and had a negative impact on the performance of business processes.

Resource-Based View

More recently, the search for a unifying framework resulted in the application of resource-based view (RBV) to the relationship between IT and business performance. RBV has been used in explaining the conditions for sustained competitive advantage in strategy literature. RBV attributes sustained competitive advantage to the characteristics of resources: resources that are rare, valuable, inimitable and non-substitutable deliver above-normal profits (Barney, 1991).

RBV-based IT research starts with IT and complementary resources, and relates firm performance to their availability. Bharadwaj (2000) found evidence that firms, leading in IT investment and use, outperformed those with moderate IT adoption. Devaraj and Kohli (2003) pointed out that the link between IT resources and firm performance could only be established if the actual usage was accounted for. Santhanam and Hartono (2003) looked at the relationship between IT capabilities and firm performance and established that the link remained significant across various performance measures even after accounting for prior performance. The study of Barua et al. (2004) demonstrated that online informational capabilities lead to superior operational as well as financial performance. In the e-commerce framework, Zhu (2004) provided further evidence for capability building arguments.

In particular, the study indicated that the interaction between e-commerce capabilities and IT infrastructure was positively linked with firm performance. Ray et al. (2005) pointed out the importance of shared knowledge between IT and customer service units which was found to have a significant direct effect on the business process performance as well as a significant moderating effect on the relationship between IT resources and process performance. In another study by Wu et al. (2006), supply chain capabilities were found to have a significant positive effect on firm performance if supported by IT advancement and IT alignment. Huang et al. (2006) found positive relationship between IT infrastructure and IT-related intangibles which, in turn, had a significant positive effect on firm performance. The findings of Oh and Pinsonneault (2007) showed that investments in growth-oriented applications, i.e. applications the strategic objective of which was revenue growth, were positively associated with firm revenue.

Another group of researchers identified the importance of strategic alignment of IT investments. Such an alignment was achieved when the general IT investment plan supported the priorities and goals of the firm's more general strategic plan. Sabherwal and Chan (2001) found evidence that strategic alignment of IT had an effect on overall business success if the firm sought for flexibility and innovation or for a simultaneous achievement of efficiency and innovation. But the relationship did not hold if the firm followed a defensive strategy, such as aggressive cost cutting. Dehning et al (2003) showed that transformative IT investments which redefined business and industry processes generated abnormal returns to investment announcements. Finally, Oh and Pinsonneault (2007) found that strategic alignment of IT for cost reduction purposes had a significant negative effect on firm expenses.

Ravichandran and Lertwongsatien (2005) combined the capability arguments with alignment arguments by taking a process view in the IT business value generation. They modeled business value generation process starting with resources generating IT-related capabilities which supported core competencies, and hence provided business value. They found evidence that IT support for core competencies was positively related with firm performance.

In summary, a wide range of theories with disparate perspectives are applied to the investigation of IT business value. The applications of the first three paradigms are either criticized to be either too abstract to draw conclusions from or too specific to be generalized.

However, most researchers expressed confidence in the application of RBV on IT literature because RBV allowed researchers to account for the complex process through which IT resources delivered value (Mata et al., 1995; Powell and Dent-Micallef, 1997; Bharadwaj, 2000; Melville et al., 2004). Melville et al. (2004) proposed RBV as a unifying framework "suitable for analyzing the complexity of IT and firm performance" (p. 289). Due to emphasis on firm heterogeneity and process oriented approach, studies employing RBV are credited for generating more consistent results.

This study seeks to build upon the RBV-based IT literature by refining the valuable resource portfolio. It also contributes to the literature by investigating the IT-performance relationship in the context of Turkey, a developing country. Next chapter provides a theoretical background and hypotheses of the model applied in the study.

CHAPTER III

HYPOTHESIS DEVELOPMENT

Theoretical Background on Resource-Based View

RBV looks at the relationship between firm resources and competitive advantage (Barney, 1991; Rumelt, 1984; Wernerfelt, 1984). RBV starts with the observation that firms differ in their resource endowments; hence, the basic assumption of RBV is firm heterogeneity. Barney (1991) defined resources as all assets, capabilities, business processes, information and alike, which allow the firm to follow strategies for improving both its efficiency and effectiveness (Daft, 1983; Barney, 1991). RBV holds that differences in performance stem from heterogeneous resource and capability portfolios.

Furthermore, RBV seeks to uncover the conditions under which firms can achieve sustainable competitive advantage. According to Barney (1991), 'a firm is said to have a *sustained competitive advantage* when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors *and* when these other firms are unable to duplicate the benefits of this strategy' (p. 102, emphasis in original).

Accordingly, for a resource to convey sustained competitive advantage, it must be valuable, rare, inimitable and non-substitutable; four conditions for a resource to survive competitive duplication. A valuable resource improves a firm's efficiency and effectiveness. For a resource to be rare, it must not be owned by large numbers of current, or potential, competitors. Inimitable, also called imperfectly imitable, resources are very difficult, or at least very costly, to imitate.

Substitutability refers to the situation in which distinct sets of resources can be separately deployed to strategically equivalent ends. In sum, a firm can only achieve temporary competitive advantage with a valuable and rare resource. Sustaining it would require that competing firms face significant cost disadvantages in acquiring the resource in question.

Another question logically follows from the above analysis: under what conditions do firms face difficulty in competitive duplication? What are the conditions that make resources rare and inimitable? Three conditions, also referred to as isolating mechanisms (Rumelt, 1984), were identified as potential sources of sustained competitive advantage.

The first concerns unique historical conditions. Some opportunities arise once and for all, and for a firm to benefit from these, it must be in the right place at the right time (Stinchcombe, 1965; Barney, 1991; Mata et al., 1995). Mata et al. (1995) provided Caterpillar as an example, which was subsidized by the Allies during the World War II for supply of heavy construction equipment. Time plays a second role, especially in the case of resources and capabilities which can be developed only over long periods of time. Time compression diseconomies (Dierickx and Cool, 1989) imply that resources gained over long periods of time are very costly, if at all possible, to duplicate in a shorter period of time; same results cannot be achieved in half the time with double the resources.

The second isolating mechanism is causal ambiguity. Competitive duplication requires that the competitor understands the reasons behind a competitive advantage. This is very difficult when the resource in question is tacit, in other words unspoken, taken-for-granted (Reed and DeFillippi, 1990; Mata et al., 1995). Organization's culture (Barney 1986) and its routines (Nelson and Winter, 1982) are

examples of tacit assets. Causal ambiguity may also stem from a large number of small decisions taken to achieve a single goal. For example, total quality management programs involve thousands of decisions. When competitive advantage is achieved as a result of such a large number of decisions, it is very difficult for an outsider to keep track of these, especially if these decisions are interdependent.

The last isolating mechanism is social complexity. Some firm attributes evolve within a social context, which is beyond the firm's ability to systematically manage (Barney, 1991). In that case, it is also very difficult for competitors to duplicate such resources. Socially complex resources may include an organizational culture (Barney, 1986), its reputation among customers and suppliers (Klein, et al., 1978).

Next section investigates IT resources' potential under the light of isolating mechanisms.

Information Technology and Resource-Based View

IT business value research started to utilize resource-based view (Clemons, 1991; Clemons and Row, 1991) as a response to concerns about inconsistent results in previous studies. RBV informed IT business value research that IT investments *per se* did not generate competitive advantage because they were readily available in the market (Clemons, 1991; Clemons and Row, 1991; Mata et al., 1995; Bharadwaj, 2000). IT investments can only deliver value if they are leveraged by the firm to create unique resources and capabilities to support the firm's overall strategy. These IT-based capabilities, in turn, are heterogeneously distributed among firms, because firms differ in their ability to convert 'raw' IT resources into information capabilities

even if they have access to the same IT resources (Barua et al., 2004). For example, internal conflicts among business managers prevent effective utilization of IT assets (Hoogeveen and Oppelland, 2002). Hence, a firm's tacit resources discussed before play a role in the development of IT-based capabilities. For example, an organizational culture promoting team work and open communication will facilitate capability development process; hence a difficult-to-imitate contribution (Powell and A. Dent-Micallef, 1997).

Moreover, complementarities among resources are identified as another potential source of value. Complementarity is achieved when a resource delivers higher returns combined with another resource than it does alone (Powell and A. Dent-Micallef, 1997). According to RBV, complementarity improves the value of both resources and the causality is more likely to be ambiguous. Therefore, IT resources, combined with complementary resources, turn into IT-based capabilities, which are difficult to duplicate.

Causal ambiguity as an isolating mechanism implies that the process through which IT resources are leveraged contribute significantly to the business value that is created. These processes typically involve tacit resources, a large number of decisions and complex processes. More recently, researchers identified the value creation process as one of the principal sources of firm heterogeneity and started modeling and testing the processes (Barua et al., 2004; Melville et al., 2004; Ravichandran and Lertwongsatien, 2005; Wu et al., 2006)

However, there is limited research on the value creation process (Barua et al., 2004), and underlying mechanisms of IT business value creation remain to be an unresolved issue (Bharadwaj, 2000; Barney, Wright, & Ketchen, 2001; Wu et al., 2006). Academics call for further review and testing of the resource-based view of IT

(Mata et al., 1995; Bhrardwaj, 2000). As a response, this study models the process through which IT, human and complementary resources are turned into IT-based capabilities to support core competencies and improve firm performance.

This study contributes to IT business value literature by taking a process view to the relationship between IT-based resources and firm performance. Not only does it provide further evidence for the value creation perspective, but it also improves former conceptualizations by incorporating a broader range of IT-related resources and proposing a new IT stock measure. Lastly, the study provides evidence from Turkey, a developing country.

Definition of IT and Value

Before defining the value of IT, one needs to define IT itself. Information technology refers to

> …any equipment or interconnected system or subsystem of equipment, that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. The term 'information technology' includes computers, ancillary equipment, software, firmware and similar procedures, services (including support services), and related resources.

The definition is adopted from the Electronic and Information Technology Accessibility Standards (Section 508) published by U.S. Access Board. This definition fulfils the need to incorporate software in IT conceptualizations (Melville et al., 2004).

This study adopts Melville et al.'s (2004) definition of IT business value: "the organizational performance impacts of information technology at both the intermediate process level and the organization-wide level, and comprising both efficiency impacts and competitive impacts" (p. 287, emphasis in original). Such an

approach encompasses both efficiency and effectiveness aspects of information technology where "effectiveness denotes the achievement of organizational objectives in relation to a firm's external environment" (Mellville et al., 2004, p. 287).

Drawing from Brynjolfsson et al., (2002), Cooper et al. (2000), and Dewan and Kraemer (2000); Melville et al. (2004) suggested that the value potential of IT derived from many factors, including the type of IT, management practices, organizational structure, and the competitive and macro environment. Therefore, IT business value research models should include IT, management, and procedural aspects as well as controls for the environment.

Model and Hypotheses

This study builds on the model developed by Ravichandran and Lertwongsatien (2005) presented in Figure 4. The study improves the model in the following ways. First, the model in this study looks at the breadth of the IT infrastructure of the firm instead of focusing on the flexibility aspect of IT. More specifically, the study proposes a new measure of IT infrastructure which takes into account the technology assets within the firm across all business functions and sophistication levels. Second, the model accounts for four dimensions of IT department human resources skills as opposed to the two dimensional conceptualization in Ravichandran and Lertwongsatien (2005). Third, the study models an extended IT-related resource portfolio to include six additional complementary assets. The study also controls for firm age, which may indicate higher legitimacy, stronger interfirm relationships and maturity in internal processes.

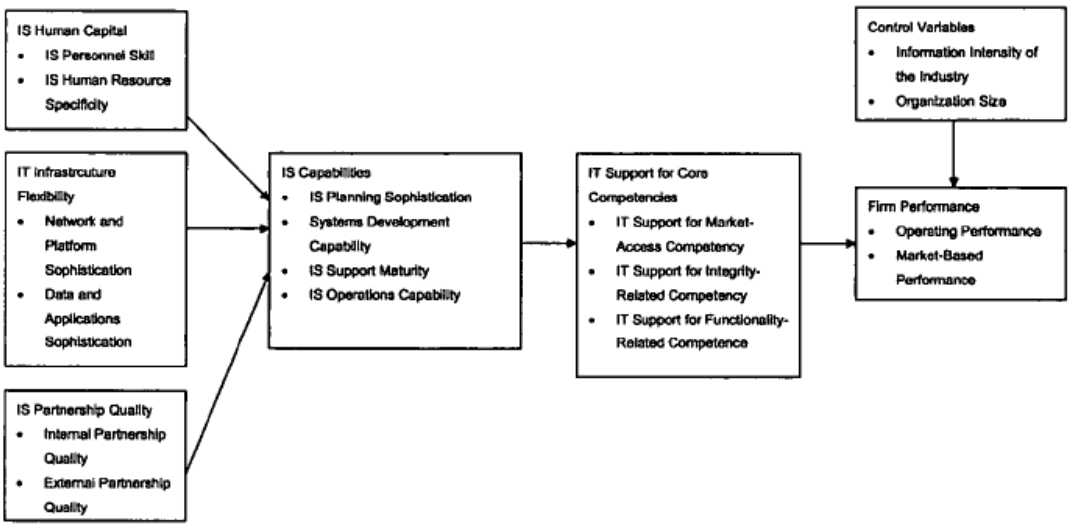

Figure 4: The research model in Ravichandran and Lertwongsatien (2005)

The research model of this study (Figure 5) relates IT-related resources, IT-based capabilities, IT support for core competencies, and firm performance. The process starts when IT-related resources are combined and leveraged to acquire IT-based capabilities. Next, these capabilities are required to provide support for firm's core competencies. Finally, these core competencies, supported by IT capabilities, improve firm performance. The details of the model are discussed next.

Hypotheses on IT-Related resources:

Resources are building blocks of capabilities. 'By assembling, integrating and deploying valued resources that work together' (Hilhorst and Smits, 2004), firms create capabilities. Grant (1991) classified resources as tangible, intangible and people-based. Following Grant's classification, IT-related resources can be classified

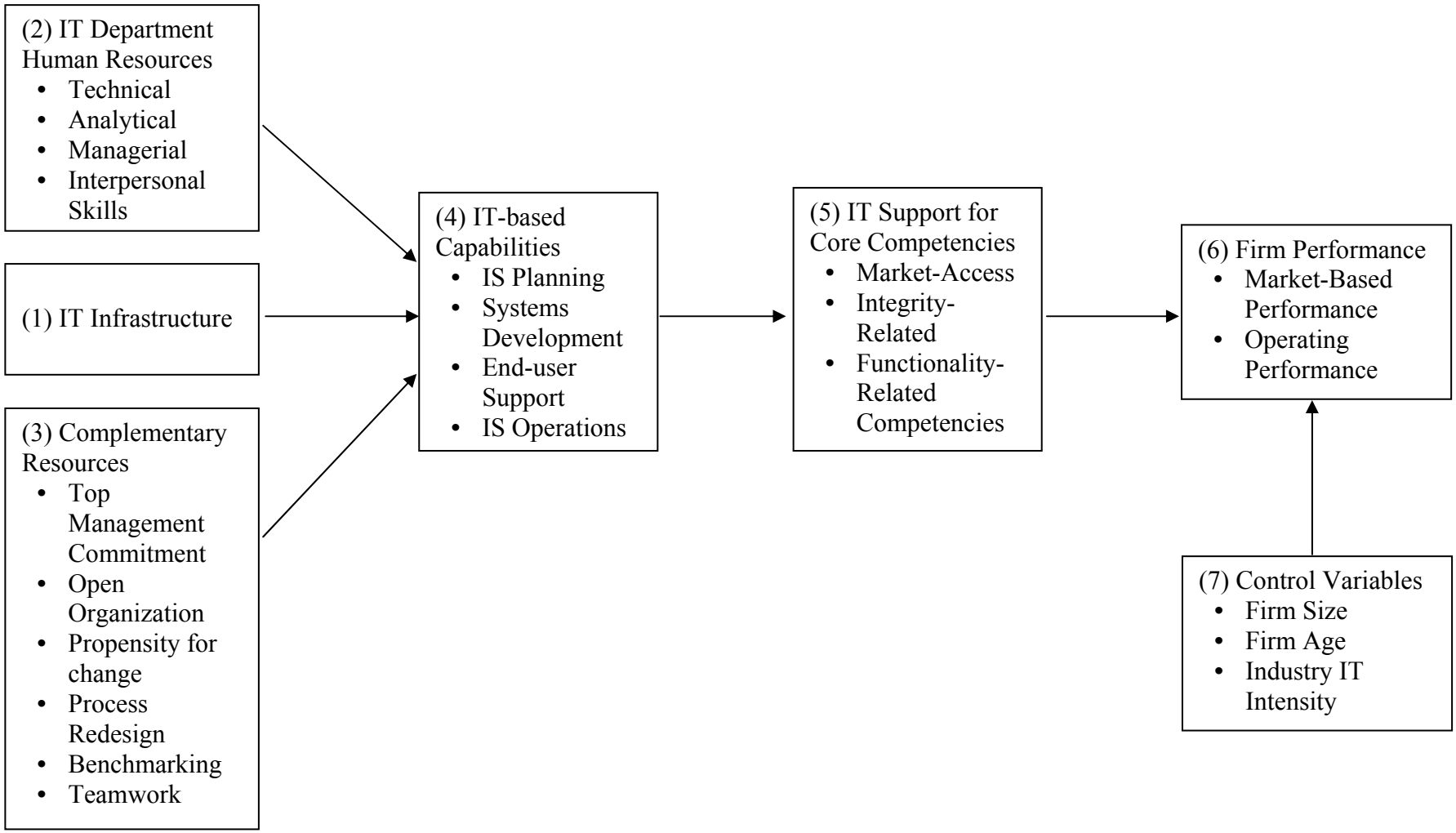

Figure 5: Research Model

as (a) tangible IT infrastructure, (b) IT department human resource (HR) skills, and (c) intangible complementary resources.

As defined above, IT infrastructure constitutes resources such as computers, ancillary equipment, software, procedures, and services. They are used to acquire, store, analyze and distribute data. The actions taken to acquire and make use of data form the basis for IT-based capability building. Hence,

Hypothesis 1a. IT Infrastructure is positively associated with IT-based capabilities.

The second critical set of resources rest in information systems departments. The skills possessed by human resources of IT departments play a significant role in IT business value creation. The success of process through which firms extract value from their IT investments is highly dependent on the personnel of the IT department, who are responsible for analyzing business requirements, planning, organizing and leading information systems (IS) projects, as well as communicating with and educating end-users.

In previous literature, IT department human resources skills were conceptualized to include not only technical and managerial IT skills (Ferguson et al., 2005; Huang et al., 2006; Bharadwaj, 2000; Melville et al., 2004), but also business-related knowledge (Caldeira and Ward, 2003; Ravichandran and Lertwongsatien, 2005). This study adopts the categorization of IT Department HR skills as in Hoffer et al. (2001). Accordingly, there are four categories: technical, analytical, managerial and interpersonal skillls. Technical IT skills include skills such as programming, database management and systems integration. Analytical skills include systems thinking, organizational knowledge, problem identification and solving. These are related with conceptualization of the organization as a system

with inputs, outputs, boundaries and subsystems, identification of the interdependencies between subsystems, understanding of the environmental constraints within which the organization operates, identification of the gaps between current and desired outcomes and development of alternative solutions. Managerial skills comprise resource, project, risk and change managements skills. They involve activities like goal setting, planning and operating under resource and time constraints, and monitoring. Lastly, interpersonal skills refer to the effectiveness with which IT department personnel is able to work with other departments and convey system requirements, benefits and drawbacks.

IT department human resources constitute an important input for the development of IT based capabilities (Byrd and Turner, 2001). Strong technical skills are necessary for IT based capability building through successful experimentation, development and maintenance (Byrd and Turner, 2001). Analytical skills allow the IT department to identify relevant problems, develop the right solutions, and to produce effective information systems embedded in the strategic framework of the firm. Furthermore, managerial skills are necessary for successful delivery of service to end-users. Finally, interpersonal skills build a link between the IT deparment and other departments of the organization, providing successful in- and outflow of information; important in capability building process. Hence,

Hypothesis 1b: IT department human resources skills are positively associated with IT-based capabilities.

Complementary intangible resources include top management commitment, open organization and communications, propensity for change, process redesign, benchmarking, and teamwork (Powell and A. Dent-Micallef, 1997). *Top management commitment* is manifested in explicit communication of the need for

and role of IT in the strategic context of the organization (Henderson and Venkatraman, 1993). Top management commitment makes resources available for information systems projects, helps integration of information systems with business strategy, and ensures investment without interruption (Kettinger et al., 1994). Zuboff (1988) defines an *open organization* as one in which employees are granted access to operating information and where traditional hierarchy is discarded. As a result, the organization operates smoothly, middle managers gain valuable experience, and communication is fostered across functional boundaries.

Benjamin and Levinson (1993) suggested that IT implementations typically required changes which influenced every function and organizational stakeholder. Furthermore, Orlikowski and Gash (1992) suggested that these changes represented "a shift to radically different frames and processes, with the shift representing a replacement of the status quo." (p. 8). Therefore, for information technologies to take effect, the organization must possess *propensity for change,* in other words, a culture that welcomes experimentation, values flexibility and encourages adoption of new technologies.

Business process redesign is a reassessment of existing business processes. Developments in information technologies make new opportunities available for firms to operate in new ways, e.g. electronic integration with key suppliers for just-in-time inventory management. Process redesign enables a firm to make use of such opportunities, increasing cost-efficiency, timeliness and reliability.

Benchmarking refers to continuous monitoring of best practices of competitors as well as other relevant actors, e.g. those with a similar vision in another industry. Benchmarking helps managers "better evaluate the features,

functionality, benefits, roles and costs of technology' (Bogan and English, 1994: 171).

It has been discussed above that information technologies encourage firms to move away from traditional hierarchies towards an open organization. As a result, a team-based structure remains as an alternative mode for operations (Jasinowski and Hamrin, 1995). The complementarity among information technologies and *teamwork* works both ways. Information technologies, e.g. e-mail, voice-mail, video conferencing as well as more sophisticated software like groupware and project management tools improve team planning and communication capabilities. On the other hand, teamwork helps IS planning and system development by providing timely and relevant information inflow to the IT professionals. Teamwork also enables the users to make the best use of existing information technologies by allowing for fruitful training and end-user support between IT department and other functions.

The complementary resources discussed above serve two broad functions. First, they combine with IT infrastructure and IT department human resource skills to produce the intended results in a productive manner. Second, drawing from the notion of complementarity, they render the resource combination imperfectly imitable through causal ambiguity. Hence,

Hypothesis 1c: Complementary assets are positively associated with IT-based capabilities.

Hypothesis on IT-based Capabilities

Drawing from Collis (1994), Ravichandran and Lertwongsatien (2005) defined capabilities as 'socially complex routines that determine the efficiency with which

firms transform inputs into outputs' (Ravichandran and Lertwongsatien (2005). They are higher-order resources used to deploy resources for the attainment of organizational goals (Amit and Schoemaker, 1993; Grant, 1991; Makadok 2001; Zhu, 2004). From an IT-based perspective, Bharadwaj (2000) defined IT-based capability as "the ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities" (p. 171). Following Ravichandran and Lertwongsatien (2005), IT-based capabilities are categorized around core functional areas: IS planning, systems development, IT support and operations. Such an approach is consistent with Grant's (1991) suggestion of standard functional classification.

The extent to which an organization can enhance its core competencies through IT support depends on IT-based capabilities. Strong IS planning capability enables an organization's managers to allocate technology resources to strategic priorities. Systems development capability improves the compatibility of intended strategic applications of technology resources with the strategic priorities. The efficiency of IT support for core competencies, in terms of both cost and time, might result from IT support for end-users and system operation capabilities by ensuring company wide end-user utilization of applications and the continuity of business operations (Ravichandran and Lertwongsatien, 2005). Hence,

Hypothesis 2: IT-based Capabilities are positively associated with IT support for core competencies.

Hypothesis on IT Support for Core Competencies

As opposed to most of the productivity paradox research discussed above, this study does not conceptualize IT as a stand-alone resource but takes the interrelationship between IT and strategic considerations into account (Wu et al., 2006). In strategy literature, core competency was defined as "an area of specialized expertise that is the result of harmonizing complex streams of technology and work activity" (Hamel and Prahalad, 1990). Following Hamel (1994), core competencies were categorized into market-access, integrity-related, and functionality-related groups.

Market-access competencies relate to the proximity with which a firm can approach its customers. The proximity, in turn, allows the firm to identify and respond to its customers' needs in an effective and timely manner. Market segmentation and targeting, brand management, product tailoring, distribution & logistics skills indicate the level of market-access competency of a firm.

Integrity-related competencies refer to the speed, flexibility and reliability with which a firm performs its operations. Integrity-related competencies allow a firm to offer reliable products and services at competitive prices and deliver them with minimal inconvenience. This requires streamlined processes in manufacturing, and supply chain operations, effective quality and inventory management.

Lastly, functionality-related competencies relate to the uniqueness of products and services offering of a firm. It is related with the capability of the firm to innovate new offerings with distinctive functionalities rather than incrementally improve existing ones. Therefore, these competencies materialize in new product development and innovation processes.

The approach taken in this study indicated that core competency development is a long and complex process which involves key resource acquisition and deployment decisions. Given that resources are limited and competency development process is complex, bundling IT with core business processes in a strategic manner is likely to yield valuable and inimitable results. Therefore, everything else being equal, firms that align their IT infrastructure with core competencies will realize more value from their IT assets and improve their competitiveness. Hence,

Hypothesis 3: IT Support for core competencies is positively associated with firm performance.

CHAPTER IV

METHODOLOGY

In this study, survey methodology was used to collect data to test the hypotheses stated previously and the questionnaire used for this purpose was mainly adopted from the one that was used by Ravichandran and Lertwongsatien (2005), the approval for which is presented in Appendix C. The questionnaire is revised to account for the renewed resource set proposed. The details of the sample, structure and administration of the questionnaire are presented in the following sections.

Sample

The population of this study was determined to be the IT executives of leading companies in Turkey since they are more likely to possess information about the IT related resources as well as IT capability and performance related issues.

The sample included 212 companies whose IT executives' interviews were published in Turkey's leading IT magazines, such as IT Business Weekly and BT Haber, in the last two years. This ensures that the sample covers a significant portion of Turkish companies which make considerable IT investments. IT vendors and service providers were excluded from the sample because their performance is directly derived from information technologies, as opposed to the indirect value creation process faced by companies in other industries.

The names and titles of the executives were collected from the IT magazines. Contact information, on the other hand, was collected from corporate websites, IT vendors, and IT education websites, when available. When unavailable,

contact information was guessed using standard email schemes such as firstname.lastname@company.com.tr, firstnamelastname@company.com.tr, f.lastname@company.com.tr, and flastname@company.com.tr. To supplement this, a web search was conducted to find out other peoples' email addresses working in the company in question in order to determine that company's email scheme.

The Structure of the Questionnaire

The questionnaire used in this study consisted of a cover and five set of questions (Appendix D). The cover of the questionnaire included information about the subject, the aims of the study and the confidentiality provisions as well as some practical information such as the expected duration required to fill in the survey, the parts of the questionnaire and instructions. The theoretical background and structuring of the questions for each part of the questionnaire are given under the five headings presented below.

Part I: IT Infrastructure

The first part of the questionnaire aimed at measuring the extent of IT resources possessed by the company.

Measurement of IT resources was listed as one of the most important issues in IT business value research. Brynjolfsson (1993) called for 'a proper index of [IT's] true impact' (p. 73). On the other hand, measurement of IT investment in terms of dollars was considered a poor proxy for the valuation of IT infrastructure of a company (Bharadwaj, 2000). This study responds to this gap by proposing a new

measurement of IT infrastructure. The types of benefits attributed to information technologies include increased quality, variety, responsiveness and improved communications. These benefits are not direct results of the hardware features of the IT infrastructure but of the IS developed to run on that hardware. Therefore, for the purposes of this study, the IT Infrastructure is measured by the type of IS running within the infrastructure.

Laudon and Laudon (2006) provided a classification of ISs based on functionality and sophistication. Accordingly, there are four levels of ISs: transaction processing systems (TPS), management information systems (MIS), decision support systems (DSS), and executive support systems (ESS) in increasing sophistication. The detailed list of these ISs can be found in Table 12 in the Appendix A.

Regarding the discussions above, ISs possessed by the company were measured in the questionnaire in terms of functional software architecture approach where the business functions were listed and corresponding IS existence and usage for that function is questioned.

From IS usage information provided by the respondents, an index of IS usage is created to measure the level of IT infrastructure utilized within the company:

$$\text{IT Infrastructure} = \sum (\text{ISUsage X ISLevel}) / \text{TotalScore}$$

ISUsage is a dummy variable taking the value 1 if the information system is in use in the company, 0 otherwise. ISLevel takes the values 1, 2, and 3 for TPS, MIS&DSS and ESS, respectively. TotalScore is the maximum level a company can score in its industry; i.e. a company that has all the information systems -across all functions and levels- in use at the time of the questionnaire. This procedure allows

for comparable scores in manufacturing and non-manufacturing industries, where manufacturing systems are not applicable.

More weight is given to more sophisticated levels of IS because the higher the level is, the more strategic importance the information system has (Laudon and Laudon, 2006). Higher levels of sophistication indicate that the information system is fed with broad data from various sources and compiles them into valuable information for managerial, strategic purposes. For example, annual budgeting software receives direct and indirect production costs, available capacity, shipping costs, and makes sales forecasts, assigns macroeconomic indicators, and produces financial statements. The information provided by higher-level information systems to company executives is valuable and unique to the company. It is also more related to the strategic direction and achievement of the company. Therefore, the higher-level systems are more likely to contribute to the firm performance.

Furthermore, the index above is better in measuring real usage and in cancelling out the cases in which the investment is made but the related assets are not being used. Devaraj and Kohli (2003) find that the link between IT investment and firm performance will be valid only if real usage is accounted for.

Part II: Complementary Resources

The second part of the questionnaire measured the level of other resources present in the company. It consisted of multiple 1 to 5 likert-scale questions asking the respondents their level of agreement with the statements provided. These statements concerned the availability of IT department HR skills and other complementary assets, hence two sets of resources hypothesized to deliver improved firm

performance if combined with IT infrastructure assets.

IT department human resource skills were categorized by four distinct set of skills: technical, analytical, managerial and interpersonal skills (Hoffer et al, 2001). Technical skills are necessary for technical aspects of work such as application programming, network management and maintenance. Analytical skills refer to the ability to identify cause and effect relationships manifested in system thinking, problem solving and organizational knowledge. Managerial skills convey the ability to fulfill a goal by combining limited resources, such as project management and risk management. Finally, interpersonal skills allow for effective communication in cases like teamwork and expectation management.

In this survey, IT department human resource skills were measured by 6 item scales for technical skills and 7 item scales for other three types of skills (Appendix B, Tables 13 through 16) using 1 to 5 likert-scale questions. The scales were adopted from (a) Byrd and Turner (2000) and reshuffled to match the 4-item categorization of Hoffer et al. (2001), and (b) others were added in line with the descriptions in Laudon and Laudon (2006) when necessary.

Other complementary resources, such as top management commitment, propensity for change, open organization, etc. were also measured with multiple 1 to 5 likert-scale items. The measurement items for all constructs were adopted from refined measurement scales in Powell and Dent-Micallef (1997) and are presented in Table 17 in Appendix B.

Part III: IS Capabilities

The third part aimed at measuring the extent to which the company possesses IT-based capabilities. These capabilities refer to the skills acquired through experimentation with and usage of existing IT-related resources. In this study, IT-based capabilities were measured in four dimensions: IS planning, system development, end-user IT support, and IS operations capabilities (Ravichandran and Lertwongsatien, 2005). IS planning capability was measured by a four item scale which looks at the degree of formality, level of participation and comprehensiveness of the ISs planning process. Systems development capability was related with the ability of the IT department to develop the planned systems in a formal, effective, and reliable manner. Accordingly, this construct was measured by a six item scale referring to the degree of formality, control, reliability and reusability. End-user IT support was defined as the support provided to the end-users by the IT department personnel in case of problems. It was measured by a five item scale looking at the attributes of the support process such as speed and quality of service, prioritization, and formality. The last construct, IS operations capability, was defined as the ability of IT department to meet the requirements of day-to-day systems operations. It was measured by a six item scale looking at automation, backup, security, and again, formality of the IS operations' procedures. All items here were adopted from Ravichandran and Lertwongsatien (2005) and measured by 1 to 5 likert-scales (Tables 18 through 21 in Appendix B).

Part IV: IT Support for Core Competencies

The fourth part measured IT support for core competencies. Ravichandran and Lertwongsatien (2005) defined IT Support for Core Competencies as 'the extent to which IT is used to support and enhance the development of a firm's market access, integrity-related and functionality related competencies' (p.250). IT support for market-access competency measures the degree to which information technologies are used to identify customer needs, tailor products/services and improve responsiveness, whereas IT support for integrity-related competency pertains to the degree to which information technologies are used to streamline key manufacturing, logistics and supply chain operations. Lastly, IT support for functionality-related competency measures the degree to which information technologies enhance new product development and innovation capacity of the organization. All three constructs were measured by multiple item scales adopted from Ravichandran and Lertwongsatien (2005) through 1 to 5 likert-scale questions The questionnaire items are presented in Table 22, 23 and 24 for market-access, integrity-related and functionality related competencies, respectively.

Part V: Firm Based Information

The last part had double objectives: (a) measuring the current firm performance (b) measuring control variables.

Firm performance was measured by respondents' subjective evaluations of last year's corporate performance. Corporate performance has two dimensions. Operating performance is related to traditional performance measures such as

profitability and productivity. It is also related to the performance assessment relative to the competitors. Market-access performance, on the other hand, measures how successful the organization has been in entering new markets and launching new products/services. These two constructs were measured by three and four item scales as in Ravichandran and Lertwongsatien (2005) using again 1 to 5 likert-scale questions. The measurement items measuring firm performance are listed in Table 25 and 26 in Appendix B.

The research design in this study controls for firm size, firm age and industry IT intensity in order to account for possible other factors which could have an effect on the dependent variable. Firm size is one such factor because large firms may possess slack resources which may help utilize IT more effectively than smaller firms can do (Grover et al., 1997). In the context of this study, it was measured by the logarithm of number of employees. The data was collected by asking the respondents the number of employees working in the company at the time of the questionnaire.

Firm age may indicate higher legitimacy, stronger interfirm relationships and maturity in internal processes. Also, the performance of the younger firms may be subject to the liability of newness (Hannan and Freeman, 1984). Age was measured by the number of years that passed since the foundation of the organization. Age data was collected by asking the respondents the number of years that passed since the inception of their company. Lastly, Industry IT Intensity will affect the value extracted from IT investments because in industries, where information is more intensely used, IT may have more of an effect on performance (Byrd et al., 2006). Industry IT intensity was measured by a three item scale presented in Table 27 in Appendix B.

Administration of the Questionnaire

The questionnaire was first applied to three IT executives in order to check for possible measurement problems. The respondents reported that, in general, the measurement items were easy to understand. Those items which led to confusion were revised. The average duration for response was recorded as 13.5 minutes.

After the pilot study, the questionnaire was sent to the IT executives via e-mail. For each e-mail sent, a return receipt was requested. The mails which returned with delivery failure due to incorrect email address were resent using other mail formats. An iterative approach was taken to ensure that all possibilities were accounted for.

The respondents who received the questionnaire but did not provide a response in two weeks received a reminder. The questionnaire was successfully sent to 181 IT executives; for 31 of whom the consecutive trials were returned with delivery failure. The number of responses received totaled 36 with a result rate of 19.89 percent. Two responses were left out due to missing data.

The respondents represent a wide spectrum of industries including apparel, finance, fast moving consumer goods, food & beverages, healthcare & pharmaceuticals, retail, telecommunications, and transportation. Seven of the respondents are IT Directors whereas 22 are department managers. The remaining seven respondents are managers of an IT function such as software, network, or project.

CHAPTER V

RESULTS

The statistical analysis of the research model was conducted in multiple steps. First, descriptive statistics for continuous variables were evaluated, then the multiple item scales were tested for validity by examining the individual items' loadings. Next, principal components of refined measurement items were created to be used as formative indicators of higher level latent variables. Finally, partial least squares (PLS) method was applied for hypothesis testing to analyze the research model. The details of these steps are provided in the following sections.

Descriptive Statistics for Continuous Variables

There are three scale variables in the research model: IT infrastructure, company age and size. The average IT infrastructure score is 0.595 with a standard deviation of 0.192. The descriptive statistics of IT infrastructure are listed in Table 5.

Table 5. Descriptive Statistics for IT Infrastructure Score (n=34)

Statistic	Value
Mean	0.595
Standard Deviation	0.192
Standard Error	0.033
Median	0.616
Mode	0.766
Sample Variance	0.037
Kurtosis	-0.618
Skewness	-0.363
Range	0.767
Minimum	0.128
Maximum	0.895

The average number of employees for the respondent companies was 1189. The standard deviation for the number of employees is 235.5. The mean for the firm age is 23.67 with a corresponding standard deviation of 17.9.

Scale Validation for Latent Variables

The scales were validated using the factor analysis method. A scale presents sufficient convergent validity if all of its items load highly on one factor. The loadings of all measurement items on their corresponding scales are reported in Appendix B. The items with loadings lower than 0.5 were removed from the scale, hence a total of four items have been removed from the analysis. The remaining scales were used in the next step, principal component analysis.

Principal Component Analysis of Latent Variables

Principal component analysis was conducted to come up with a single variable for each indicator of the latent variables. For example, 6 items were used to measure the level of technical skills which, in turn, was the formative indicator of higher-level latent variable IT department HR skills. The principal component of these 6 items were used as a single indicator of technical skills. The principal component analysis was necessary to reduce the complexity of the model.

In order for a principal component to represent enough variation among the variables, its eigenvalue must be greater than 1. All eigenvalues for formative indicators in this study were found to be higher than 1 as reported in Table 6.

Table 6. Eigenvalues for Principal Components of Latent Variables

INDICATOR	EIGENVALUE
IT Department HR Skills	
Technical Skills	3.485
Interpersonal Skills	3.695
Managerial Skills	4.183
Analytical Skills	3.530
Complementary Resources	
Process Redesign	1.650
Benchmarking	1.480
Teamwork	1.231
Top Management Commitment	1.528
Propensity for Change	1.258
Open Organization	1.481
IT-based Capabilities	
IS Planning	2.172
Systems Development	2.838
End-user IT Support	3.541
IS Operations	3.752
IT Support for Core Competencies	
IT Support for Market-Access Competencies	3.967
IT Support for Integrity-Related Competencies	2.943
IT Support for Functionality-Related Competencies	2.996
Firm Performance	
Market-Based Performance	2.068
Operating Performance	3.264

Analysis of the Research Model

The research model was tested using PLS technique which is generally used for the analysis of causal paths. PLS was developed to overcome the limitations of the better-known covariance-based Linear Structural Relation Systems (LISREL) approach (Hulland, 1999). Hulland (1999) reported that these limitations were large

sample size requirements and nonunique results. In other words, PLS is more suitable in cases where sample size is small.

PLS Technique

PLS is a component-based structural equation modelling (SEM) technique (Petter et al., 2007) and a PLS path model is composed of two models: a measurement model and a structural model (Tenenhaus et al., 2005). The measurement model relates the manifest variables to their latent variable. Manifest variables correspond to the measurement items manifesting an underlying latent, or unobservable, variable. They can be related to the latent variables in reflective or formative ways. In a reflective relationship, a change in the latent variable is hypothesized to result in a corresponding change in all the manifest variables. In a formative relationship, however, a change in the manifest variable causes a corresponding change in the latent variable. In this case, each manifest variable captures a different aspect of the latent variable (Petter et al., 2007). The structural model, on the other hand, relates the latent variables to other latent variables within the model and analyzes the hypothesized relationships.

In the research model of this study, there are five latent variables: IT department HR skills, complementary assets, IT-based capabilities, IT support for core competencies, and firm performance. The relationships between the latent variables and their manifest variables are formative. Table 7 provides a list of latent variables and their corresponding formative indicators.

Table 7. Latent Variables and Their Formative Indicators

Latent Variable	Formative Indicators
IT department HR skills	Technical, analytical, managerial, interpersonal skills
Complementary assets	Top management commitment, open organization, propensity for change, business process redesign, benchmarking, teamwork
IT-based capabilities	IS planning, systems development, end-used IT support, IS operations
IT support for core competencies	IT support for market access, integrity-related and functionality-related competencies
Firm Performance	Operating and market-based performance

Figure 6 illustrates an example for the overall PLS methodology followed in the study. It lays out the process in three steps with their respective statistics of interest (in brackets). In the example, the first step consists of creating the principal components of individual scale items to be used as a single variable reflecting technical HR skills. Combined with the principal components of other three types of skills, they constitute the formative indicators for the higher level latent variable IT department HR skills (step 2). The structural model of PLS algorithm, in turn, relates these higher level constructs to each other as designed in the model. In the overall methodology, the first and second steps are omitted for variables such as IT infrastructure, organizational size and age because they are continuous variables reflecting their variable in isolation.

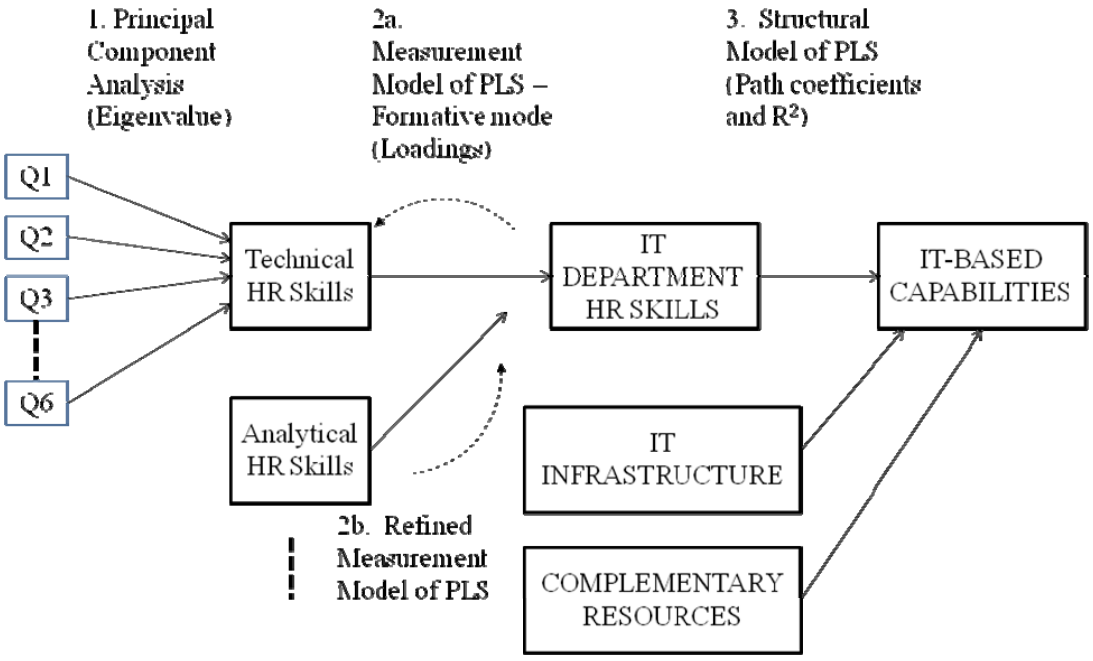

Figure 6. The illustration of the methodology followed

PLS Findings

In this study, the PLS model was analyzed using PLS-Graph 3.0 both for the measurement model and the structural model and the findings of this analysis are explained in the following sections.

The Measurement Model of PLS

The measurement model, also known as the outer model, relates the manifest variables to their corresponding latent variables. In this study, the measurement model relates the formative indicators (e.g. technical, analytical, managerial skills) to the higher level latent variables (e.g. IT department HR skills). The resulting statistic of interest is, again, the loadings. Similar to the scale validation process explained

above, a formative indicator is required to have a loading higher than 0.5 to present enough validity.

Table 8. Results of the Measurement Model

Formative Indicators	Original Model Loadings	Refined Model Loadings
IT Department HR Skills		
Technical Skills	0.6751	0.8331
Interpersonal Skills	0.7408	0.8812
Managerial Skills	0.3957	Dropped
Analytical Skills	0.3418	Dropped
Complementary Resources		
Process Redesign	0.7800	0.8323
Benchmarking	0.8011	0.8523
Teamwork	0.5453	0.5700
Top Management Commitment	0.3409	Dropped
Propensity for Change	-0.0757	Dropped
Open Organization	-0.2102	Dropped
IT-based Capabilities		
IS Planning	0.6755	0.6609
Systems Development	0.8384	0.8037
End-user IT Support	0.7497	0.7667
IS Operations	0.9139	0.9289
IT Support for Core Competencies		
IT Support for Market-Access Competencies	0.9177	0.9222
IT Support for Integrity-Related Competencies	0.6591	0.6377
IT Support for Functionality-Related Competencies	0.7228	0.7322
Firm Performance		
Market-Based Performance	0.9598	0.9590
Operating Performance	0.7719	0.7737

Table 8 depicts the loadings for all formative indicators. Using the results of the measurement model, the PLS model was refined by dropping the formative indicators with loadings lower than 0.5. Five of nineteen indicators had loadings lower than 0.5, and therefore, were excluded from the next analysis, the structural model.

Another outcome of the measurement model is composite reliability. The reliability statistics for the refined model are depicted in Table 9 below. Composite reliability is a measure developed by Fornell and Larcker (1981) for PLS modeling and is required to be greater than 0.7 (Nunnally, 1978). All latent variables in the measurement model were found to present sufficient reliability.

Table 9. Reliability Statistics for the Measurement of Latent Variables

Latent Variable	Composite Reliability
IT Department HR Skills	0.847
Complementary Resources	0.802
IT-based Capabilities	0.872
IT Support for Core Competencies	0.813
Firm Performance	0.862

The Structural Model of the PLS

The structural model looks at the causal paths, the relationships between the latent variables. The statistics of interest are (a) path coefficients and (b) R-squares. The results of the structural model are presented in Figure 7.

The model explains 48.1 percent of variance in IT-based capabilities, 25.8 percent of variance in IT support for core competencies, and 52.1 percent of variance in firm performance.

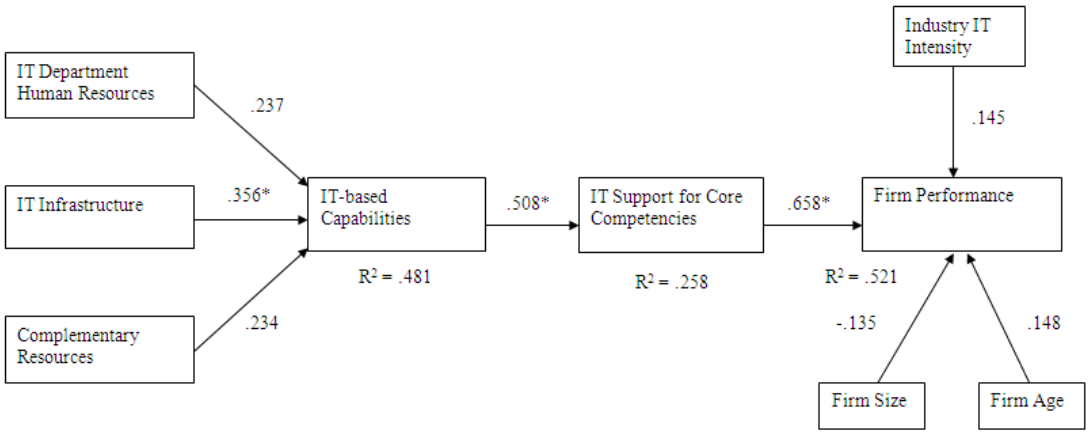

Figure 7. The results of the structural model

The t-statistics of path coefficients in Table 10 showed that three of five coefficients of the hypothesized relationships were statistically significant. T-statistics imply statistical significance for the coefficients and are required to be greater than 2. T-statistics were generated using bootstrapping, a significance assessment technique. Bootstrapping involves resampling with replacement from the original sample. As suggested in Tenenhaus et al. (2007), 200 resamples were used for bootstrapping in this study.

Table 10. Significance of Path Coefficients

Path	Coefficient	Standard Error	T-Statistic
IT Department HR – IT-based Capabilities	.237	0.2041	1.1612
IT Infrastructure – IT-based Capabilities	.356	0.1458	2.4422
Complementary Resources – IT-based Capabilities	.234	0.1747	1.3392
IT-based Capabilities – IT Support for Core Competencies	.508	0.1658	3.0640
IT Support for Core Competencies – Firm Performance	.658	0.2012	3.2704
Industry IT Intensity – Firm Performance	.145	0.1887	0.7684
Firm Size – Firm Performance	-.135	0.1498	0.9014
Firm Age – Firm Performance	.148	0.1163	1.2726

The coefficients which are statistically significant are depicted with an asterisk in the Figure 7. Accordingly, the relationships between (a) IT infrastructure and IT-based capabilities, (b) IT-based capabilities and IT support for core competencies, and (c) IT support for core competencies and firm performance are positive and significant. Hence, the findings support Hypothesis 1a, Hypothesis 2 and Hypothesis 3. The relationship between IT department HR skills and IT-based capabilities turned out to be positive as hypothesized, yet the coefficient was statistically insignificant. Similarly, the relationship between complementary resources and IT-based capabilities was found to be positive, yet again statistically insignificant. Therefore, no support was found for Hypothesis 1b and Hypothesis 1c. Overall, support was found for three out of five hypotheses of the study. Coefficients of control variables were found to be statistically insignificant.

The breakdown of explained variance in firm performance can be inferred as in Ravichandran and Lertwongsatien (2005) using the results of "control variables only model" and "theoretical variables only model". The breakdown is shown in Table 11.

Table 11. Breakdown of Explained Variance in Firm Performance

	Full Model	Control Variables Only Model	Theoretical Variables Only Model
Total number of paths	8	3	5
Number of significant paths	3	1 (Age)	3
Variance explained in firm performance	52.1 %	15.4 %	47.1 %
Additional variance explained by the theoretical variables	36.7 % (= 52.1% - 15.4%)		
Additional variance explained by the control variables	5 % (= 52.1% - 47.1%)		

In the full model, there are eight paths, five of which depict the relationships among theoretical variables of interest. The remaining three paths represent the relationships between firm performance and three control variables. The PLS Model can be futher analyzed by seperating the full model into two models: one with theoretical variables only and another one with control variables only.

This study presented five hypotheses corresponding to the five paths in the full model. The results of both the full model and theoretical-variable-only model showed that three of five coefficients were statistically significant, corresponding to Hypotheses 1a, 2 and 3. In the control-variables-only model, only the coefficient for firm age was found to be statistically significant, which, however, turned out to be statistically insignificant in the full model. All the paths between control variables and firm performance were statistically insignificant in the full model.

The variance explained in the control-variables-only model was 15.4 percent. Given that the variance explained in the full model was 52.1 percent, one can conclude that the theoretical variables explained an additional variance of 36.7 (52.1% - 15.4%) percent. This shows that the theoretical variables contributed more to the model than the control variables. A similar conclusion can be drawn by starting with the theoretical-variables-only model. This model alone explains 47.1 percent of variance in firm performance. Hence, the control variables, when added in the full model, explain an additional variance of only 5 (52.1% - 47.1%) percent.

CHAPTER VI

CONCLUSION

Resource-based view informs our understanding of IT business value by stressing the valuable, rare and inimitable resources (Barney, 1991). Given the fact that information technologies are increasingly available in the market for every actor, the question remains for the academics to discover the process through which IT can be leveraged to build firm-specific capabilities that support firm strategy.

This study accounted for two main factors in IT business value creation process. First, the study modeled an extended combination of resources suggested in the literature complementing IT infrastructure. These include various aspects of human resources as well as other organizational resources. The complementarity among these resources increases the likelihood of firm specificity and decreases that of competitive duplication which, in turn, allows for sustained competitive advantage. The study finds support for the hypothesis that IT infrastructure is a necessary factor for capability building. However, it fell short of finding significant results for HR and complementary assets, although the coefficients imply a positive relationship.

The second factor the study accounted for is the process through which IT investments are aligned with corporate strategy. The study hypothesized positive relationships between IT capability and IT support for core competencies as well as between IT support for core competencies and firm performance. Even after controlling for industry IT intensity, organizational size and age, the findings strongly supported these hypotheses. Therefore, one can conclude that it is the

process of continuous leveraging of resources for capability building that leads to performance differentials.

The study provided partial support for resource-based arguments and was not free from limitations. The major limitation was the small data set. Although considerable effort was put on data collection, the response rate stalled at around 20 percent. This was partly overcome by choosing the appropriate methodology –PLS Modeling. However, a larger data set would provide more consistent results.

Another limitation concerns the measurement which can still be improved. The IT infrastructure score proposed here can be supplemented by monetary investment levels. However, there is no such data publicly available in Turkey, and companies are reluctant to provide that information.

In addition, the measurement of firm performance in this study was subjective. Again, it is very difficult to collect objective performance data for companies not listed in stock exchange.

Final limitation stems from the nature of the data. Cross-sectional data implies association but not causality. Therefore, the question remains open if the relationships present in this study will be sustained over time.

This study offered implications for future research. It should be complemented with comprehensive data sets and objective measurements. Second, the relationships should be checked for robustness across industries and over time. Furthermore, although the coefficient for relationship between IT-based capabilities and IT support for core competencies was positive and statistically significant, the variance explained in IT support for core competencies was relatively low which leaves room for futher theoretical contribution. Additional theoretical variables, such as end-user resistance and availability of slack resources, might moderate the

relationship between IT-based capabilities and IT support for core competencies. Lastly, the model explained more than 50 percent of variation in firm performance. Although this is considered a relatively high percentage, there is still room for researchers to reveal the rest. Other theoretically interesting factors need to be discovered and included in IT business value analysis.

Finally, the results bear implications for management. The findings shed light upon the process through which managers can create value from their IT investments. Managers must be aware that stand-alone IT investments are less likely to deliver business value. These investments must be leveraged to build IT-based capabilities. There is no doubt that the level of IT investment contributes significantly to IT-based capability building, however, the link to improved firm performance is indirect: these capabilities need to be used to support the competence areas of the company. In other words, the IT strategy must be aligned with the overall firm strategy.

On the other hand, the study did not support the wide-spread suggestion that IT investments need to be complemented with other resources such as corporate culture and human resource skills. However, conclusion must be made carefully here because the theory about complementarity is rather strong. The insignificant results may be due to the sample size or measurement problems.

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APPENDIX A

SOFTWARE

Table 12. List of Sofware, Corresponding Levels and Functions

INFORMATION SYSTEM FUNCTION	OPERATIONAL LEVEL (Level 1)	MIS &DSS LEVEL (Level 2)	ESS LEVEL (Level 3)
Sales	Order Processing	Sales Management Regional Sales Analysis Customer Relations Management (CRM)	5-year Sales Trend Forecasting
Manufacturing	Plant Scheduling Material Movement Control Machine Control	Inventory Control Production Scheduling	5-year Operating Plan
Finance	Cash Management Securities Trading	Annual Budgeting Cost Analysis	5-year Budget Forecasting
Accounting	Payroll Accounts Payable/Receivable	Capital investment analysis Pricing, Profitability Analysis	Profit Planning
Human Resources	Compensation Employee Record Keeping Training & Development	Relocation Analysis Contract Cost Analysis	Manpower Planning
Other	Document Management Quality Assurance Workflow Corporate Portal (Intranet) E-commerce Platform, Extranet Groupware	Knowledge Management Data Mining	

APPENDIX B.

MEASUREMENT ITEMS

Table 13. Factor Analysis of IT Department Technical Skills

ITEM	LOADING
Our IT Personnel is skilled in multiple programming languages	0.6330
Our IT Personnel is skilled in multiple microcomputer operating systems	0.7345
Our IT Personnel is skilled in distributed processing or distributed computing	0.8675
Our IT Personnel is skilled in network management and maintenance	0.7319
Our IT Personnel is skilled in developing Web-based applications	0.8186
Our IT Personnel is skilled in data warehousing, mining, or marts	0.7399

Table 14. Factor Analysis of IT Department Analytical Skills

ITEM	LOADING
Our IT Personnel has the ability to identify the inputs, outputs and the boundaries of our information systems.	0.8228
Our IT Personnel has the ability to understand our organization's policies and plans.	0.7668
Our IT Personnel has the ability to identify the gaps between the current and desired situations.	0.7682
Our IT Personnel has the ability to identify the interdependencies between information and organizational systems.	0.8348
Our IT Personnel has the ability to learn about other business functions.	0.5830
Our IT Personnel has the ability to interpret business problems and develop appropriate technical solutions	0.7748
Our IT personnel are knowledgeable about the environmental constraints within which the organization operates (e.g. competition, regulation)	-

Table 15. Factor Analysis of IT Department Managerial Skills

ITEM	LOADING
Our IT Personnel has the ability to accomplish multiple assignments.	0.6128
Our IT Personnel has the ability to plan, organize, and lead projects.	0.9435
Our IT Personnel has the ability to identify risks of IS projects.	0.8007
Our IT Personnel has the ability to predict resource usage and track resource consumption.	0.8659
Our IT Personnel has the ability to use project management tools (e.g. MS Project, Primavera, Timeline) and techniques (e.g. PERT, CPM, GANTT).	0.7141
Our IT Personnel has the ability to Create action plans and taking necessary measures to minimize risks	0.8293
Our IT Personnel has the ability to Deal with resistance to change.	0.5612

Table 16. Factor Analysis of IT Department Interpersonal Skills

ITEM	LOADING
Our IT Personnel has the ability to work closely with clients	0.7143
Our IT Personnel has the ability to work cooperatively in a project team environment	0.8165
Our IT Personnel has the ability to work well in cross-functional teams	0.8471
Our IT Personnel has the ability to communicate a realistic view of the developed systems	0.7954
Our IT Personnel has the ability to write clear, concise, and effective memos, reports, and documentation	0.6918
Our IT Personnel has the ability to plan and execute work in a collective environment	0.5796
Our IT Personnel has the ability to identify and reject impracticable development requests.	0.5223

Table 17. Factor Analysis of Complementary Resources

ITEM	LOADING
Top Management Commitment:	
Our top executives have clearly communicated their commitment to information technology.	0.8566
Our top executives have championed information technology within the company.	0.9104
Open Organization	
We have very little formal bureaucracy.	0.7856
Our people are open and trusting with one another.	0.7376
Written and oral communications are very open, informal, and interactive.	0.5109
Propensity for Change	
In general, our people accept change readily.	0.9600
We have had difficulties fitting information technologies within our company culture.	0.5077
Business Process Redesign	
We have an overall business plan to redesign some of our key processes.	0.8989
Improving company processes has become a key part of our business plan.	0.8803
Benchmarking	
We actively research for the best information technology practices of other companies.	0.9169
We devote time to analyze other companies' IT strategies	0.8271
Teamwork	
We frequently use cross-departmental teams to solve key problems	0.7367
Collaboration is encouraged among business units in our company.	0.8614

Table 18. Factor Analysis of IS Planning Capabilities

ITEM	LOADING
IS Planning is initiated by senior management; senior management participation in IS Planning is high.	0.5511
We have formalized methodology for IS Planning.	0.9377
Our Planning methodology has many guidelines to ensure that critical business, organizational, and technological issues are adressed in evolving an IS Plan.	0.9071
Business Units' participation in the IS planning process is very low.	-

Table 19. Factor Analysis of System Development Capabilities

ITEM	LOADING
Our systems development process has matured, is well defined and documented.	0.6857
Our systems development process is continuously improved using formal measurement and feedback systems.	0.7164
Our systems development process can be easily adapted to different types of development projects.	0.8168
Our systems development process has adequate controls to achieve development outcomes in a predictable manner.	0.8936
Our systems development process is flexible to allow quick infusion of new development methodology, tools, and techniques.	0.6106
Our systems development process facilitates reuse of software assets such as programs, design, and requirement specifications.	-

Table 20. Factor Analysis of End-User IT Support Capabilities

ITEM	LOADING
We have clear guidelines on how to prioritize service requests from users.	0.6613
We have well-defined service quality criteria for all IS support tasks	0.8915
We have established service level agreements with all user groups for IS Support.	0.8629
We have appropriate performance standards to monitor IS service quality	0.9164
We have sophisticated systems to record, track, and respond to service requests.	0.8249

Table 21. Factor Analysis of Information Systems Operations Capabilities

ITEM	LOADING
We have automated most systems operation tasks; very little manual intervention is required to run our computer systems.	0.7147
We have detailed procedures for responding to unplanned system outages	0.8370
We use automated tools to monitor and fine-tune the performance of our computer systems, networks, databases, and telecommunication infrastructure	0.7138
Backup procedures are strictly enforced in all our data centers.	0.7599
We periodically do mock trials to test our disaster recovery plans.	0.7980
We continuously review our security systems and procedures to assess our vulnerability	0.8788

Table 22. Factor Analysis of Market-Access Competencies

ITEM	LOADING
We use our information systems for enhancing the responsiveness to customer service requests	0.8617
We use our information systems for providing necessary information to customers	0.8646
We use our information systems for identifying groups of customers whose needs are not being met.	0.8253
We use our information systems for determining customer requirements (i.e. Products, preference, pricing, and quantity)	0.7631
We use our information systems for tailoring the products/services to match customers' needs	0.8116
We use our information systems for fulfilling customer demand online (through e-business platforms).	0.7160

Table 23. Factor Analysis of Integrity-Related Competencies

ITEM	LOADING
We use our information systems for reengineering business processes	0.8186
We use our information systems for enhancing business process flexibility	0.8410
We use our information systems for integrating the firm's supply chain	0.5782
We use our information systems for integrating internal business units	0.6902
We use our information systems for increasing the speed of logistic activities	0.8321

Table 24. Factor Analysis of Functionality-Related Competencies

ITEM	LOADING
We use our information systems for developing new products/services	0.6776
We use our information systems for improving the speed of product development	0.7222
We use our information systems for improving the speed of product/service delivery	-
We use our information systems for improving the speed of responding to business opportunities/threats	0.5104
We use our information systems for identifying new market segments	0.6562
We use our information systems for redefining the scope of our business	0.7451
We use our information systems for entering new markets	0.7242

Table 25. Factor Analysis of Market Performance

ITEM	LOADING
We have entered new markets very quickly.	0.7771
We have brought new products and services to the market faster than our competitors.	0.8822
The success rates of our new products and services have been very high.	0.8268

Table 26. Factor Analysis of Operating Performance

ITEM	LOADING
Our productivity has exceeded that of our competitors.	0.8160
Our profit has exceeded that of our competitors.	0.9298
Our financial performance has been outstanding.	0.9176
Our financial performance has exceeded that of our competitors.	0.9440

Table 27. Factor Analysis of Industry IT Intensity

ITEM	LOADING
IT is used extensively by our competitors	0.8512
IT is used extensively by our suppliers and business partners.	0.7270
IT is a critical means to interact with customers in this industry.	0.8799

APPENDIX C

APPROVAL FOR THE ADOPTION OF RESEARCH MODEL

----- Original Message -----
From: "Ravichandran, T." <ravit@rpi.edu>
To: <birgul.arslan@boun.edu.tr>
Sent: Tuesday, August 28, 2007 2:17 PM
Subject: RE: Permission Request

Dear Birgul:

Thanks for your note and interest in my work. Please do feel free to adapt my published work for your on-going research. It is through such cumulative work we build a solid body of knowledge in any area. I would be interested in your adaptations and would appreciate if you could send me an overview of your research when it is ready.

Thanks,

ravi

T. Ravichandran, Ph.D
Associate Professor, Information Systems and Operations Management
Lally School of Management & Technology
RPI, Troy, NY 12180
Tel: 518.276.2035

APPENDIX D

THE QUESTIONNAIRE

PART I. IT INFRASTRUCTURE

Please fill the third column with Y (yes) if the related software is currently in use in your company, otherwise please fill with N (no). If you do not know the availability of an application please leave the column blank. If any software mentioned below is inapplicable to your company (e.g plant scheduling is unapplicable to a financial institution), please indicate it with the letter 'X' in the third column.
AVAILABILITY: Y(yes) N(No) X(Inapplicable) Blank(I don't know)

(1) Business Function	*(2) Functional Software*	*(3) Availability*
Sales & Marketing	Order Processing	
	Sales Management	
	Regional Sales Analysis	
	Customer Relations Management (CRM)	
	Long-term (3-5 years) Sales Trend Forecasting	
Manufacturing	Plant Scheduling	
	Material Movement Control	
	Machine Control	
	Inventory Control	
	Production Scheduling	
	Long-term (3-5 years) Operating Plan	
Finance	Cash Management	
	Securities Trading	
	Annual Budgeting	
	Cost Analysis	
	Longterm (3-5 years) Budget Forecasting	
Accounting	Payroll	
	Accounts Payable/Receivable	
	Capital investment analysis	
	Pricing, Profitability Analysis	
	Long-term Profit Planning	
Human Resources	Compensation	
	Employee Record Keeping	
	Training & Development	
	Relocation Analysis	
	Contract Cost Analysis	
	Long-term Manpower Planning	
Other	Document Management	
	Knowledge Management	
	Quality Assurance	
	Workflow	
	Corporate Portal (Intranet)	
	E-commerce Platform, Extranet	
	Groupware	
	Data Mining	

PART II. HUMAN AND COMPLEMENTARY RESOURCES

Please indicate your level of agreement with the following statements by filling the boxes with 'X'.

1: Strongly Disagree 2: Disagree 3. Neutral 4. Agree 5. Strongly Agree

Our IT Personnel are skilled in……..	1	2	3	4	5
Multiple programming languages					
Multiple microcomputer operating systems					
Network management and maintenance					
Developing Web-based applications					
Decision Support Systems					
Data warehousing, mining, or marts					

Our IT Personnel have the ability to……..	1	2	3	4	5
- Identify the inputs, outputs and the boundaries of our information systems.					
- Understand our organization's policies and plans.					
- Identify the gaps between the current and desired situations.					
- Identify the interdependencies between information and organizational systems.					
- Learn about other business functions.					
- Interpret business problems and develop appropriate technical solutions					
- Our IT personnel are knowledgeable about the environmental constraints within which the organization operates (e.g. competition, regulation)					

Our IT Personnel have the ability to……..	1	2	3	4	5
- Accomplish multiple assignments.					
- Plan, organize, and lead projects.					
- Identify risks of IS projects.					
- Predict resource usage and track resource consumption.					
- Use project management tools (e.g. MS Project, Primavera, Timeline) and techniques (e.g. PERT, CPM, GANTT).					
- Create action plans and taking necessary measures to minimize risks.					
- Deal with resistance to change.					

Our IT Personnel have the ability to……..	1	2	3	4	5
- Work closely with clients					
- Work cooperatively in a project team environment					
- Work well in cross-functional teams					
- Communicate a realistic view of the developed systems					
- Write clear, concise, and effective memos, reports, and documentation					
- Plan and execute work in a collective environment					
- Identify and reject impracticable development requests.					

In our company, ……..	1	2	3	4	5
Our top executives have clearly communicated their commitment to information technology.					
We have an overall business plan to redesign some of our key processes.					
In general, our people accept change readily.					
We have very little formal bureaucracy.					
We actively research best information technology practices of other companies.					
We frequently use cross-departmental teams to solve key problems					
Improving company processes has become a key part of our business plan.					
We have had difficulties fitting information technologies within our company culture.					
Our people are open and trusting with one another.					
We devote time to analyze other companies' IT strategies					
Collaboration is encouraged among business units in our company.					
Our top executives have championed information technology within the company.					
Written and oral communications are very open, informal, and interactive.					

PART III. INFORMATION SYSTEMS FUNCTIONS

Please indicate your level of agreement with the following statements by filling the boxes with 'X'.

1: Strongly Disagree 2: Disagree 3. Neutral 4. Agree 5. Strongly Agree

IS Planning	1	2	3	4	5
IS Planning is initiated by senior management; senior management participation in IS Planning is high.					
We have formalized methodology for IS Planning.					
Our Planning methodology has many guidelines to ensure that critical business, organizational, and technological issues are adressed in evolving an IS Plan.					
Business Units' participation in the IS planning process is very low.					

Our systems development process……..	1	2	3	4	5
Has matured, is well defined and documented.					
Is continuously improved using formal measurement and feedback systems.					
Can be easily adapted to different types of development projects.					
Has adequate controls to achieve development outcomes in a predictable manner.					
Is flexible to allow quick infusion of new development methodology, tools, and techniques.					
Facilitates reuse of software assets such as programs, design, and requirement specifications.					

IT Support	1	2	3	4	5
We have clear guidelines on how to prioritize service requests from users.					
We have well-defined service quality criteria for all IS support tasks					
We have established service level agreements with all user groups for IS Support.					
We have appropriate performance standards to monitor IS service quality					
We have sophisticated systems to record, track, and respond to service requests.					

System Operations	1	2	3	4	5
We have automated most systems operation tasks; very little manual intervention is required to run our computer systems.					
We have detailed procedures for responding to unplanned system outages					
We use automated tools to monitor and fine-tune the performance of our computer systems, networks, databases, and telecommunication infrastructure					
Backup procedures are strictly enforced in all our data centers.					
We periodically do mock trials to test our disaster recovery plans.					
We continuously review our security systems and procedures to assess our vulnerability					

PART IV. IT USAGE FOR BUSINESS PROCESSES

Please indicate your level of agreement with the following statements by filling the boxes with 'X'.

1: Strongly Disagree 2: Disagree 3. Neutral 4. Agree 5. Strongly Agree

We use our Information Systems for……..	1	2	3	4	5
Enhancing the responsiveness to customer service requests					
Providing necessary information to customers					
Identifying groups of customers whose needs are not being met.					
Determining customer requirements (i.e. Products, preference, pricing, and quantity)					
Tailoring the products/services to match customers' needs					
Creation of customer awareness through online tools (e-marketing)					
Reengineering business processes					
Enhancing business process flexibility					
Integrating the firm's supply chain					
Integrating internal business units					
Increasing the speed of logistic activities					
Developing new products/services					
Improving the speed of product development					
Improving the speed of product/service delivery					
Improving the speed of responding to business opportunities/threats					
Identifying new market segments					
Redefining the scope of our business					
Entering new markets					

PART V. FIRM AND INDUSTRY

Please indicate your level of agreement with the following statements by filling the boxes with 'X'.

1: Strongly Disagree 2: Disagree 3. Neutral 4. Agree 5. Strongly Agree

Last year, …….	1	2	3	4	5
We have entered new markets very quickly.					
We have brought new products and services to the market faster than our competitors.					
The success rates of our new products and services have been very high.					
Our productivity has exceeded that of our competitors.					
Our profit has exceeded that of our competitors.					
Our financial performance has been outstanding.					
Our financial performance has exceeded that of our competitors.					
IT is used extensively by our competitors					
IT is used extensively by our suppliers and business partners.					
IT is a critical means to interact with customers in this industry.					