Prologue

ABSTRACT

As attention to IT increases and society becomes more knowledge intensive, IT valuation will become a subject of great focus. New IT emerges rapidly as technological, societal, and competitive pressures push firms to transform and innovate themselves. New IT will shape our daily lives, jobs and firm structure, inter-firm relationships, and the industry in different ways from what it has been so far. Because of the potential benefits and costs created by IT, firms need to carefully assess every IT opportunity and threat to ensure that their resources are spent judiciously. This paper reviews the existing IT value research from IT justification, IT valuation, and business process perspectives. This paper also provides a basis for enhancing our understanding of IT value creation and measurement, and maximizing the value of IT-based business systems. A future research direction is also discussed.

INTRODUCTION

Increased competition, customer-centered market, and IT advances have rapidly changed the ways firms operate their businesses. These changes have driven firms to cut costs, enhance product/service quality, and redesign their business processes. Knowledge-intensive business organizations are utilizing IT to create new knowledge, store knowledge, share information, and facilitate inter- and intra-organizational collaboration. The timing and magnitude of new technology adoption and process redesign have become more critical than before as most firms strive to gain and sustain their competitive advantage.

In the past decade, e-commerce has revolutionized our society. E-commerce has created highly competitive market environments across all industries and contributed to the emergence of new business models and the demise of old business models. E-commerce pushed traditional firms to integrate e-commerce into the existing business models and to tightly digitize business processes. Leading click and mortar companies have tightly integrated front-end online order process systems with back-end support systems to minimize the discontinuity in the order fulfillment process. According to Jupiter Research (2006), the U.S. residents will increase their online spending for retail products and services at a 12% annual average through the end of 2010. Americans bought goods and services worth $81 billion from online retailers in 2005, and the online sales are expected to reach $144 billion in 2010.

Business systems management is a process of identifying IT, developing information systems, and managing information systems infrastructure to achieve business objectives. In this era of e-commerce and digital economy, business systems get more attention from senior management as a potential weapon for their sustainability and competitive advantage. As the business environment gets more dynamic,

complex, and competitive, senior managers scrutinize the resource productivity more closely, and IT managers often compete with other functional managers to secure the required IT budget. As IT advances continue to open new opportunities and challenges for firms, the fundamental questions for IT managers to answer are whether IT can create a value that will justify its investment, and how the IT value can be measured.

Despite preponderant interests from industries, IT valuation methods have not been fully established, and measuring IT value has been elusive for IT researchers and managers. Traditionally, accounting and financial methods have been widely used to assess the value of projects. Return on investment, net present value, and payback period methods are classic in accounting and financial literature. However, the traditional accounting and financial methods have played a limited role in justifying the IT investment opportunities, because many of its benefits are non-quantifiable. Therefore, most studies have investigated ways of justifying and measuring IT business value beyond financial benefits (Lee, 2004).

In the early 90s, because of intensive global competition and a decline in the US industry's competitiveness, business process reengineering (BPR) drew manager's attention as a potential breakthrough for achieving competitiveness. The benefits obtained from BPR often cited in the literature include faster cycle time, reduced resource waste, improved productivity, enhanced customer service, and heightened competitive advantage.

Many studies reported that in managing business systems, BPR is one area where business strategy and IT have played a crucial role in generating potential value (Broadbent et al, 1999; Davenport, 1993; Hammer, 1990 & 2000; Ray et al., 2004). Some firms have reported significant productivity gains by integrating IT into their core business processes. Among successful examples of IT integration with BPR are Wal-Mart just-in-time inventory control systems with EDI and satellite network systems, Pfizer's web-based new product document management systems, Frito Lay's purchasing management systems with handheld scanning devices, and Dell Computer's supply chain management systems with web-based technologies. BPR has been further facilitated with ERP, CRM, and e-commerce applications (Ho, et al., 2004; Kotorov, 2003).

In light of the ongoing debate on the measurement methods and tools for IT valuation, this study will give an overview of existing studies and present a future direction for researchers and practitioners. Our paper proceeds with a literature review in Section 2 and a future direction for IT valuation and BPR research in Section 3.

LITERATURE REVIEW

Forrester research (Bartels, 2004) predicted that spending on IT goods, services, and staff will grow 7% in 2005 and continue at a similar pace through 2008, which is slightly faster than overall economic growth. According to IDC (2007), worldwide end users spent $1.16 trillion on IT in 2006 and will increase IT spending at a compound annual growth rate (CAGR) of 6.3% to reach $1.48 trillion in 2010. These statistics suggest that IT has become one of the most important cost drivers in business operations, thus IT investment deserves special attention from management. Large and small, many businesses have agreed that they should capitalize on business opportunities through the deployment of new IT such as e-business and m-commerce applications. On the other hand, another recent survey has sent alarming signals to IT professionals and researchers of a declining annual IT investment growth rate and a rapidly declining confidence of senior management in IT value (Martin, 2007).

The main purpose of IT value research is to develop theories and measurement tools that will help managers apply knowledge gained from the research to make an investment decision and to enhance the IT value. The term 'IT business value' is commonly used to measure the organizational performance of IT, which includes cycle time reduction, productivity improvement, profitability improvement, cost reduction, customer surplus, competitive advantage, sustained competitive advantage, inventory reduction, market share, and other metrics of performance (Hitt and Brynjolfsson 1996; Mata, et al., 1995; Melville et al., 2004).

Definition of IT

Information Technology Association of America (ITAA) defined IT as "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware (wikipedia, 2008)." Researchers in information systems area have developed diverse views of IT, extending a widely accepted view of IT which includes hardware, software, supporting services, and infrastructure that are used to store, convert, process, retrieve, and securely transmit data and information. Observing that IT researchers have not engaged deeply in IT studies, Orlikowski and Iacono (2001) presented five conceptualizations of IT as a base for future theoretical research: (1) tool view, (2) proxy view, (3) ensemble view, (4) computational view, and (5) nominal view. The tool view regards IT as an engineered tool that does what its designers intended such as labor substitution, productivity, information processing, and social relations tools. In the proxy view, IT is conceptualized by one or a few key elements in common that are understood to represent the essential aspects or properties of IT which can be captured by individual perceptions of its usefulness or value, the diffusion rates, or dollars spent. The ensemble view focuses on the interaction of people and technology in both the development and use of IT. The research concerning this view regards IT as development project, development network, embedded systems, and structure. The computational view concentrates on the computational power of the IT and focuses on algorithm and systems development and testing as well as modeling and simulation. Finally, the nominal view invokes IT in name but not in fact. Examples of the nominal view include computer security and outsourcing practices. Understanding how IT has been conceptualized provides a firm foundation of IT business value research. The definition of IT sets the scope and granularity of IT valuation. IT value has been measured at different levels: individual, process, business unit, firm, network of firms, industry, and economy. Depending on the purpose and level of analysis, different metrics of IT value have been developed. In the following, two major IT valuation approaches are discussed: *ex ante IT justification* and *ex post IT valuation*.

IT Valuation: Ex Ante IT Justification Methods

While most studies have focused on the ex post evaluation of IT value, a number of studies have focused on ex ante IT project justification methods and specialized tools that can be used to predict and analyze IT investment benefits and costs. Most IT justification studies pointed out the limitations of traditional capital budgeting methods in measuring the true value of IT (Clemons, 1991; Kumar, 2004). Consequently, many IT investments are based upon "gut feelings" or "intuition," rather than quantifiable criteria (Dos Santos, 1991). However, given the financial impacts of IT investments and tight budgetary constraints, it is essential for IT managers to clearly understand whether their investments are financially justifiable, and likely to yield sufficient benefits or fail.

To investigate how organizations make IT investment decisions and how they should, Bacon (1992) conducted a survey of 80 major companies in four countries: the United States, Britain, Australia, and

New Zealand. He found that discounted cash flow (DCF) methods are the most widely used investment criteria for IT projects. The survey findings indicate that there exists a need to close a gap between practice and research, since many researchers do not recommend DCF methods, but practitioners prefer to use them most.

On the other hand, a recent study of 130 senior executives from large companies that spend an average of $230 million annually revealed a strikingly different picture of IT investment practices from the above-mentioned Bacon's study. This study reported that 51% of respondents have no process to evaluate IT investments against business strategy; 68% do not compare their IT projects' benefits to original targets; 74% do not track financial metrics after making an investment decision; and 80% lack the necessary financial skills (Chabrow, 2003). The lack of necessary measurement and analysis skills by the senior executives potentially leads to misalignment of IT and business strategies, over- or under-investment, inopportune investment, and eventually the lowered profit and productivity and decreased IT investments. The implications of this survey results are significant as the executives are the ultimate sponsor and champion of IT projects. In light of the significant lack of IT valuation knowledge by the senior executives, IT researchers and professionals urgently need to develop an education program to deliver executives the needed knowledge and skill sets.

Clemons (1991) suggested that managers take into account such factors as tangible and intangible benefits and costs of undertaking the program, the risks of proceeding with the program, expected competitive impact, and possible partnership with competitors. Business functions finance the IT projects, and the involvement of the relevant business functions in translating non-quantifiable benefits into monetary value was suggested by Tiernan and Peppard (2004). In addition to the above-mentioned IT justification approaches, more theoretical approaches based on option theory, game theory, and network effect have been proposed to gain insights into the elusive nature of the IT benefits.

Research on option theory-based investment emphasizes that companies must decide how to exploit various investment opportunities most effectively (Bardhan et al., 2004; Dixit and Pindyck, 1995; Dos Santos, 1991). These studies suggested that a company with an opportunity for project investment is holding something similar to a financial option: the company has the right, but not the obligation, to buy an asset before or at a future time of its choosing. The studies contended that the experience gained from initial investments could prove to be extremely valuable in the follow-on investments into other projects. However, appropriate option-based IT investment decisions require accurate estimation of key parameters, such as project risk and time to invest, which are still the most elusive part of the option theory.

Game theory has been also applied to capture behaviors mathematically in IT investment decisions, where an organization's success in making IT investments depends on the choices of others. Zhu and Weyant (2003) applied game theory to understand interdependencies of IT investment decisions among competing companies. They found decision dynamics more complicated, yet more interesting, when information asymmetry exists between firms. They also demonstrated that information asymmetry leads to different incentives and strategic behaviors in the IT adoption game.

Network effect suggests that as the number of IT adopters/organizations in a network gets larger, benefits to the network participation increase. Network effect becomes significant after a certain critical mass is achieved as shown in social networking. The side-effects such as utility and benefits arising from network effect are known as network externalities. Kauffman et al. (2000) suggested that due to the network effect, a company's technology adoption justification was influenced by the expected size of the shared network. Au and Kauffman (2003) showed the importance of expectations, as well as the network effect, on an IT investment decision.

A wide range of other IT pre-investment justification methodologies have been developed by researchers and practitioners including: index and ranking methods (Sethi et al., 1993), business process simulation

(Lee, 2004), analytical hierarchical process (AHP) (Goh, 1997), balanced scorecard (Kaplan and Norton, 1992), IT portfolio management (Bardhan et al., 2004; Jeffery and Leliveld, 2004), business case (Ross and Breath, 2002), technology road-mapping (Groenveld, 1997), Activity Based Costing method (Peacock and Tanniru, 2005), and total value of ownership (Luftman and Muller, 2005). The challenge for IT managers is that the success of the translation of non-quantifiable benefits into financial metrics often depends on the choice of justification methods and the validity of the assumptions made.

IT Valuation: Ex Post IT Valuation Methods

While ex ante IT justification studies suggested methodologies to predict IT value before investment occurs, most IT value research has focused on the ex post IT valuation theory building based on empirical data analysis. However, empirical studies show mixed results, and point to the measurement difficulties/errors as the sources of the inconsistent results (Brynjolfsson and Hitt, 1996; Floyd and Wooldridge, 1990; Harris and Katz, 1991). Researchers attributed inconclusive results to imprecise data, time lag, and mismeasurements (Barua et al., 1995; Brynjolfsson and Hitt, 1996). Barua and Mukhopadhyay (2000) pointed out that the tasks of obtaining granular data on IT investments, assessing changes in IT functionality, and isolating effects on a value-based variable are barriers to the attribution of IT value. Brynjolfsson and Hitt (1998) suggested that the value of IT should be measured not only by cost savings, but also by improvements in quality, customer service, and new product development. Other sources of firm productivity include organizational characteristics (Wade and Hulland, 2004), process redesign (Ho, et al., 2004), workplace practices (Bharadwaj, 2000; Black and Lynch, 2001), and environment (Dewan and Kraemer, 2000).

While many studies demonstrated the existence of positive returns on IT investment, their approaches provide limited insights into the value creating process of IT. Realizing the limitation of the traditional output-focused IT value measures, a number of studies focused on the development of IT valuation methods from process-oriented perspectives (Banker et al.1990; Barua et al., 1996; Kohli and Hoadley, 2006). Mooney et al. (1996) argued that a process focus should enhance the validity of the IT value assessment and the ability to explain the technological features, process characteristics, organizational settings, and competitive environments conducive to producing IT business value. Synthesizing previous studies, Melville et al. (2004) defined IT value as the organizational performance impacts of information technology at both the intermediate process level and the organization-wide level which comprises both efficiency impacts and competitive impacts. They suggested that the challenge of understanding IT value creation is addressed by the insights of multiple theoretical paradigms.

Most recently, Kohli and Grover (2008) summarized findings of the prior IT value research with seven concise statements: (1) IT does create value; (2) IT creates value under certain conditions; (3) IT-based value manifests itself in many ways; (4) IT-based value is not the same as IT-based competitive advantage; (5) IT-based value could be latent; (6) There are numerous factors mediating IT and value; (7) Causality for IT value is elusive. They further presented four major themes to understand how IT value is changing and what we must do to capture, measure, and demonstrate it: (1) IT-based co-creation of value, (2) IT embeddedness, (3) Information mindset, and (4) Value expansion.

Integration of BPR and IT

BPR is defined as the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in firm performance. Process is defined as a set of related tasks performed to achieve business objectives. IT enables firms to redesign business processes, strengthen their customer

relationship management, integrate business functions, and develop a new business model (Hammer and Champy, 1993).

BPR drew manager's attention as a potential breakthrough for staving off competition and achieving strategic advantage in the early 90s. A recent study shows that about 87% of firms surveyed were either engaged in BPR projects or indicated their intention to embark on BPR projects in the next few years (Ranganathana and Dhaliwal, 2001). Realizing many BPR projects fell short of the expected payoffs, Attaran (2004) identified seven barriers to effective IT-enabled BPR implementations: (1) misunderstanding of the concept; (2) misapplication of the term; (3) lack of proper strategy; (4) unrealistic objectives; (5) management failure to change; (6) failing to recognize the importance of people; (7) IS failure to change.

BPR has received much attention from researchers as well (Davenport, 1993; Davern and Kauffman, 2000; Hammer, 1990; Markus and Benjamin, 1997; Venkatraman, 1994; Whitman, 1996). These researchers have argued that IT and BPR together can create more cost-effective, agile, collaborative, and communicative process capability than BPR or IT alone. Information-intensive business organizations are utilizing IT to create new knowledge, manage existing knowledge, distribute information, and facilitate inter- and intra-organizational collaboration. IT makes it possible to achieve coordination-intensive business processes in a way it was not possible before (Teng et al., 1994).

The performance evaluation of BPR and justification for BPR is a primary concern of senior management. Senior management expects a high payoff from BPR, since it requires significant financial investments, dramatic process change, risk management, and organizational change. IT can fundamentally change the ways in which business organizations interact with internal and external constituents, and therefore IT and BPR integration processes should take external business strategy and internal IT strategy into account. A few case studies attempted to identify metrics organizations use to measure the performance of IT-enabled BPR (Devaraj and Kohli, 2000; Kohli and Hoadley, 2006; Stiroh, 2001). However, drivers and inhibitors of IT integration of BPR have not still been well studied (Grovera et al, 1998) and reengineering projects have shown mixed results (Sarker and Lee, 1999). Thus, there is a need to develop a methodology that measures the degree of BPR and IT integration and evaluates the impacts of the integration on business value (Barua et al., 1996; Kohli and Hoadley, 2006).

More recently, BPR crossed the boundaries of the business organization to include suppliers, partners, and customers into the process redesign mix. Champy (2002) calls this approach X-engineering. Companies such as Cisco, Dell, Intel and Solectron are examples of successful X-engineering implementations. This new approach is a natural development as more companies begin to deploy the web-based inter-organization information systems, taking advantage of the web technology standards such as XML, web services, and Internet protocols.

FUTURE DIRECTION OF IT VALUATION RESEARCH

While a larger body of researchers has focused on the measurement issues of IT strategic value or firm-level productivity, senior managers have been consistently interested in the practical IT evaluation methodologies to financially justify IT investment. In time of economic downturns, they tend to be more conservative and risk-averse on IT spending. Recent surveys have sent alarming signals to IT professionals and researchers of a declining annual IT investment growth rate and diminishing roles of IT leaders (Martin, 2007). IT managers frustrated with the marginal benefits attempted to shift the responsibility of proving or securing value from IT investments to the internal business functions. It is time to critically review what we have learned and set a new direction for IT valuation research to turn

around the declining IT status in organizations, to regain the confidence of senior management, and to jump-start the sagging IT value creation and productivity.

Our review reveals that a wide range of diverse views have been developing in the IT valuation and BPR studies. The existence of these diverse views strongly suggests that a single view is likely to provide only a limited understanding of how value is created. Most researchers agree that traditional budgeting and project evaluation methods are not enough to justify IT investments because these methods can not properly capture idiosyncratic IT values in novel contexts. Many studies indicate that operational, organizational, and strategic issues should be addressed when IT investments are justified. Since IT may fundamentally change the ways in which the business organization interacts with external constituents, we need to consider extended business processes in the evaluation process as well.

While numerous studies attempted to address the complex problem of linking IT to organizational performance, the absence of a unified theoretical framework has led to a fractured research stream with many simultaneous but non-overlapping studies (Chan, 2000), and there is still a debate on the nature of IT business value and whether IT is capable of creating value (Kohli and Grover, 2008). IT valuation research needs to deepen our understanding of the relationships between IT and value creations in many levels of organizations. Otherwise, the roles of our IT managers will continue to diminish and the significance of IS discipline will decrease further. To understand these relationships, we need to enrich our knowledge on what, when, where, how, and why these values are generated, and how we measure these values. More importantly, our research needs to move beyond the descriptive IT valuation studies to value maximizing IT prescription studies, the outcomes of which should be able to guide our IT professionals to plan on what IT we need to invest; how much we need to invest; when we need to invest; and how we can enhance the values. To do so, we need to develop a unified framework of IT valuation that links business strategies and processes with a multi-perspective valuation model derived from rich grounded theories and rigorous empirical validation.

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