ASSESSING A NEW IT SERVICE MODEL: CLOUD COMPUTING

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Abstract

Recently we have witnessed a new kind of IT advancement. It is a phenomenon where various types of IT capabilities are centralized into data centers to ensure that such resources are available wherever and whenever they are needed. Cloud computing is the latest version of IT service practice that reflects such new trends in IT. Although cloud computing is considered a paradigm shift of IT service design and delivery in IS communities and generates large amounts of interest from business entities, few studies have examined this new IT and business environment. To better understand the organizational application of cloud computing, this study aims both to investigate economic payoffs from cloud computing investment and explore cloud computing adoption within the firm. This study is one of the first of its kinds to assess this new IT service model (i.e., cloud computing) using empirical validation. The proposed study can make contributions to the IS literature by (1) extending the boundary of the IS literature by reflecting the new trend of the IT industry; (2) continuing the debate about business value of IT; and (3) establishing a theoretical framework for cloud computing adoption, which can be applied to further studies on cloud computing.

Keywords: Cloud computing, Economic analysis, Event study, Innovation diffusion, IT adoption, Market value of firm, Service innovation.
1 INTRODUCTION

A long-lasting key question for IS researchers and practitioners is how IT can contribute to better business performance. In particular, as the business environment has been increasingly competitive and globalized, firms are being required to improve their strategic and technological agility and reduce the complexities of their business and IT operations to sustain their competitive advantage in a rapidly changing environment (Sambamurthy et al. 2003). Responding to these business challenges, today’s IT has evolved into a new shape, becoming increasingly centralized as various types of IT resources move into data centers in order for such resources to be available wherever and whenever they are needed. As a new form of IT deployment, cloud computing is an innovative way to provide various on-demand IT resources to multiple clients using Internet technologies in a pay-per-use manner (Plummer 2008). From the perspective of strategic IT use, the value of cloud computing resides in its potential to meet a firm’s business need to enhance dynamic capabilities (Teece et al. 1997) to hold its business competence in the market (Pavlou and El Sawy 2006). Dynamic capability is defined as the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments (Teece et al. 1997). The link between cloud computing and dynamic capability is attributed to the differentiated characteristics of cloud computing. The service-oriented feature of cloud computing indicate that such benefits include cost reduction, IT management flexibility, and technology agility. In particular, IT management flexibility and technology agility enable a firm to procure appropriate IT resources upon business request and flexibly reorganize those resources according to a different set of business strategies and environments. Such beneficial factors may enhance a firm’s dynamic capability to respond to a turbulent business environment, thereby contributing to sustaining the firm’s competitive advantage.

Considering the strategic role of cloud computing, one may recognize that cloud computing is not just limited to technology or technical infrastructure. Instead, it reflects a new way in which IT can be used more strategically in business value creation. Thus, deploying and using cloud computing encourages IS researchers and practitioners to develop a better understanding of how its potential benefits could be maximized and address the problems inherent in successfully applying the new IT service model in the organization. How can we have a better understanding of the application of cloud computing to the business environment? This research will conduct two separate studies in the context of cloud computing (see Figure 1): (1) validating economic payoffs of cloud computing; and (2) exploring the organizational adoption of cloud computing. These research components collectively aim to investigate cloud computing phenomena across the two stages of pre- and post- adoption (Karahanna et al. 1999). Since the process of IT adoption and use takes place across a sequence of steps in organizations (Rogers 1983), each stage of the process (e.g., pre- and post- adoption) provides different research settings that can be manipulated for different research implications (Kwon and Zmud 1987). Thus a multi-stage approach in the study can provide a chance to broaden our knowledge and derive diversified research implications regarding the application of cloud computing for the real business environment.

![Conceptual Framework of the Study](image)

Furthermore, the outcomes of each research stream can be interchangeably utilized as guidelines for organizational decision-making of cloud computing deployment. For example, for potential users,
empirical evidence regarding the economic values of cloud computing can be used as a benchmark for identifying expected returns from cloud computing investments. On the other hand, for vendors of cloud computing, influencing factors for successful cloud computing adoption and their impact level can provide useful references for refining their capabilities to exploit this new IT service model in appropriate ways.

2 STUDY 1: ECONOMIC PAYOFFS OF CLOUD COMPUTING

For firms that have decided to deploy cloud computing, it is necessary to investigate economic returns attributed to cloud computing investments. This particular line of research focuses on validating the values of cloud computing and its effect on firm performance. Suspicious opinions about the economic validity of cloud computing have emerged in both industry and academics (Brynjolfsson et al. 2010). Based on this research perspective, it is critical to clarify the economic salience of deploying this IT service model in a real business environment and specify the optimized conditions under which a firm can realize business values by conducting cloud computing practices.

2.1 Theoretical Background: Business Value of IT

Today, most organizations recognize that information technologies are playing an extremely important role in sustaining their business operations. Some previous IS studies have made plausible claims that IT investment can have important strategic consequences. This literature suggests that IT investment decisions have the potential to improve a firm’s competitive position (Cash and Konsynski 1985; Porter and Millar 1985). However, it is also ironic that as IT investment increases, evaluating the effectiveness of IT investment becomes elusive (Im et al. 2001). Does information technology really pay off? Many attempts have been made to answer this question. Some studies have indicated that IT has been a critical contributor to productivity (Bharadwaj et al. 1999; Brynjolfsson and Hitt 1996, 1998). Despite such findings, the results of other empirical studies have been ambiguous (Weill 1992). Given these contradictory results, it has been argued that the intangible benefits of IT, such as improved quality, variety, timeliness, and customization have not been appropriately measured primarily because of the use of conventional productivity measurement techniques (Brynjolfsson 1993). Furthermore, because many factors influence firm performance, it is difficult to establish clear and proprietary causality between IT investment and firm-level performance.

To provide a different way of measuring business performance, some IS researchers have adopted a stock market valuation approach based on the event study, which is an efficient way to capture an overall assessment of a firm’s value (McWilliams and Siegel 1997). The event study usually measures the stock market’s reaction to unexpected events, such as announcements, to estimate how the event impacts the value of the firm. The underlying assumption is that capital markets are sufficient for evaluating new information about the key event, including IT investment, which can potentially impact the firm’s expected future profits. This methodology has recently been used within the IS literature. For example, the impact of unexpected announcements has been studied for IT investment in general (Dos Santos et al. 1993), outsourcing (Peak et al. 2002), and ERP system (Hayes et al. 2001). Considering the recent emergence of cloud computing in the market, it is difficult to acquire internal data directly from the firm. Analyzing stock price movement upon cloud computing events can be one viable alternative for measuring the impact of cloud computing on firm performance.

2.2 Research Model and Hypotheses

The study’s research model conceptually incorporates the overall effect of cloud computing investment announcements on shareholders’ positive abnormal stock returns. Other than such a main effect, the study also seeks to identify conditions under which the influence of cloud computing investment can be modified. These conditions can be conceptualized as contextual factors that represent the firm’s organizational and environmental aspects. Reflecting this research setting, firm size, industry sector, and strategic intention are implemented in the research model to investigate their moderating effects on the market value of the firm. Firm size and industry sector have been frequently considered as salient moderators in event study works (Dehning et al. 2003; Im et al. 2001). Strategic
Cloud Computing Adoption. Cloud computing allows firms to outsource various types of IT resources by renting them through the Internet. In addition to the benefits of a low initial cash investment, cloud computing provides customers with a certain degree of flexibility (Ranganathan and Brown 2006). More importantly, because companies can obtain a broad range of IT capabilities through cloud computing, they can concentrate on the core competencies of their businesses in the market, which can positively affect organizational performance. Announcements of cloud computing adoption are one way in which organizations can communicate favorable information to investors and stakeholders by leveraging their new technological innovations. Thus:

**Hypothesis 1:** Cloud computing adoption announcements yield positive abnormal shareholder returns.

Strategic Intention. Business strategy can be characterized as having two key objectives, operational efficiencies, which attempts to reduce costs and increase productivity and speed, and strategic positioning, which aims to extend the existing market by providing customer access and better market practices. Such objectives have been used to link firms’ strategic intents for IT (Tallon et al. 2000). In operations-focused firms, IT is primarily implemented to improve the efficiency and effectiveness of the organizational processes; meanwhile in market-focused firms, IT is used to enhance their strategic positioning. Firms that favor strategic positioning over operational efficiencies should achieve superior levels of firm performance. Previous event studies have found that the market reacts more positively to announcements of innovative and transformative investments than non-innovative ones (Dos Santos et al. 1993). Thus, we recognize that the stock market would likely react to a firm’s cloud computing announcements in different ways based on their strategic intention because shareholders and investors can usually evaluate the future value of the firm through the cloud events. This leads to:

**Hypothesis 2:** Cloud computing adoption announcements yield a significantly different level of abnormal shareholder returns according to strategic intention.

Firm Size. We also examine how the stock market reactions are affected by firm size. Traditional IT outsourcing primarily targets large companies since the up-front investments and maintenance costs are substantial (Meng and Lee 2007). However, the cloud computing business model offers potentials to small and medium size enterprises (SMEs) that want to focus their resources on building their businesses rather than making significant IT investment (Plummer 2008). Supply-side economies of scale make cloud computing model a viable and affordable option for SMEs that have struggled to acquire sufficient IT resources. SMEs have found that the lower up-front investment and range of applications provided to be particularly attractive. Considering such relative advantages to SMEs, we anticipate that market returns of firms’ cloud computing adoption can differ according to the size of the firm. This leads to:

**Hypothesis 3:** Cloud computing adoption announcements yield a significantly different level of abnormal shareholder returns according to firm size.

Industry Sector. Although IT has been a major factor in changing business practices, its role differs according to industry (Melville et al. 2004). In particular, in information-intensive industries, IT is altering the dynamics of the industry and changing the requirements for competitive success. Previous studies have argued that the financial service industry is likely to have more information-intensive processes than the manufacturing industry (Dos Santos et al. 1993). As a result, the outcomes of IT investments may differ across industry sectors. For example, the service industry, which requires more information-intensive capabilities, tends to be affected to a greater degree than the manufacturing sector in cloud computing adoption (Porter and Millar 1985). This leads to:
Hypothesis 4: Cloud computing adoption announcements yield a significantly different level of abnormal shareholder returns according to industry sector.

2.3 Research Method: Event Study

In the study investigating economic returns on cloud computing investment, event study is applied as a primary research methodology. Event study is a powerful tool that can help IS researchers assess the business performance of IT investments using such market-based measures as stock price or trading volume (McWilliams and Siegel 1997). The stock’s abnormal return—the difference between the expected returns based on general market movement and the actual returns—provides an estimate of the economic worth of the event (Brown and Warner 1980). Once abnormal returns of sample cloud investment announcements are calculated, cumulative abnormal return (CAR) can also be calculated by aggregating all sample abnormal returns across the event window, which is defined as plus and minus a certain amount of days from the event date (e.g., ±5 days or ±10 days). In order to avoid confounding effects due to the wide range of the event window, a narrow event window—namely, ±1 day from the event—is applied in the study (McWilliams and Siegel 1997). CAR for all sample abnormal returns usually represents the overall effect of cloud computing investment on the firms’ market value. Finally, CAR is examined to check its statistical significance using t-test with the null hypothesis that CAR is equal to zero. The event is defined as a public announcement of a firm’s cloud computing initiative in the media. Sample announcements are collected from a full text search of news sources such as PR Newswire and Business Wire using the Lexis-Nexis academic search engine for a specific time period. The target firms in the study are the constituents of the S&P Index. In addition, daily stock returns of the sample firms are retrieved from the Center for Research on Security Prices (CRSP) database.

3 STUDY 2: ORGANIZATIONAL ADOPTION OF CLOUD COMPUTING

For firms with potential to implement cloud computing, it is more relevant to identify the factors that affect firms’ behavioral intention to adopt cloud computing. Since the real application of cloud computing in business has recently emerged, many firms still face a series of obstacles in identifying relevant criteria for decision-making related to cloud computing adoption. Thus, in this line of research, the focus is on: (1) establishing a theoretical framework specific to cloud computing adoption; (2) conceptualizing factors affecting cloud computing adoption and developing measurements; and (3) performing empirical assessment based on a large sample of data from the real business world.

3.1 Theoretical Background: TOE Framework

Cloud computing is considered a new style of business computing whereby various IT resources are delivered as service items through the Internet based on subscription. This implies a paradigm shift of IT service practices. Based on this, cloud computing takes on differentiated features in broad ways—namely,(1) a service-oriented design, (2) service delivery over the Internet, (3) flexible use of shared service, and (4) pay-per-use-billing. These features as a whole characterize cloud computing as a new IT service model capable of transforming existing IT operations. Previous literature provides a theoretical background for interpreting the identity of cloud computing from innovation perspectives. According to the IS innovation typology (Swanson 1994), cloud computing can be viewed as a Type III innovation in the sense that cloud computing can be applied to integrate various service-oriented IT resources with a firm’s core business technology; such application leads to a wide scope of changes in a firm’s business operation, IT management, and strategic use of IT. In the technology aspect, cloud computing aggregates modern IT features (e.g., virtualization, service-oriented architecture, and grid computing) into a new business computing environment in response to the growing need for greater business integration, flexibility, and agility. Considering such a nature, we can consider cloud computing as a synthetic innovation (Hage 1980), which involves the combination of existing technologies in ways that create significantly new products or services. These theoretical perspectives
support innovation features pertaining to cloud computing and emphasize its strategic role of business value creation in organizations. Thus, it is useful to investigate the organizational adoption of cloud computing from technological innovation diffusion perspectives.

A theoretical model for cloud computing adoption needs to take into account factors that affect the behavioral intention to adopt cloud computing, which is rooted in the specific technological, organizational, and environmental circumstances of an organization (Zhu and Kraemer 2005). A review of the adoption literature indicates that Tornatzky and Fleischer’s (1990) work provides a useful starting point to investigate the organizational adoption of cloud computing. Tornatzky and Fleischer (1990) developed the technology – organization – environment (TOE) framework, which identified three aspects of a firm’s context that influence the process of adopting and implementing technological innovations. The technological context focuses on how features of technologies can influence both the adoption process and implementation, thereby embracing technologies internally and externally available to an organization. The organizational context is related to a variety of descriptive characteristics of an organization. The characteristics include firm size, complexity of its managerial structure, the quality of its human resources, and the amount of slack resources available internally. The environmental context refers to an area in which a firm retains its business. Examples include the industry sector, competitors, and partnerships with external suppliers. The TOE framework implies that the process of innovation adoption depends on the combined effects of technology features, organizational properties, and business environment (Chau and Tam 1997; Zhu et al. 2003). Previous studies have empirically supported the relevance of the framework across various IS domains such as electronic data exchange, open systems, and e-business (e.g., Chau and Tam 1997; Zhu et al. 2003; Zhu and Kraemer 2005). The TOE framework is also consistent with Rogers’ (1983) innovation diffusion theory, which emphasizes the influence of technological characteristics (innovation attributes) and both internal and external organizational characteristics on potential adopters. In this sense, as a generic theory of technology diffusion, the TOE framework can be used to study the organizational adoption of IT innovation like cloud computing.

3.2 Research Model and Hypotheses

The framework for cloud computing adoption needs to take into account factors that affect organizational propensity to adopt cloud computing in regard to technological and environmental circumstances of organizations. In addition, in order to develop a research model specific to cloud computing adoption, differentiated characteristics of cloud computing should be reflected within the model. In this sense, we need to conceptualize several model constructs that can be used to examine the causal relationship between unique attributes of cloud computing and the organization’s behavioral intention to adopt cloud computing. Based on such an argument, the proposed model includes three perspectives on cloud computing adoption: (1) characteristics of cloud computing (technology context), (2) organizational capabilities (organization context), and (3) external environment (environment context). Figure 2 illustrates the proposed model.

![Cloud Computing Adoption Model](image)

Figure 2. Cloud Computing Adoption Model
Characteristics of Cloud Computing (Technology Context). The adoption of new technology innovation requires concrete analysis for reliable decision-making references based on the relative amount of total expected benefits earned from and total costs paid for adopting a new technology (Fichman 2004). In this sense, the adoption of cloud computing usually depends on the relative size of estimated benefits and costs. Expected benefits and costs regarding a specific technology innovation are usually attributed to its original characteristics (Chau and Tam 1997). Thus, perceived benefits and barriers represent the technology context of the research model.

Perceived benefits hereby refer to the operational and strategic benefits a firm anticipates from the adoption of cloud computing. In innovation diffusion theory, perceived benefits (i.e., relative advantages) play a central role in facilitating new technology adoption (Rogers 2003). Since cloud computing is an innovative way of providing various on-demand IT capabilities, it proposes such potential benefits as cost reduction, IT management flexibility, and technology agility in a broad sense (Plummer 2008). These kinds of values can generate firms’ plausible expectation, possibly resulting in the real adoption of cloud computing. Thus, the argument leads to the following hypothesis:

Hypothesis 1: Increased perceived benefits of cloud computing lead to a higher level of firms’ expectations, thereby increasing the possibility of cloud computing adoption.

While premising the expected benefits, cloud computing has negative effects recognized as costs or barriers. Exemplified perceived barriers are unverified service quality due to recent commercialization, unclear data storage location, security issues, vulnerability to system crashes or natural disaster, and the reliability of service providers (Nelson 2009; Robertson 2008). Such perceived barriers can be inhibiting factors associated with the transition of current information systems to cloud computing environment if not properly fixed in the near future. This leads to:

Hypothesis 2: The increased level of potential barriers attributed to risk factors negatively affects cloud computing adoption.

Organizational Capability (Organization Context). Organizational capability refers to embracing the ability of an organization to accept new technological innovations and utilize them to build its business competence. Such a capability can be achieved based on the organization’s skill, knowledge, experience, etc. Organizational capability perspective consists of two parts: organizational learning capability (Kogut and Zander 1992) and organizational IT capability (Bharadwaj 2000).

Organizational learning capability refers to the ability of an organization to identify the value of new technology, internalize it, and apply it for commercial purposes. The capability originates from a firm’s level of prior related knowledge and experience (Cohen and Levinthal 1990). If a firm has a previous successful IT practice, it acquires comprehensive and concrete knowledge of how to manipulate the technology to achieve its business goals and tends to actively consider another technology innovation like cloud computing. Based on this argument, the following hypothesis is derived:

Hypothesis 3: Higher organizational learning capacity leads to an organization’s active attitude toward new technology and thereby increasing cloud computing adoption.

In the IS literature, organizational IT capability is recognized as having three subsets: infrastructure, IT personnel, and IT-related knowledge (Mata et al. 1995). Thus, capability is an integrative concept that reflects a firm’s knowledge as well as physical assets. In manipulating organizational IT capability, a firm is able to monitor the current use of IT to enable business operations, identify IT-related issues to be resolved, and finally apply a new technology innovation for better performance. Thus, a firm with a high level of organizational IT capability tends to enjoy greater readiness to use cloud computing in its business processes (Zhu and Kraemer 2005). This argument leads to:

Hypothesis 4: Firms with higher IT capability are more likely to adopt cloud computing.

External Environment (Environment Context). The external environment also plays a salient role in affecting a firm’s decision-making regarding adopting technology innovations available in the
market (Tornatzky and Fleischer 1990). Since cloud computing is characterized as a strategic IT alternative in achieving a firm’s business competence by enhancing its IT agility, business IT alignment, and IT cost-effectiveness, competitive pressure can be a relevant factor for predicting the variance of organizational intention to adopt cloud computing. Another factor that can be applicable to the cloud adoption model is expectation of network dominance, which originates from bandwagon effect (Fichman 2004) and herding behavior (Bikhchandani et al. 1992).

Competitive pressure refers to the level of pressure that a firm perceives from competition within the market (Zhu et al. 2003). Competitive pressure is analyzed as an innovation diffusion driver in the business strategy literature. The literature suggests that, by utilizing a new technology innovation, the firm can change the rules of competition, affect the industry structure, and find a new way to outperform rivals (Porter and Millar 1985). Thus, firms in a highly competitive industry more often tend to pursue a new technology innovation to enhance their competitive advantages. This leads to:

**Hypothesis 5:** Firms with higher competitive pressure are more likely to adopt cloud computing with the purpose of enhancing their business competence in the market.

The expectation for network dominance of a technology is defined as the extent to which a specific technology innovation is likely to achieve a dominant position in the market relative to other competing technologies (Fichman 2004). The argument is based on theoretical backgrounds like bandwagon effect and herding behavior. Bandwagon effect arises when an organization’s preference for a certain product is positively affected by the fact that others are also purchasing the same product (Leibenstein 1950). Similarly herding behaviour refers to the situation in which a certain kind of decision-making is predominantly affected by observing or learning about other organizations’ decisions (Banerjee 1992). Since, cloud computing services have recently become commercialized, most firms do not possess sufficient information on cloud computing. Given this situation, if a leading company in an industry adopts cloud computing, potential users are more likely to follow the predecessor’s decision. Thus:

**Hypothesis 6:** Increased expectation for dominance of cloud computing increases the expected value of potential returns, thereby increasing the possibility of adopting cloud computing.

### 3.3 Research Method: Field Survey

In order to test the organizational cloud computing adoption model, a field survey methodology will be applied. The unit of analysis in this study is an organization currently considering the introduction of a cloud computing solution into its business practice. Survey instruments are designed to measure several key factors as proposed in the research model. In developing the measurement, multiple-item measures are used for all variables to improve the reliability and validity of the measures (Churchill 1979). This study plans to conduct interviews with academic and industry experts to determine the measurements’ face validity and perform a pilot test with a small sample to investigate the questionnaire’s internal validity. Once the instrument is finalized based on the results of two pre-tests, the main survey will be conducted. The statistical method that will be used to test the proposed model is structural equation model (SEM).

### 4 RESEARCH PLAN

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