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Exploration vs. Exploitation: An IT Dilemma?

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ABSTRACT

Information technology (IT) decisions in regards to the effective refinement, management and implementation of IT have been a long running challenge for many organizations. Firms have the option of following an IT exploitation or IT exploration strategy for answering their IT dilemma. This paper examines the tradeoff between IT resource refinement (exploitation) and discovery (exploration) of emerging technologies for firms while incorporating the turbulence in the environment. We know little as to what drives an organization to espouse an exploration or exploitation IT strategy when facing turbulent environments. We argue for a direct effect between IT exploration and exploitation based on organizational structures and on various outcomes: cost, speed, efficiency and competitive advantage mediated by environmental turbulence. The potential research findings may suggest that organizational exploration or exploitation IT strategies play a significant role in understanding the role of organizational outcomes in turbulent environments.

Keywords
IT Strategies, Exploration, Exploitation, Environmental Turbulence, Organizational Structure

Introduction

The effective management, implementation, and practice of information technology (IT) are increasingly becoming key sources of innovation, competitive advantage, and business performance (Argyres 1999; Sambamurthy et al. 2003; Tippins and Sohi 2003). The importance given to IT by the organization is evident by the massive IT investments, where the average enterprise spends more than 4% of revenues annually on IT (Gormoloski and Potter 2001). In addition, investments in IT account for nearly 50% of a firms’ total capital budget (Weil and Broadbent 1998). When evaluating their IT investment strategy, firms may either follow an exploitation or exploration strategy. An exploitation strategy involves discovering, and investigating and building up new technologies. An exploitation strategy focuses on optimizing and refining the firm’s current technologies and on optimizing the capability of the existing technology to the fullest. Furthermore, the environment in which organizations are operating in is becoming increasingly dynamic and competitive which makes it critical for firms to answer their IT dilemma with an appropriate IT exploitation or IT exploration strategy. Thus, the tradeoff between (IT) resource refinement (exploitation) and discovery (exploration) of new technologies is a crucial balancing act for organizations in both stable and turbulent environments.

For firms operating in turbulent environments, it is critical that they understand how IT can act as an enabler, providing competitive advantage (Sambamurthy et al. 2003). Environmental turbulence can be described as change in customer demand, emerging opportunities and new technology developments (Mendelson and Pillai 1998). Environmental turbulence destroys the value of firm’s existing competencies (Danneels 2002), thus forcing firms to reconfigure or acquire newer resources to sustain their survival (Brown and Eisenhardt 1997). Considering the high uncertainty between existing and new innovative technologies (exploration and exploitation) in turbulent environments, the need for understanding the potential benefits or pitfalls of either strategy (exploitation or exploration) becomes very important for a firm. In turbulent environments, where the need to respond to changing market dynamics is greatest (Grant 1996), there is heightened urgency to either reconfigure or acquire resources. In such circumstances, IT plays a critical function in supporting resource reconfiguration or acquisition for business process adjustment, required to respond to turbulence in environment (Mendelson and Pillai 1998).
Employing the organizational learning concept of exploration and exploitation from March (1991), our study proposes a framework to understand the role of organizational structure in regards to IT exploration or exploitation strategies on organizational outcomes while incorporating the turbulence in the environment. The goal of our study is to contribute to the understanding of exploration and exploitation and the tradeoff between organization ability to maximize innovation, efficiency, and competitive advantage, while minimizing cost. Our work shows that an organization decision to adopt either an exploration or exploitation strategy has specific effects on various outcomes with environment turbulence moderating these effects. To this end, we developed a set of propositions and a framework for understanding firm behavior in terms of IT decisions whether to explore or exploit. The current research aims to investigate following questions:

1. What is the role of organizational structure on an IT exploitation or IT exploration strategy?
2. What are the organizational outcomes for firms following an IT exploitation or IT exploration strategy?
3. How does environment turbulence moderate the relationship between IT exploitation or IT exploration?

**Research Model**

![Diagram of IT Exploration & Exploitation Model]

**Exploration vs. Exploitation**

March’s (1991) theory of organizational learning presents two contrasting managerial perspectives, influencing organizational performance: exploration and exploitation. As March states, “The essence of exploitation is refinement and extension of existing competencies, technologies, and paradigms. Its returns are positive, proximate, and predictable. The essence of exploration is experimenting with new alternatives. Its returns are uncertain, distant, and often negative” (March 1991, pg. 85). These models of organizational learning help organizations to distinguish the two approaches to compete, adapt or adopt to gain strategic advantage over others.

In the context of IT, during exploration an organization’s goal is to explore and build up new technologies while during exploitation their main focus is to remove friction in the current technologies to optimize the capability to the fullest. The goal of exploitation could be pinned down to increase in efficiency and standardization while the goal of exploration could be to quickly develop or innovate new technologies to respond to changes in the environment. Thus, an organization moving from exploration to exploitation should align it focus from innovation to efficiency, cost and optimum utilization. Such organization transformation from exploration to exploitation is a critical process and requires the balancing of critical features like innovation, quality, risk and cost.
Organizational Structure and IT Exploration and Exploitation

The inherent characteristics in the organization’s structure may play a role in the alignment and effective implementation of IT exploitation and exploration strategies. Organizational structure is defined as the recurrent set of relationships between organizational members, and is one of the most commonly seen aspects of organizations (Ambrose and Schminke 2003). Organizational structural forms were originated and designed to match the communications needs of the organization. Organizational forms have gone through an evolution where the managerial hierarchy and divisional structures are being replaced by decentralized and more flexible approaches to coordinating activities (Daft and Lewin 1993). Classical organizational structural forms: mechanistic and organic (Burns and Stalker 1961) are applied according to their inherent relationships to IT exploitation and exploration strategies. It is important to note that organic and mechanistic organizational structural forms represent ends of a continuum and are not a dichotomy. No organization is perfectly organic or mechanistic and interactions between the two will occur naturally and by definition (Ambrose and Schminke 2003).

Organic Organization

Organic organizations typically consist of low degrees of formalization (in terms of specification of job duties and division of labor), open communication with significant lateral communication and few hierarchical distinctions (Burns and Stalker 1961). Organic structures by definition attempt to deliberately support managerial discretion, organizational adaptiveness, flexibility, open communications and a de-emphasis on formal rules and procedures (Slevin and Covin 1997). Earlier research suggests that exploration strategies are accompanied by more organic structures of loose coupling and improvisation (Levinthal and March 1993). Thus, organic structural forms by their inherent definition may be more associated with the need to quickly develop or innovate new technologies and respond to changes in the environment through exploration strategies.

Proposition 1(a): An organic organization structure will be more conducive for exploration of technologies.

Mechanistic Organization

Mechanistic structures are signified by high degrees of specialization and divisions of labor, a hierarchical command structure based on legitimate authority and or a routinization of job duties (Burns and Stalker, 1961). Mechanistic structures are typically characterized by impersonal transactions and strict adherence to formally prescribed rules and procedures (Slevin and Covin 1997). Mechanistic structures through their bureaucratic configurations strive for efficiency. Earlier research suggests that during exploitation, organizations seek to maximize quality and efficiency while minimizing cost and risk. As shown by multiple process improvement studies (Humphrey 1989) exploitation of existing competencies result in cost reduction, increased quality, low risk and increased efficiency; however at the cost of innovation. Thus, exploitation is more closely associated with highly mechanized structures, tight coupling and bureaucracy (Levinthal and March 1993). Thus, mechanistic structural forms by their inherent definition of standardized routines; tight structures and routinization may be more associated with the need to increase efficiency and standardization through exploitation strategies.

Proposition 1(b): A mechanistic organization structure will be more conducive for exploitation of technologies.

IT Exploration and Exploitation Organizational Outcomes

IT exploration and exploitation strategies are expected to impact a number of organizational outcomes. As previously discussed, organizations through exploitation refine their IT competencies by repeated actions, thus exploitation strategies can be labeled as refinements, efficiency improvement, and selection (Eisenhardt and Martin 2000). On the other hand, exploration allows organization to create new IT competencies and can be labeled as search, discovery, experimentation, and innovation (Eisenhardt and Tabrizi 1995; Winter and Szulanski 2001). Organizations can rely on exploitation strategy (learning capability) to improve their technologies to achieve desired outcomes, while exploration strategy focus more on innovative capabilities.
Responsiveness and Quality

Responsiveness could be defined as the organization’s ability to continuously adapt their IT (technology) capabilities to address increasingly competitive and dynamic business environment (Weill et al., 2002). In the exploration period technologies are innovated in short and intense timeframes during which hyper-learning is valued (Lyytinen et al. 2004). During such periods an organization may discover significant and radical new technologies. Once a technology has been standardized the organization needs to move into an incremental exploitation strategy by further refining and adding to the current technology. During exploration, organizations must be willing to face higher costs through exploring new technologies. However, if organizations want to control cost and risk they may have to forgo innovativeness. During exploitation, organizations seek to maximize quality and efficiency while minimizing cost and risk (Humphrey 1989). Thus, an exploitation strategy could be more advantageous for incremental refinement of technologies to deliver significant improvements.

When an organization moves from radical IT exploration it must create a balance with its increase in exploitation capability. The goal of exploitation could be pinned down to increase efficiency and standardization, while the goal of exploration could be to quickly develop or discover new technologies to respond to changes in the environment. Thus, an organization moving from exploration to exploitation should also align its focus from innovation to efficiency, cost and optimum utilization. Such organization transformation from exploration to exploitation is a critical process and requires the balancing of critical features like innovation, quality, risk and cost.

Proposition 2(a): IT Exploration maximizes responsiveness and the associated cost and risk.

Proposition 2(b): IT Exploitation maximizes quality and speed while minimizing cost and risk.

Innovativeness

As previously discussed, IT exploitation refers to the further refinement of existing technologies. However, this refinement of existing technologies may result in lost opportunities and technological exhaustion in the long run (Lee et al. 2003). A firm highly experienced in using a particular technology may become locked and blinded to (better) alternatives described as a ‘competency trap’ for organizations (Levitt and March, 1988). Firms may also lose their innovation edge, through the continued exploitation of existing technology if the firm competes for developing new products (Lee and Ryu 2002).

Proposition 2(c): A firm adopting an IT exploitation strategy may lose its innovative edge and miss out on better available IT-alternatives.

Firm Performance

IT has demonstrated to play a critical role on impacting a firm’s overall performance (Mukhopadhyay et al. 1995), however multiple dimensions exist when examining firm performance. The impact of Information technology on organizational performance is commonly referenced throughout the literature as productivity enhancement, profitability improvement, cost reduction, competitive advantage, inventory reduction, and other measures of performance (Devaraj and Kohli 2003; Hitt and Brynjolfsson 1996; Kriebel and Kauffman 1988). Following Melville et al. 2004, firm performance and the impact of IT on firm performance was separated into: efficiency and effectiveness. Efficiency emphasizes an internal perspective employing such metrics as cost reduction and productivity enhancement in the assessment of a given business process. Based on our earlier definition of exploitation, an exploitation strategy would appear to correspond with firm performance as an efficiency measure. Effectiveness refers to the achievement of organizational objectives in relation to a firm's external environment and achieving a competitive advantage. Based on our earlier definition of exploration, firm performance from an effectiveness perspective would appear to be related with an exploration strategy.

Proposition 2(d): A firm adopting an IT exploitation strategy would achieve greater firm performance as a measure of efficiency.

Proposition 2(e): A firm adopting an IT exploration strategy would achieve greater firm performance as a measure of effectiveness.
Competitive Advantage

The S-Curve (Figure 2) is frequently applied to the adoption of consumer and business technologies (Geroski 1999). The S-Curve specifies how the adoption of a new technology takes place (Christensen 1992). Initially, a new technology is risky, untested, expensive, difficult to implement and is accompanied by a lack of standards and best practices. At this stage, only a few clients (first-movers) begin utilizing the technology. As the value of technology is proven, there is a huge surge in adoption by organizations, clients and users resulting in the emergence of standards and diminishing costs. At the end of the curve, the technology becomes widely adopted throughout the industry/market. Applying the S-curve, we can formulate that during the early stages, the strategic potential is at it’s peak but as the adoption rate increases, there is formulation of standards, homogeneity and price deflation of the technology which leads to diminishing advantages, lower cost, formal standards thus lowering the potential for a firm to gain competitive advantage over others. Finally, as the technology reaches maturity or ubiquity, the strategic value approaches zero (Carr 2004).

Proposition 2(e): A firm adopting an exploration strategy will sustain competitive advantage over a long period of time but with higher initial cost and risk.

Proposition 2(f): A firm adopting an exploitation strategy will not gain competitive advantage but would be less prone to high costs and risk.

Moderating Role of Environmental Turbulence

Environmental turbulence can be described as the general conditions of uncertainty or unpredictability due to changes in the marketplace, consumer preferences, government regulations, competitive pressures and technology developments (Mendelson and Pillai 1998; Pavlou and Sawy 2006). Environmental turbulence arises mainly from unpredictability in market and consumer demands and competitor strategies as well as uncertainty created by new technologies innovation. Increased environmental turbulence requires organizational, strategic and business process adjustments and the need for agile technologies to respond to uncertainty and implement decisions quickly. Turbulent business environments result in environmental change and uncertainty as a normal course of business. In turbulent markets, speed, experimentation and flexibility are crucial (Tushman and O’Reilly 1996) because they enable firms to retain competitive advantage for a limited time and in some cases sustain the competitive advantage for a longer period through a series of temporary competitive advantages.
The advantage from exploiting existing technologies is weakened in turbulent environments while increasing the chances to gain competitive advantage from exploration as the new opportunities arises (Kogut and Zander 1996; Teece et al. 1997). A similar view is supported by Leonard-Barton (1992), that during stable environments, the exploitation of existing competencies (in our case IT) is more advantageous compared to exploration. Thus, we formulate the view that during environmental turbulence, a firm stands to gain maximum (competitive) advantage from exploration rather than from exploitation. Our contention is that during environmental turbulence as the need to respond quickly is heightened; an organization would tradeoff innovativeness and speed while losing quality, and efficiency resulting in increased cost and risk. Furthermore, during a turbulent environment an organization would be forced to move quickly between both exploration and exploitation stages to gain the maximum positive benefits. Thus an organization in such situation would be more inclined to continuously shift between these two stages.

**Proposition 3(a):** High levels of environmental turbulence will negatively moderate the relationship between exploitation and efficiency (IT).

**Proposition 3(b):** High levels of environmental turbulence will negatively moderate the relationship between exploitation and quality (IT).

**Proposition 3(c):** High levels of environmental turbulence will positively moderate the relationship between exploration and competitive advantage.

**Proposition 3(d):** High levels of environmental turbulence will positively moderate the relationship between exploration and responsiveness.

**Proposition 3(e):** High levels of environmental turbulence will positively influence continuous organization alteration between exploration and exploitation.

**Research Methodology**

A survey instrument is envisioned to test the proposed model. Whenever possible, measurement items will be adopted from prior literature or existing scales. With most of the measurements being based on pre-tested surveys we can ensure a higher level of reliability and validity. The face validity and content validity would be tested and confirmed during the instrument development stage. Our intention is to pretest the survey instrument by an academic and a professional panel. The data collection would be conducted in two phases. During phase 1, we are planning to pretest the instrument in an MBA level course at an urban university. The results of the pilot study will allow us to further refine and validate the instrument. In the final study, we will focus on firms in Information Technology and Financial sectors, since they are considered as fast-moving industries surviving in turbulent environment. Our sample would be limited to US based firms. The research model would be transferred into a structural equation model (SEM) to be analyzed with the Partial Least Squares (PLS) approach (Chin 1998). PLS approach is considered more suitable for application and prediction and is best suited for explaining complex models (Chin et al. 2003) and a small data set.

**Limitations**

This paper has addressed the role of organizational structure in regards to IT exploration or exploitation strategies on organizational outcomes while incorporating the turbulence in the environment. No claim is made as to the completeness of the organizational outcomes included in this research study. There may indeed be other frameworks and criteria in evaluating organizational outcomes. The outcomes discussed are employed as a representation of a variety of organizational outcomes and should not be treated as an exhaustive list. This paper was designed to introduce how IT exploitation and exploration strategies could be utilized to examine the impact on organizational outcomes. The current research is limited by the lack of data collection. Data collection is scheduled to begin in the fall of 2007 and all propositions should be treated as that until they are supported or not supported through data collection.
Implications and Conclusion

In conclusion, March’s (1991) concept of organizational adaptation (exploration and exploitation) is a fertile area for examining IT strategy. We examined the relationship between organizational structure and IT exploration and exploitation strategies on outcomes while incorporating the turbulence of the environment. Our study shed light on the effect of environmental turbulence on IT strategy, suggesting the importance of exploration of informational technologies as environments become turbulent. Our framework offers insights about the drivers of technology exploration or exploitation, which should be useful to managers in understanding the fit of their IT strategy decisions given their organizational structure and turbulence in their environment. The framework presented suggests organizations consider the tradeoff between IT exploration and exploitation against organizational outcomes like risk, efficiency, cost and competitive advantage. An organization trying to balance between these approaches in order to gain a niche for itself will significantly benefit from our framework in understanding the dynamics and tradeoffs involved based on exploitation and exploration strategies. The contribution of this study is to provide early insights to evaluate organizations’ adaptive decisions with respect to IT exploration and exploitation.

References


