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How IT Makes Organizations More Innovative: The Influence of IT Capabilities on Organizational Innovation

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ABSTRACT
Organizations in the Internet economy require significant IT capabilities for developing and delivering their products and services. Therefore, IT leadership within the industry is an antecedent of the firm’s ability to engage in business innovation and accomplish industry leadership. This paper is based on research-in-progress investigating the influence of an organization’s IT capability on its capacity for product and process innovation. IT capability is characterized as having five dimensions, and the innovation process is characterized as a three-stage process. Preliminary findings suggest that different dimensions of IT capability can enhance the effectiveness of the innovation process. This paper examines how and why this is so, and enunciates propositions to this effect.

Keywords
IT-capabilities, IT-leadership, Innovation, Competitive advantage.

INTRODUCTION
Organizations operating in the Internet economy use information and knowledge to create value and increase their productivity and efficiency. In these organizations, often known as “net-enabled” (Wheeler 20021) organizations, successful creation of goods and services depends on the presence of significant information technology (IT) capabilities and a robust Internet-based IT infrastructure (Broadbent et al 1999). The Internet also plays an important role in digitally integrating the different processes of manufacturing, procurement, marketing and distribution, thus enabling instantaneous information flow and fast information analysis. This allows firms to flexibly combine resources and stimulate business innovation in products, services and channels (Wheeler 2002, Sambamurthy et al 2003). In modern firms therefore, the existence of IT capabilities is an antecedent to business innovation (Wheeler 2002). IT leaders can hence affect business innovation by developing appropriate organizational IT capabilities.

In this context, IT leaders, to be most effective, need to understand why and how IT capabilities help their organizations innovate to achieve competitive advantage (Wheeler 2002). This understanding helps them guide their firms to strategically develop and leverage the IT capabilities most appropriate to these objectives. While studies have investigated the effect of IT investment (Barua et al 2000, Brynjolfsson and Hitt 1996) and IT capability (Bharadwaj 2000) on firm performance measures such as profits, productivity and customer value, there has been no significant research on the effect of IT capabilities on business innovation.

This paper is based on research-in-progress investigating the influence of the IT capabilities of an organization on its capacity for business innovation. The research question that we seek to answer is, “How should IT leaders develop and focus their firms’ IT capabilities to best motivate and support business innovation in the firm?”

LITERATURE SURVEY
In this section we first take a look at concepts that describe innovation processes in organizations. We subsequently examine different dimensions associated with IT capability.

1, 2 and 3 Due to space constraints we have not mentioned other studies.
Innovation Processes in Organizations

The innovation process has been described as a multi-stage process. Some studies (Damanpour 1991) mention two stages while others (Zmud 1982) talk about three stages. We have considered three stages, broadly termed as “Initiation”, “Development” and “Implementation”. Each stage has different characteristics and activities.

The “Initiation” stage is the first step and involves the decision on part of the organization to adopt an innovation as a result of some kind of “tension”. This tension could result from a gap between actual and expected performance, as evidenced by indicators such as falling market share, losses or loss of industry pre-eminence (Tushman and O’Reilly 1997, Kanter 1982), or could be internally created as a consequence of a need for proactive business innovation (Tushman and Nadler 1986).

In the “Development” stage, product and process innovations planned in the Initiation stage are designed and developed. This stage has activities such as idea generation and problem solving (Tushman and O’Reilly 1997). Internal environments are characterized by risk taking, tolerance for mistakes and ambiguity (Tushman and O’Reilly 1997), encouragement for experimentation, entrepreneurship and learning (Drucker 1998). Information processing is rapid and decision making fast (Eisenhardt and Tabrizi 1995). New information is acquired from competitors (Tushman and O’Reilly 1997) and customers (Drucker 1998), and connected with existing knowledge (Galbraith 1982). Information exchange takes the form of discussions, conflict resolution, co-ordination and feedback. It is accomplished through formal means such as cross-functional groups, virtual teams and boundary-spanning roles (Tushman and Nadler 1986) and through informal means such as diffusion networks (Rogers 1995) and grapevines (Kanter 1982). Innovation efforts are recognized and communicated within the organization through survey results and customer reviews, to provide visibility to innovation efforts (Tushman and O’Reilly 1997).

The third stage, the “Implementation” stage is the one where innovations developed in the Adoption stage are implemented and integrated into the organization. Process and product redesign takes place as changes in different processes and control systems are implemented to reflect the innovations (Davenport 1993). Effective and reasonably strict control systems are required for efficiently accomplishing the administration and co-ordination tasks necessary for implementation of the innovation (Galbraith 1982, Seely Brown 2002).

Information Technology Capabilities in Organizations

Bharadwaj (2000) assumed a resource-based perspective to classify IT capabilities along the dimensions of “infrastructure”, “human resources”, and “IT-related intangible resources”. We have partially disaggregated the “infrastructure” dimension by extracting IT-governance and IT-coordination as components of IT capability in their own right. Accordingly, we have identified the following five dimensions of IT capability.

**IT infrastructure:** Includes physical IT assets in terms of hardware, software and networks (Broadbent et al 1999). IT infrastructure is required for implementing Internet based systems.

**IT human resources:** Include technical (programming, systems analysis, network administration and database management) and managerial (project management, interaction with users and management of IS functions) skills of IS employees (Copeland and McKenny 1988). These skills evolve over time through interaction and experience, and are highly firm specific.

**IT related intangible resources:** Sustained use of IT can lead to the development of various intangible resources. These include knowledge assets, a customer orientation, synergy among IT resources, and IT-enabled organizational flexibility (Bharadwaj 2000). To give some examples, effective use of CRM systems, can help firms track changing customer preferences. Appropriate response to these changes can increase the customer orientation of the firm. Similarly, the use of knowledge management technologies help in knowledge formalization and consolidation, and can lead to the creation of inimitable knowledge assets for the firm (Quinn et al 1994). Finally, IT-enabled sharing of resources and information can eliminate spatial and temporal limitations to communications and increase the flexibility of different organizational units.
**IT governance:** Governance arrangements represent a firm’s IT related authority patterns between three kinds of stakeholders – central IS, divisional IS and line management. Governance can be *central*, where central IS has all the authority, *federated*, where both the central IS and the line management/divisional IS share their authority in making decisions, and *decentralized*, where all decisions are left to line management. Governance influences IT project management practices, planning for security control and disaster recovery, and IT evaluation and control (Sambamurthy et al 1999).

**IT coordination:** Coordination mechanisms include standard operating procedures, liaison roles, task forces, and oversight teams (Galbraith 1974). Coordination mechanisms promote collaboration, sharing of risks, distribution of knowledge, and partnering (Bharadwaj 2000).

**RESEARCH MODEL AND HYPOTHESIS**

The literature survey revealed three stages for the innovation process, and five aspects to IT capability. We now develop the research model by conceptually identifying how each aspect of IT capability affects one or more stages of the innovation process. The research model has been described in Figure 1.

**Influence of IT infrastructure:** IT Infrastructure influences the innovation process in three ways. First, certain technologies can increase the innovativeness of innovation development teams. For example, creativity support systems help enhance the creativity of individuals (Marakas 1997), CAD systems provide simulation capabilities that aid in problem solving and rapid prototyping of products (Davenport 1993), and collaborative technologies such as Intranets can help build virtual communities for feedback, testing and discussion amongst members of innovation teams (Sambamurthy et al 2003).

Second, IT infrastructure provides technical capabilities that can be leveraged while developing innovation solutions. For instance, capabilities of software such as data warehousing, CRM, and data mining, and capabilities of hardware such as inter-firm collaboration platforms and electronic linkages with suppliers and customers can be examined for potential use while developing solutions for product and process innovation (Bharadwaj 2000, Broadbent and Weill 1999).

From this discussion we state:

**P1**: IT infrastructure (in the form of creativity enhancing software aids for example), influences the “Development” Stage by helping innovation development teams be more creative.

**P2**: IT infrastructure influences the “Development” Stage by providing capabilities that can be leveraged while designing and developing product and process innovations.

Third, IT infrastructure makes available an overall technical base for implementing innovation solutions. For instance the presence of advanced database management systems can provide a basis for implementing a CRM system, if that is a part of the innovation solution. Therefore we state:

**P3**: IT infrastructure influences the “Implementation” Stage by providing a technical base for implementing innovation solutions.

**Influence of IT human resources:** IS professionals often interact with functional managers and discuss different technologies and their applications with them. They are also aware of the how other companies in the industry use these

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4 “P” stands for “Proposition”
technologies. They hence can enhance the IT awareness of innovation teams through interactions and information exchange. This helps these teams understand better, how specific technologies can be used in the innovation solution.

Therefore:

**P4: IT human resources capabilities influence the “Development” stage by enhancing the IT awareness of the innovation team**

Once the innovation has been conceived, IT professionals are responsible for designing and developing the corresponding technical solutions, helping the innovation teams understand them and educating end users about their use. Hence the role of IT professionals in developing technical platforms for implementation, problem solving, training and end user support is crucial to the success of the implementation process, as stated below.

**P5: IT human resources capabilities influence the “Implementation” stage by providing technical support and helping execute implementation.**

**Influence of intangible resources:** Intangible resources from sustained IT use often take the form of increased customer orientation and enhanced market knowledge. Therefore they add to organizational capabilities for exploration and exploitation of market opportunities. This influences the “Initiation” stage as explained below.

**P6: Intangible resources influence the “Initiation” Stage by helping firms to proactively identify opportunities for business innovation.**

**Influence of IT governance:** The “Development” stage requires quick information dissemination and rapid decision-making. Hence the decentralized mode of IT governance, which permits these conditions to exist by vesting line managers and divisional IS executives with decision making authority, is desirable. In contrast, the “Implementation” stage requires a structured program for efficiently accomplishing the technical roll out of the innovation. The centralized mode, which provides a top down systematic approach to IT management, is desirable in this stage.

**P7a and P7b: Decentralized (Centralized) IT governance increases the effectiveness of the “Development” (“Implementation”) stage**

**Influence of IT coordination:** One of the capabilities from the use of IT is the ability to co-ordinate, by quickly sharing information across time and distance. Chatterjee et al (2002) have suggested that IT coordination enhances the adoption of new technology by legitimizing and enabling the sharing of knowledge and perspectives between business and IT. In a similar vein, Van de Ven (1986) suggests that coordination is necessary to manage the complexity associated with the innovation process and to allow the best-qualified people to work on specific tasks while assuring that their work can be integrated. Therefore, coordination through IT is likely to affect the “Development” and “Implementation” stages, as described below.

**Proposition 8a: Coordination of IT influences the “Development” stage by enabling organizations to identify areas where IT can be used for business innovation.**

**Proposition 8b: Coordination of IT influences the “Implementation” stage by reducing the complexity of implementing the innovation process.**
The model assumes the influence of IT leaders in developing IT capabilities, and the possibility of an iterative effect between business innovation and the development of IT capabilities, as shown below.

**RESEARCH METHODOLOGY**

This research has been essayed in two stages. The first stage consists of a qualitative study of innovative organizations through primary and secondary data. The objective of this stage is to analyze how different aspects of IT capability affect stages of the innovation processes, and hence to broadly verify and extend the eight propositions. The second stage includes a survey of organizations, for validating and refining the findings of Stage 1. A two-stage process is appropriate because there being no existing models that link IT capabilities with business innovation, it is necessary to develop both qualitative, process-based conceptions and quantitative understanding. At the time of the conference we expect to be in a position to present some results from interviews. The truth of the hypothesized influences and propositions and possible existence of other influences will be determined upon completion of our field research.

**EXPECTED CONTRIBUTIONS FROM THE COMPLETED RESEARCH**

The research outlined in this paper is one of the first to explicitly explore perspectives on how organizational IT capabilities influence organizational innovation. We believe it makes the following contributions:

1. It provides an understanding of how IT capabilities influence business innovation processes, by considering linkages between individual aspects of IT capability and the innovation process.

2. The propositions help managers identify specific aspects of IT capability that would need to be developed in order to appropriately influence a specific stage of the innovation process.

3. The propositions help managers to focus on and leverage individual aspects of IT capability during specific stages of the innovation process.
References