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Information Systems Maintenance: A key driver of Business Process Innovation

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ABSTRACT

This paper proposes a conceptual model to investigate the relationship between information systems maintenance and process innovation. A comprehensive review of information systems innovation and business process innovation literature is presented and proposed research model is discussed. The model highlights four innovation enabling factors of process innovation and its relationship with information systems maintenance. Research contribution and implications for practitioners and researchers are also highlighted.

Keywords

Information Systems Maintenance, Process Innovation

INTRODUCTION

Over the past 10 years, three developments have increased the importance of Information Systems Maintenance (ISM). First, the deployment of global information systems to support firm's business processes and attract new customers. These systems require various types and nature of maintenance from their counterparts. Second, the business processes that are supported by the Internet technologies require companies to significantly change their business model to cope up with the change. Third, doing a global business is complex task that is hard to manage and control. Advances in Internet and computing technologies are unprecedented and so are the changes in the business models, strategies and scope. The consequence of this advancement is that the senior management teams have been continuously under pressure to improve the innovation capabilities. A quick conversation with the senior management will reveal that the ability to develop new ideas and innovations is one of their top priorities. In an era of intense global competition, innovation becomes the most important contributing factor for an organizations long term success. Innovation is a process by which companies create new products, services and processes required for addressing change in the market place (Dougherty and Hardy, 1996).

In a survey (Gartner, 2007) of CIO's, 87% of the respondents state that innovation is important to the continuous success of their organization but only 26% of the respondents believed that they have the right innovation processes in place. Furthermore, improving business processes remain the top most priority of many CIOs (Gartner, 2009) for four years in a row. Despite huge concern shown in the research and practitioner community, very little is known on how these processes can be improved to address the growing market needs. One way to improve the businesses processes is through continuously refining the process so that it meets growing business needs. The process of refining the existing system is referred as maintenance.

Although maintenance has been reported as the most expensive part of the Information Systems Development lifecycle yet few or less studies exist that look at ISM area from non-technical perspective. The maintenance work is often left for students, entry level worker or inexperienced personnel. The maintenance work is not well regarded and high staff turnover rate is common in different organizations. The people who carry out maintenance work are treated as "second class citizen" and no or fewer incentives are attached with their work. Despite a substantial body of knowledge present in different areas of

Information Systems, to date there have been no rigorous paper investigating the relationship between ISM and innovation consequences. The question that derives the research agenda for this research is: what is the influence of post adoptive activities (i.e. IS maintenance and support) on process innovation? Following two sections review the innovation literature from Information Systems and business perspective followed by discussion on the proposed research model.

UNDERSTANDING INFORMATION SYSTEMS MAINTENANCE

In order to stay competitive in the market, almost all organizations have to pass through some sorts of maintenance and evolution of their system. The need to change the system normally emerge from a change in the business rules, manifestation of new technology, introduction of new functionality, or fixing an error in the existing system and so on. Several issues related to technical, management and financial areas are involved while managing the overall system evolution and maintenance process. Organizations are continuously finding out new ways to find out how to manage this process with a minimum cost. Several studies including Erlikh (2000) reports that maintenance work is costing companies billions of dollars every year. One of the greatest problems cited by many researchers is the lack of attention on managerial issues to the maintenance work. The reason for this is because maintenance process involves multi-dimensional activities. ISM is about a process of refining the existing information systems to make sure it continues to meet business needs. Empirical evidence shows that money required maintaining a system is far greater than initial development of the system. Chapin et al. (2001) have suggested that ISM involves complex activities, both of the “doing” and the “managing” character. Furthermore, they reported that few practitioners understand the procedure involved in carrying out ISM activities. Khan & Zheng (2005) have suggested that there is a need for “defined formalism describing various tasks, tools and methods is required to enable a clear understanding of the IS evolution and maintenance activities”. These activities may not only be superficial operation work but could potentially link to the business pulses, i.e., the change of business environment or market climate via data maintenance in the decision support systems.

PROCESS INNOVATION

In today’s highly competitive business environment, an organization ability to innovate remains the number one driving force behind long term sustainability in the market place. Edwards B. Roberts (1987) explains innovation as “The first generalization is innovation = invention + exploitation. The invention process covers all efforts aimed at creating new ideas and getting them to work. The exploitation process includes all stages of commercial development, application, and transfer, including the focusing of ideas or inventions toward specific objectives, evaluating those objectives, downstream transfer of research and/or development results, and eventual broad-based utilization, dissemination, and diffusion of the technology-based outcomes”. There were many different explanation of innovation provided by different authors since 1930. It was Rothwell (1994) who explained the composition of the idea behind the concept innovation. He explained the concept of innovation as a series of five generation behavior. According to him, the First generation innovation (1G) occurred during the industrial revolution. In this era, innovation came through the huge push of technology to be used for products and means of production. Another name given for 1G is called “technology push”. Second generation of innovation (2G) occurred when companies shifted their focus to provide market/customer. In this era, market or customer determines the need for products and services and the production systems reply to that need in different ways. This innovation is also some time referred to as “need pull”. Third generation innovation (3G) involved uniting push (1G) and (2G) pull models. In this era, focus was shifted to have a capacity to leverage both 1G and 2G models. It is during this generation that when research and development R&D department start working side by side with the marketing department. Fourth generation innovation (4G) demanded the companies to develop tight integration between R&D, marketing, suppliers and customers. This generation of innovation provides the companies to respond to market (pull or push) needs and at the same time deliver the products and services more efficiently and in less time. The last generation of innovation refers to as Fifth generation of innovation (5G). This generation of innovation builds on the integrated model. This model also refers to as system integration and networking model (SIN). This model is combination of 4G but with the addition of having strategic partnership with suppliers, customer with collaborative marketing and research arrangements. In this innovation, special emphasis is put on the rate of speed by which new products and services are developed with a special focus on quality and other non-price factors.

The goal for this research is to paper the process innovation because this type of innovation deepens the relationship with the existing customer instead of focusing on acquiring new ones. The assumption behind this type of innovation is that no extra effort is required to establish the relationship between customers. On the contrary, product innovations require significant efforts to first establish a relationship between new customers.

Information systems for process innovation

The leading work in defining what constitutes Information Systems Innovation was conducted back in 1994. In this paper, Swanson suggested that the “overall domain of IS innovation may be mapped on two basic dimensions: 1) business impact

and 2) technological and organizational feature composition” (Swanson, 1994). His research work extended the dual-core model (technical vs administrative) of organization innovation and present tri-core model of IS innovation. Following table summarize the type of IS innovation types identified in this paper:

| Innovation Types | Description | Illustrations |
|------------------|---|---------------------------------|
| Type Ia | IS Administrative Process-Innovation | Maintenance Departmentalization |
| Type Ib | IS Technological Process-Innovation | Systems Programming |
| Type II | IS Product and Business Administrative Process-Innovation | Accounting Systems |
| Type IIIa | IS Product and Business Technological Process-Innovation | Airline Reservations Systems |
| Type IIIb | IS Product and Business Product Innovation | Remote Customer Order Entry |
| Type IIIc | IS Product and Business Integration Innovation | Electronic Data Interchange |

Table 1: IS Innovation Types (Swanson, 1994, p. 1076)

The author explained that Type I can be defined as a process innovation that enhances the efficiency or effectiveness of Information Systems. If the focus is the IS administration, then Type 1a will be used. If the focus is about technical IS tasks, then Type 1b will be highlighted. Some examples include the usage of relational database or object oriented technologies in the company. It is suggested that Type I has a potential to support other business innovations in the company but in a “weak-order effects; they may support but they do don’t compel innovation elsewhere” (p.1077). Another example of Type I innovation is software maintenance which is likely to have effects beyond the boundary of the Information Systems unit. Type II innovation contributes in the enhancement of the administrative work processes of an organization. Few examples include payroll systems, office productivity software and decision support systems. The main focus of this type of innovation is towards enhancement of administrative tasks and activities. Type III innovation involves integration of IS products and services with organization’s core technology. This type of innovation enables firms to gain competitive advantage. An example of Type III innovation includes the usage of technology systems like Enterprise Resource Planning (ERP) systems in the organization.

In 2004, Erja and Kalle conducted a qualitative research (Mustonen-Ollila & Lyytinen, 2004) in defining the categories of ISPI. Their model suggests that ISPI can be divided in to two categories (as shown Figure 1)

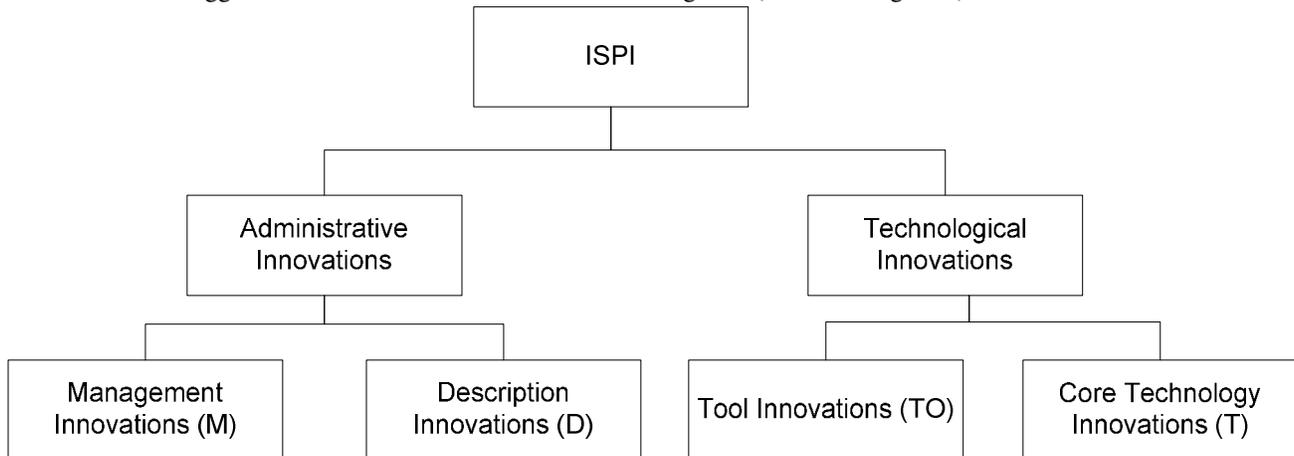


Figure 1: ISPI categories (Mustonen-Ollila & Lyytinen, 2004, p. 37)

They suggest that ISPI covers broad range of innovative activities. Furthermore, they explain that ISPI can “embrace changes in the technologies that offer new computing functionality or novel non-functional features (like portability, security) for the delivered IS. Typical technological innovations include adoptions of programming languages or operating systems. Likewise, ISPIs can include administrative innovations, such as the deployment of project management methods, the introduction of participative approaches to guiding development interactions, or the contracting of development work outside” (Mustonen-Ollila and Lyytinen, 2004, p. 37). Their view of Information Systems Process innovation completely aligns with the

terminology explained by the previous research (Swanson, 1994). The terminology used by Swanson for these type of innovation were called Type1a (Technological) and Type1b (administrative).

Mustonen-Ollila and Lyytinen (2004) further subdivided Type 1a and Type 1b into two categories. Administrative innovation was subdivided into Management Innovations (M) and Description Innovations (D) and Technological innovation was subdivided into Tool innovation (TO) and Core Technology Innovations (T). Furthermore, they suggested that this classification is based on the IS development literature that distinguish between organizational innovations (innovate project management principles, new programming techniques) and usage of innovative notational techniques (Unified Modelling Language) in the organizations.

Management innovations (M) deal with bringing changes in the administrative processes that deal with the overall IS development activities. The result of this change can bring improved project management guidelines or new organizational structure. Description innovations (D) deals with bringing changes in the notational systems that can be used for effective communication between different stakeholders of the project. Few examples include the usage of standardize notational techniques like Data flow diagram (DFD) or Unified Modelling Language (UML) in Information Systems development projects. Tool innovations (TO) deal with the adoption of the technology tools to support IS processes. Core Technology (T) innovations deal with bringing improvements in the overall technical infrastructure that is required to deliver IS products. Few examples include the usage of programming language and database management system in the organization. The constant change in the technology landscape makes it difficult to sustain this type of innovation for long duration.

Following sub section reviews the business process innovation literature and identifies the innovation enabling constructs based on the recent studies.

Business process innovation

Business process innovation is a type of innovation that focuses on extracting waste not from product or service but from the enabling processes that produce it (Moore, 2008). The goal for this type of innovation is to remove the no value-adding steps from the workflow. Dell's direct-retail is a typical example of process innovation. The concept of process innovation has been looked from different perspectives including and not limited to Resource Based View (RBV). The origins of the RBV can be traced back to 1959 when Penrose suggested that an organization should be viewed as 'a collection of human and physical resources bound together in an administrative framework, the boundaries of which are determined by the area of administrative coordination and authoritative communication'. Several different views emerge until 1984 when Wernerfelt noted that "bundle of assets" are required to achieve firm's competitive position. These assets can be tangible or intangible and when applied in bundles, create a capacity to achieve desired objective, and hence called competencies of the organization. This paper assimilates previous research on RBV and process innovation and identifies innovation enabling constructs for this paper. Table 2 and Table 3 show the list of innovation-enabling IS competencies, activities and roles with supporting literature.

In this paper, we are concerned with how the post adoptive activities like ISM & support bring process innovation related to technological changes in the organization. Mustonen-Ollila and Lyytinen (2004) classify technological innovation in to Tool innovations (TO) and Core Technology Innovations (T). Both TO and T are part of process innovation as shown in Figure 1. The focus of this paper is to examine how the ISM activities bring incremental technical innovation in the organization. Incremental innovation relates to enhancement or refinement made to the existing tasks, routines, processes, products or services Administrative changes like structural or notational changes are not focus of this paper. This paper extends the incremental technical innovation literature by examining the effect of Information Systems Maintenance on this type of innovation within an organization context. Madanmohan (2005) explains that these innovations are "construed as refinements and improvisations to existing technology based on an established foundation of technical knowledge". In the IS literature, technological innovation is classified into Tool innovations (TO) and Core Technology Innovations (T) (Mustonen-Ollila & Lyytinen, 2004). We believe that these two incremental technological innovations are different in terms of their inputs, source and investment.

| Source | Innovation-enabling Competencies |
|--------------------------|--|
| Tarafdar & Gordon (2007) | Knowledge Management Collaboration Project Management Ambidexterity IT/innovation governance |

| | |
|--|--|
| | Business IS Linkage Process Modelling |
| Ray et al. (2005) | Shared knowledge IT infrastructure flexibility |
| Ravichandran and Lertwongsatien (2005) | IS planning sophistication System Development Capability IS support maturity IS operations capability |
| Bhatt and Grover (2005) | IT Infrastructure IT business experience Relationship infrastructure |
| Wade and Hulland (2004) | External relationships management Market responsiveness IS business partnerships IS planning and change management IS infrastructure IS technical skills IS development capability Operational efficiency |

Table3: Innovation-Enabling Competencies

According to Mustonen-Ollila and Lyytinen (2004), an innovative activity triggers other types of innovations in the spirit of social-technical design. They further explain that the introduction of the Computer Aided Software Engineering (CASE) tools may bring changes in organizational principles of software engineering. In the same sense, Information Systems Maintenance activity brings a socio-technical system innovation in the firm. The focus of this change can be towards bringing technical or administrative innovation in the organization.

| Source | Innovation-enabling Activities & Roles |
|-------------------------------------|---|
| Shin (2006) | Inter-Organizational systems |
| Karahanna and Watson (2006) | IS Leadership |
| Marjanovic (2005) | Knowledge Management Coordination |
| Mustonen-Ollila and Lyytinen (2004) | Knowledge Transfer Mechanisms Slack IS resources |
| Attaran (2003) | Infrastructure flexibility Communication Coordination Project Management Process Analysis |

Tab4: Innovation-Enabling Activities and Roles

CONCEPTUAL RESEARCH MODEL

Two steps process was used to identify the innovation-enabling constructs for this paper. First step involves the identification of innovation-enabling constructs that could affect process innovation. For example, the term “coordination” is expected to have an influence on the process innovation. Several studies including (Marjanovic, 2005; Attaran, 2003) identified coordination as an innovation enabling construct. Based on the extent literature, it is proposed that “inter functional coordination” as innovation-enabling construct for this paper. Second step involves critical review of the available competencies, activities and roles and identify only those constructs that positively affect business process innovation. This step further reduces the number of innovation enabling construct to only those which contribute in the successful innovation outcome. For example, Tarafdar and Gorden (2007) suggested that Project Management and Business IS Linkage competencies may pose problems in the overall innovation process. They further added that they did not find evidence if Process modelling competency has any effect on the process innovation.

Based on the above discussion, the research model is proposed as shown in Figure 2. Four innovation enabling constructs are identified based on the literature.

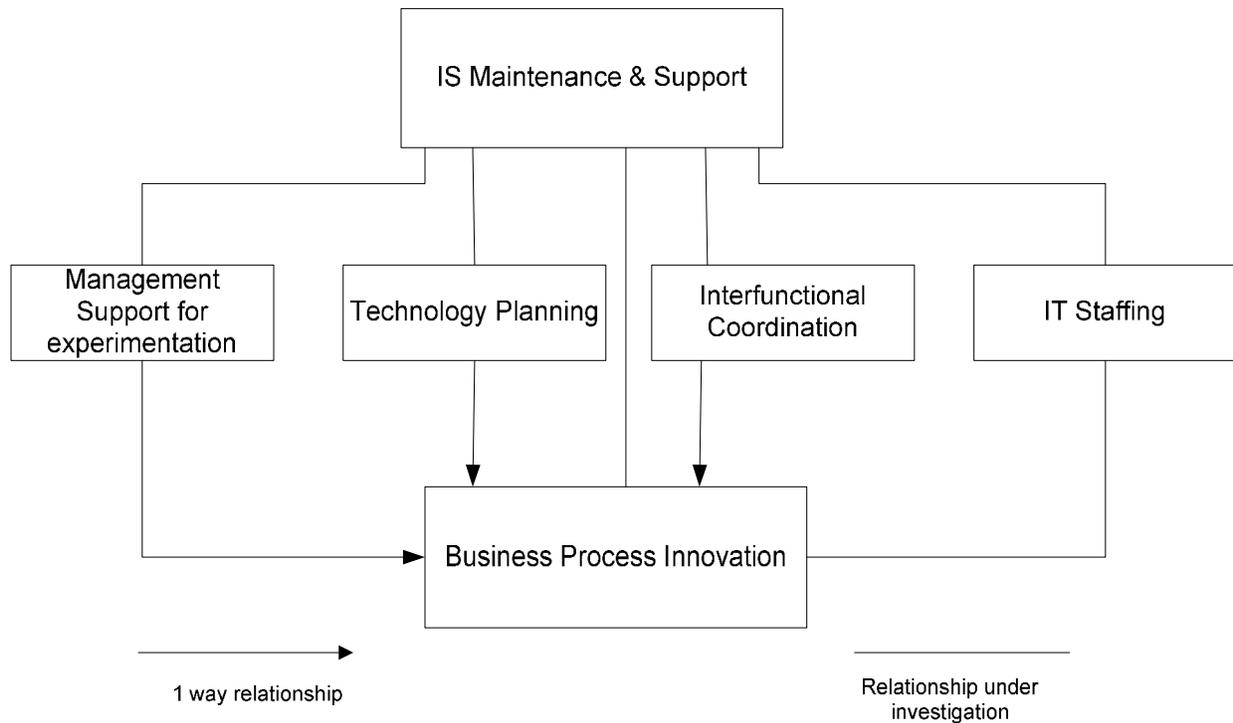


Figure 2: Proposed Research Model

Management Support for experimentation

Total Quality Management and Human Resource Management literature suggest that discovery and utilization of local knowledge increases when senior manager delegate the authority of problem-solving to junior staff. Several studies including Madanmohan (2005) confirms this proposition and state that the speed of experimentation in an organization also increase when there some incentives in place to recognize and reward that discovery (Aoki & Dore, 1994; Jensen and Meckling, 1992). Furthermore, Madanmohan (2005) reported that rate of innovation increases when management has a positive attitude towards experimentation.

Technology Planning

Cusumon and Elenkov (1994) suggested that firm’s ability to develop technical innovation depends on their technical capabilities. Several studies including Panizzolo (1998) have suggested that these technical capabilities are developed when serious attention is given to the technological planning phase. Furthermore, IS literature suggests that technology planning plays an important role towards building technological innovation.

Inter functional Coordination

Wheelwright and Clark (1992) identified that interface management is required to achieve product or process innovation. Interface management is about managing the issues among people, departments, and discipline and not within teams. Malone and Crowston (1994) explained that coordination is about “managing of dependencies between activities”. Grinstein (2008) argued that increased inter-functional coordination is one of the critical factors for achieving process innovation.

IT Staffing

Staffing is a management function that includes recruiting, hiring, training, evaluating and compensating activities. The firm's ability to innovate depends on the inventive or imaginative skills of its employees. IT staffing plays a critical role at the pre and post-adoption phase of a IS/IT project. Several studies including Curtis, Hefley and Miller (2009) and Dennis & Wixom (2008) suggested that staffing decisions impact the performance of the organization.

Relationships

This aim of this research is to explore six relationship represented by a line in the Figure 2. Three relationships are identified based on the review of the existing literature. These relationships will be examined again in the context ISM. Following section explains the relationship identified for this research:

One way relationship

One way relationships are represented by an arrow in Figure 2. Three relationships are identified based on the empirical evidence drawn from Mandanmohan (2005), Panizzlo (1998) and Grinstien (2008) which indicate that Management support for experimentation, Technology planning and Inter functional coordination positively influence business process innovation. These relationships will be re-examined again in the context of this paper.

Relationship under investigation

In Figure 2, a solid line is used to represent the relationship that will be investigated in this research. Six relationships are identified based on the following premises:

First relationship will examine the link between top management support for experimentation and IS maintenance & support. Curtis, Hefley, & Miller (2009) argued that top management support is required to initiate a change process in the organization. In some cases, it is mandatory to bring the management on board before initiating a project. IS/IT adoption studies suggest that top management support is a critical factor for the successful pre-implementation of IS/IT project. In the same sense, we predict that IS maintenance & support work will be influenced when management has positive attitude toward experimentation. Second relationship will examine the link between technology planning and IS maintenance and support. Technology planning plays an important role at the IS development stage (Panizzolo, 1998 and Dennis and Wixom, 2003). We predict that IS maintenance and support will be influenced when serious attention is given to technological planning phase. Third proposed relationship will examine the link between inter functional coordination and IS maintenance and support. It is important to test this link because at the post adoption phase, the essence of IS maintenance and support work is to manage dependencies and provide solution to carry out activities in better way. Fourth and fifth proposed relationship will examine the influence of IT staffing on business process innovation and IS maintenance & support. Several studies including Swanson (1994) suggested that inexperienced personnel or entry level workers are employed to carry out maintenance work. We predict that IT staffing will have an influence on IS maintenance and support activities as well as on business process innovation. Sixth proposed relationship will examine the link between IS maintenance & support and business process innovation. It is important to examine this link because informed and intelligent decisions are only made possible when proper data maintenance protocols are in place. The whole chain from data to intelligent decision making will be broken if data is not properly maintained.

RESEARCH CONTRIBUTIONS

This research should interest both academics and practitioners as it investigates an important conceptual issue which also has significant practical value for Information System practitioners.

Theoretical value

This research will add theoretical value to the existing literature in the field of information systems by establishing a theory explaining Business Process Innovation. It also extends Post-adoption literature by introducing the role of Information Systems Maintenance in it. The proposed model can be used to further develop theories on IS product or services innovation.

Practitioner value

Information Systems practitioner will also benefit from this paper. This paper will help them better understand the value of maintenance operations and the innovation it can bring in the organization. This paper would enable practitioner to make better case for higher management to put serious attention to this issue.

CONCLUSIONS

In this paper, we predict that post adoptive activities like maintenance and support contribute to the business innovation. Four innovation enabling constructs were identified from the business and IS innovation literature. The proposed research model is an attempt towards addressing an issue raised by the practitioner community (Gartner, 2009) and building a theoretical model that study the effect of post adoptive activities on business innovation.

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