# The organizational dynamics of knowledge and IT-enabled innovations

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**ABSTRACT**

The paper presents an integrated framework for IT-enabled organizational innovations. The framework highlights the factors that affect the effective introduction of knowledge and information systems to become organizational innovations. It conceptualizes the innovation process as an open system and takes into consideration knowledge management and performance evaluation. The rationale for this framework is that because of the narrow scope of current frameworks, managers and IT personnel often fail to see the whole picture of their organizations. This difficulty reduces managers' ability to understand the interrelationships between IT-based innovations and business processes. Consequently, introducing IT/IS into an organizational context doesn't achieve its intended objectives and often fails entirely. The framework will be useful to managers in their efforts to transform their organizational operations with the use of IT applications.

Key words: IT applications, Innovation, Open systems, Knowledge management

## INTRODUCTION

This paper introduces a conceptual framework of IT-enabled innovations which conceptualizes the innovation process as an open system. The framework builds on the recent trends in the business and computing environments. For example, organizations have been moving away from being rule-based systems that focus on regulating employee behavior and procedures to mission-based organizations that emphasize outcome-based measurements. This paradigm shift has allowed the creation of a managerial culture that promotes quality, openness, and innovation. Similarly, the dominant paradigm of computing has shifted from an efficiency and automation focus to effectiveness and knowledge management focus. This shift is demonstrated by management efforts to align the technological innovations with the organizational mission.

The knowledge management process and organizational learning are becoming essential keys to organizational creativity and innovation (Henard, D. and M. Ann McFadyen. 2008). Innovative managers take advantage of the opportunities that IT can provide to add value to existing services and products and create new ones. This can be achieved by adopting an effectiveness-based strategy rather than efficiency-based strategy. Innovative managers use IT not only to streamline the existing business processes of their organizations, but as a catalyst to rethink and redesign them, establish new ones, or create a paradigm shift (Feeny & Willcocks, 1998). An effectiveness-based strategy demands more resources and faces higher resistance, therefore, executive level commitment is essential for this strategy to be successful.

In order to sustain a high level of quality in their services and products, organizations continuously improve their production and delivery systems. In this context, innovative managers rely more on informal networks to establish goals, on flexible teams to produce, and on customers' feedback to establish criteria for effectiveness (Pyka, 2002; Rodan, 2002).

Managers' decisions about IT/IS are critical, because the productivity and quality of work life of employees depend on the quality of the systems supporting them. In order for managers to make better decisions they need to have a comprehensive view of their organizations. The rationale for the new framework developed here is that managers and IT personnel often fail to see the whole picture of their organizations. This difficulty reduces managers' ability to understand the interrelationships between IT-based innovations and business processes. Consequently, introducing IT/IS into an organizational context doesn't achieve its intended objectives and often fails entirely. The proposed framework will help managers and practitioners see the whole picture of their organizations when adopting IT-enabled systems to become organizational innovations.

The following sections will focus the discussion on IT-enabled innovations, and then it presents the elements of the framework with extended section on knowledge and knowledge management.

## IT-ENABLED INNOVATIONS

Introducing IT/IS-based innovations is a complex process which has the potential to radically change organizational operations. Innovation can be defined as inventions or adaptations that result in new ways of transforming the production system (Chen et, al, 2004). An innovation is an idea, product, practice, or service that is perceived as new by the

organization or the unit of adoption (Rogers, 1983). Innovation may also be defined as the knowledge process that allows the creation, sharing, and assimilation of new knowledge a particular context (Herkema, 2003). Innovation takes place through three overlapping stages: invention, implementation, and diffusion (Dosi, 1988). The multi-phase nature of the innovation process adds to the complexity of the problem. For example, organizational conditions that may facilitate idea generation may conflict with the forces that facilitate implementation (Zaltman, et al, 1973).

The adoption and implementation of IT/IS into organizational operations would be considered a process-based innovation. IT tools may be introduced for streamlining purposes, this will qualify as incremental intervention (enabling minor improvements), while in other cases it may be introduced as a radical intervention (enabling structural shift in organizational operations). There is no unifying theory of innovation adoption, and most researchers agree that innovation adoption and diffusion should be examined in the context of its introduction (Fichman & Kemere; 1993).

For a new information or knowledge system to become an innovation, it has to be accepted by organizational members, and it must enable positive change in organizational operations. Therefore, the successful introduction of a new IT/IS requires adjustment in organizational dimensions because organizational members may resist its application. While, Organizational learning provides the framework for inventing and generating ideas, an innovation culture, on the other hand, provides the framework of implementing and diffusing these new ideas. A culture that accepts change and has a reward system reduces organizational resistance to change, thus enabling an invention to break through organizational resistance to become an innovation. It is important that managers be open minded and involve the potential users of a new information system at the initial stage of its design and inception. Managers must also invest a great deal of time and effort on problem identification and analysis to make sure that the proposed system is appropriate to solving the problem (Taylor, 1998).

Reality does not consist of sets of independent problems, but as a system of interrelated problems. The effectiveness of a system is derived from the interaction of its parts, not from the actions of its parts taken separately (Ackoff, 1981). Introducers of IT-enabled innovations must realize that all the parts of the organization have to be aligned in order to improve organizational performance. Managers' attention should be directed at the interactions of the parts or the subsystems, not only on the parts themselves.

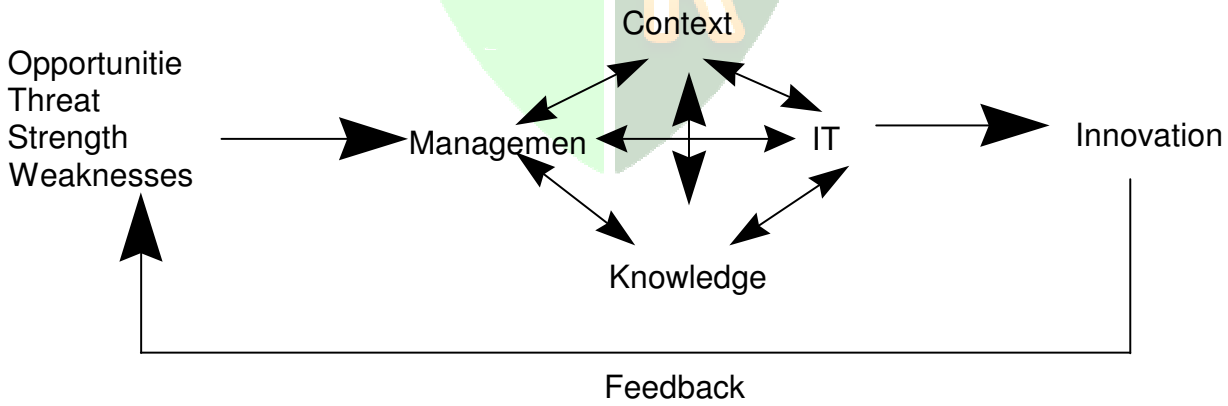
Focusing on the interactions prevents managers from making major mistakes in solving problems. Often the most effective treatment may not be best where the problem (symptom) appears. For example, in one high tech company, management realized that the development of new products was behind schedule. With little investigation management found that a high percentage of its engineering staff time was spent in answering customers' questions regarding new products. Initially management proposed to hire more engineers. However, when they looked at the interaction between help desk staff and engineering staff, they realized that hiring more engineers was not the best solution. It seems that the help desk staff could not handle most inquires and therefore forwarded them to the engineering staff. Consequently, the help desk personnel became idle. The company did not need more engineers; it needed better trained help desk personnel. The company decided to design a knowledge-based system to assist help desk staff. With the new system they were able to answer the majority of the questions (Dhar & Stein, 1996).

## THE FRAMEWORK FOR IT-ENABLED INNOVATIONS

The framework constructed in this paper is based on several bodies of knowledge such as: systems theory, systems thinking, KM, organizational change, IS, organizational learning, and innovation. For example, systems thinking has been considered as one of the core IS capabilities for exploiting information technology (Feeny & Willcocks, 1998; Gharajedaghi, 2005; Checkland & Poulter, 2006). Systems thinking allow managers to envision the business process that technology makes possible and learn how to integrate business development with IT capability (Lampela & Kakkainen. 2008).

The framework of IT-enabled organizational innovations is presented in Figure 1 which shows the nature of the interaction among the constructs that impact the effectiveness of the innovation. The model represents an open system in which the output is the new system and the inputs are opportunities (i.e. new technology), threats (i.e. public dissatisfaction), strengths (i.e. trainable workforce), and weaknesses (i.e. lack of computing skills), that affect the organization. There is also a feedback loop that informs decision-makers on the usefulness of the system in reducing threats and weaknesses or enhancing strengths and creating new opportunities to the organization. Indeed, managers should continuously scan the internal and the external environments and devise tools and mechanisms to evaluate the usefulness of the system. These evaluation instruments must fit the context of their organizations (see the section on Evaluation Criteria and Feedback).

**Figure 1: IT-Enabled Organizational Innovations**




The central part of the framework is diagrammed as a diamond (Leavitt, 1965) with four elements: management activities, the organizational context, the knowledge base of the organization, and IT availability. A change in any element in the diagram affects all the others. The interplay among these elements determines the final shape of the system becoming an organizational innvation. From business and strategic perspectives, these four elements must be understood and nurtured in order to effectively bring IT-enabled innovations to solve organizational problems or meet environmental challenges.

In the framework presented in Figure 1, IT availability (i.e. designers, software applications), organizational knowledge base (i.e. designers, conceptual modeling tools), organizational context, (i.e. processes, operations, users' acceptance of the system) and managerial action (i.e. champions, awareness) interact to impact the innovation process positively or negatively. For example, in one scenario management may introduce new system to solve business problem such as inventory management. The analysis (knowledge base, modeling) is based on entity-relational modeling, and the technology needed (IT availability) is a database base management system such as Oracle. If management doesn't pay attention to user training (organizational context) then the dynamic of the elements would impact the innovation process negatively. The following sections will focus the discussion on the four elements of the central part of the model and on the feedback loop.

## MANAGEMENT & MANAGERIAL ACTVITIES

It is important to note that the experience, qualification, and attitude of managers involved in the process of technological innovation affect the outcome of the process. Managerial activities aimed at managing the process of introducing IT/IS are essential for its success. Regarding the introduction of IT-enabled innovations, managers face several challenges. First, managers usually don't have the tools or the time to measure the benefits of the systems they introduce. Second, often the unintended results of introducing a new system outweigh its planned objectives. Managers' reaction is crucial, specifically when results are negative. They should learn from the experience and avoid wasting time justifying what happened. Third, with IT continuously changing, managers must learn how to build and maintain flexible IT infrastructure to support organizational goals (for more details see the section on *IT Availability: Building Flexible IT/KM Infrastructure*). Fourth, there is high turnover of trained IT personnel. Therefore, a reward system and adequate incentives must put in place to help retain productive workers.

In general managers tend to be somewhat conservative in their efforts to innovate with information technology applications. Most managers may seek only incremental improvements in factors related to task execution, productivity, and service delivery when they implement IT in their organizations (Watad, 2000). They seek very little change in structural arrangements and attributes. Due to the high level of uncertainty of the outcomes of IT-enabled innovation, managers tend to react to external pressure more than to initiate or take advantage of opportunities. However, technology awareness and champions are very important factors in changing the organization culture to adopt radical IT/IS-based innovation. According to Curley and Gremillion (1994) champions are those "who make decisive contributions to the innovation by actively and enthusiastically promoting its progress through the critical stages of its development and adoption." Technology awareness by managers determines the relative timing of the introduction compared with other organizations. Usually high awareness corresponds with high tolerance of uncertainty, and managers with higher awareness tend to try new ideas. Managers should help their organizations develop technology awareness by organizing seminars and forming relationships with other organizations. In addition, since transformation efforts demand resources and faces higher resistance, therefore, executive level commitment is essential for IT-enabled innovations to be successful.

## ORGANIZATIONAL CONTEXT

The second component of the central part of the model is the organizational context. Since IT/IS can be viewed as an instrument of organizational change. Its introduction can trigger transformations that may have an impact on the different elements of an organization, such as its people, and its structure. The introduction may also transform the degree of effectiveness of the organization. The organizational context of IT-enabled organizational innovations requires managers to evaluate potential organizational resistance for change and continuously scan the internal environment for opportunities for improvements.

Leavitt's model is useful to describe and explain organizational resistance. An organization's elements, according to Leavitt (1965), include its structure, its technology, its people and its tasks. A change in one element may result in changes in the others. For example, changing the technology by introducing IT may generate change in other elements of the organization. Similarly, change in the basic tasks performed by an organization is almost inevitably accompanied by a change in technology, that is, modifications in the way in which tasks are accomplished. Managers may bring IT into a unit to facilitate change in a particular task by changing the method of performing the task: to make the task easier to complete, to enhance accuracy, to achieve better access to information, and/or to obtain greater control over the task. These changes may require modifications in other elements of the organization such as the people performing the task. Employees may require training to learn the new method, they may ask for changes in their job titles to reflect their changed duties, which, in turn, impact the organization's structure.

In general, the ultimate way to reduce resistance is to change all the elements simultaneously. Organizational resistance causes many system failures. There is a need to "unfreeze" organizations before implementing a new system (Keen, 1981; Kolb and Frohman, 1970). Organizational innovation is difficult to achieve and requires more than just getting the technology. Elements of the organization must adjust in order to benefit from introducing new systems. For example, workers' attitudes and values may have to change accordingly. Top level commitment may also be a key for managing the social adjustment that accompanies the technological change in the organization.

## KNOWLEDGE & KNOWLEDGE MANAGEMENT

The most recent IT--enabled innovations relate to knowledge systems and knowledge management. The purpose of KM is to add value to information already held by the organization and leverage human expertise resulting in knowledge that will enhance organizational performance (both the efficient use of resources and enhancing the effectiveness of the organization).

In order for organizations to be innovative they have to develop the ability to create and acquire new knowledge, the ability to apply it, and the ability to translate it into new ways of behaving. Creating and deploying knowledge are key components of organizational learning, a condition necessary for innovation and systems thinking. Therefore, KM efforts should be advanced as a continuous effort, which requires a commitment to learning (on learning see Garvin, 1993). Building knowledge assets takes place, for example, through creating skills, model bases, documenting procedures, and streamlining standards. Deploying knowledge takes

place through training, rotating jobs, attending seminars, circulating information, using on-line services, and web tools.

Knowledge assets in organizations can be analyzed at either the individual, group, organizational, and external links levels (Dutta, 1997). In general, the individual is the main unit that creates and uses knowledge in an organization. However, organizations can learn through their external links with suppliers and customers. Groups and networks within the organization may also produce knowledge that exceeds the sum of the group members' skills. Therefore, managers have to pay attention to these aspects of knowledge creation and deployment within their organizations.

There are two types of knowledge, explicit and tacit (Nonaka, 1994*).* Explicit knowledge (EK) exists in documents and databases. Tacit knowledge (TK) flows in the experiences of individuals, exists in their heads or in their group interaction and informal associations\networks. Knowledge management efforts rest on two pillars: first managing EK, which is basically adding value to an organization's articulated information resources, and second, managing employee's tacit knowledge.

Tacit knowledge is essential in enhancing the firm's innovation performance. Organizations can tap TK by allowing knowledge sharing in the work environment and support the sharing with IT enablers such as groupware, email, video conferencing and bulletin boards. However, managers have to provide incentives for sharing by creating a new organizational culture that rewards people for sharing their ideas. For example, organizations can institute partial telecommuting as an incentive for employees sharing their knowledge. In this sense telecommuting offers organization a way to manage talent by keeping these people working for the organization.

IT provides many tools that are useful in supporting knowledge management in organizations (Maglitta, 1996; Watad, 2002), such as intranets, groupware videoconferencing, knowledge-based systems, content systems, project management systems, and skills inventory systems. IT tools that support knowledge management may be categorized along various dimensions. For example, the maturity dimension informs us that databases, networks and distributed systems are very mature, while advanced (intelligent) technologies such as search engines, data warehouses, OLAP, discovery and AI tools are still evolving. The technology (platform) dependency dimension informs us that tools such as artificial neural net and intelligent applications are technology dependent and context-specific, while tools such as email and relational database systems are independent.

In the last few years there has been a flood of multiple views, definitions, and frameworks of KM (Prusak, 2001; Lundvall & Nielson, 2007; Du Plessis, 2007). The main reason is that KM is very complex process and managers lack an understanding of knowledge flows. Also KM efforts lack clarity, lack evaluation measures, and suffer many contradictions and competing objectives. For example, managers want their employees to share their knowledge but don't offer incentives to do so. Employees feel that they should hold on to their knowledge, otherwise they will lose their importance and consequently lose their jobs. However, most researchers agree that KM plays central role in enhancing the capabilities of organizations to innovate by enabling the sharing of tacit knowledge and collaboration both internally and externally across organizational boundaries (Cavusgil et al, 2003).

**IT AVALIABILITY & FLEXIBLE INFRASTRUCTUR**

The resource-based view of the firm supports the notion that using IT resources strategically can provide a sustained competitive advantage to an organization (Teece et al, 1997; Powers and McDougall, 2005; and Stanworth *et al.*, 2004). The rapid advancement of IT presents managers both with challenges as well as with new tools and ways to conduct their business. For example, one company is using its intranet as a platform for information exchange and to recruit current employees for key projects. The company allows its employees to update their records and process their human resource related functions on-line. This company introduced a system that enables managers to design customized development plans for employees to give them incentives for career growth.

IT tools and competences in information and knowledge management, project management, and communication, play an important role in an organization's ability to innovate (Gordon & Monideepa, 2007). There are many examples of business applications that have been either heavily facilitated by IT, such as telecommuting, or have been created by IT, such as electronic commerce, communications, and various web technologies. Contingent on adequate diffusion of IT resources in their organizations, managers can raise the level of awareness regarding the usefulness of technology among their employees and customize information to fit their needs, thus enhancing the productivity of the organization.

The growing complexity of IT and its applications, make it very difficult for organizations to develop models and systems to deliver the technology and consequently business solutions. Managers, developers and users are having a difficult time staying current. The law of requisite variety in cybernetics informs us that in order for any system to preserve its integrity and survive, its rate of learning must match the rate of change in its environment. With IT continuously changing, organizations and managers must increase their rate of learning.

To help cope with this complex IT environment, organizations may adopt guidelines that streamline technological innovations efforts in a performance driven culture. A key element in these efforts is to build a flexible infrastructure that easily adapts to new types of data, software applications and business needs. This allows organization to implement ad-hoc solutions within a framework of general guidelines. Elements of this approach are:

* Advance IT/KM as a continuing effort.
* Select scalable and open tools.
* Don’t lock yourself into any single vendor technology.
* Identify and formulate problems carefully.
* Focus on a specific high leverage problem area.
* Plan systemically (consider the organization as a whole).
* Execute systematically (be tactical and implement locally).
* Evaluate from organizational members' perspective.
* Provide incentives to promote sharing and incorporate sharing into performance measures.

Organizations and IT vendors are slowly acknowledging the importance of having flexibility in IT tools. For example, new tools such as XML and mining tools are allowing the creation and manipulation of content in context. Organizing content in its relevant context and managing documents in this fashion improves user understanding of the reasons underlying

the logic of the document. It allows instant access to themes within the document. This approach will help the user screen faster the relevant documents needed to meet his/her objectives

## EVALUATION & FEEDBACK

Literature points out to the usefulness of influence diagrams and systems thinking in recognizing set of performance measures in complex systems (Davis & O'Donnel, 1997). Feedback on what the systems does, specifically, the feedback from an effect to the original cause is very important. Systems theory considers cause-and-effect relationships to be more complex than the simple linear models depicted in cause-and-effect diagrams. This feedback is depicted in either a balancing loop or a reinforcing loop (Senge, 1994). In the balancing loop the effect of a cause provides feedback that turns the cause in the other direction. In the reinforcing loop the effect provides feedback that the cause should continue with its original action. An early diagnosis of the effect feedback will provide a signal on what loop is taking place, consequently, helping managers to adjust the system.

IT-enabled innovations should be evaluated based on their positive transformation of the organizational processes. There are three levels of evaluation that corresponds with the process of innovation: 1) the invention stage in which the development of the system is completed, 2) the implementation stage in which users use the system, and 3) the diffusion stage in which transformation and integration of organizational processes takes place. At the diffusion stage, organizational outcomes could be used as criteria to evaluate the success of the organization's IT/IS-based innovation efforts. In general, to be effective is to produce the intended outcomes. What the intended outcomes of an organization are, or should be, depends on the philosophy of its management. Literature on organizational effectiveness has identified many outcomes used as measures of organizational performance (Campbell, 1977; Heffron, 1989). The organizational outcomes most directly related to IT introduction and innovation, included: productivity, quality of work life (QWL), competitive advantage, responsiveness, and accountability (Watad, 2000).

Productivity may be measured using variables such as: increasing organizational output, reducing task processing time, and reducing operations' cost. QWL may be measured using variables such as: reducing employees' stress, improving job satisfaction, and enhancing morale. Competitive advantage may be measured using variables such as: linking related services, improving quality of product/service, and introducing new ones. Responsiveness may be measured using variables such as: delivering products faster, maintaining updated knowledge about customers, and providing more information to more customers. Accountability may be measured using variables such as: increasing organization's accountability toward the environment, and improving organizational capacity to reduce errors. These outcomes are not mutually exclusive and there is some overlap among them. An example is the relationship between responsiveness and competitive advantage. It is difficult for an organization to achieve all outcomes simultaneously, consequently, achieving one, may occur at the expense of the others. Managers can use these five criteria as a framework for evaluating IT-enabled innovations. From this framework, they can develop a short list of measures based on their focus and the intended objectives of the innovation.

## CONCLUSION

This paper introduced a new conceptual framework of IT-enabled innovations. The framework has the potential to advance knowledge in the IT/IS area and it will also be useful to researchers to develop propositions and hypotheses for further research. The framework is based on system theories and systems thinking. It conceptualizes the innovation process as an open system with a feedback loop. The output of the open system is the innovation itself and the inputs are opportunities, threats, strengths, and weaknesses that affect the organization. The feedback loop informs decision-makers on the usefulness of the innovation in reducing threats and weaknesses or enhancing strengths and creating new opportunities to the organization. The central part of the framework consists of four main constructs: managerial activities, organizational context, IT availability, and the knowledge base of the organization. The dynamics of these constructs influences the effectiveness of IT-enabled innovations. Put differently, in order for an organization to improve or transform its operations with IT-enabled innovations, these four constructs must be examined and understood. The framework emphasizes the relatedness of the constructs and simplifies the complexity of the interrelationships among them.

Innovations occur in response to changes in the environment or in response to internal dynamics such as new leadership. Most innovations are not favored by the status quo. Established patterns of organizational behavior continue to predominate. In order to survive, innovations need to pass the threshold of becoming favored by the members of the organization. Organizational learning provides the framework for inventing and generating ideas. Knowledge management and supportive innovation culture, on the other hand, provides the framework of implementing and diffusing these new ideas. A culture that accepts change and has a reward system reduces organizational resistance to change. For an information or knowledge system to become an innovation, the system has to be successfully implemented and accepted by the users. The system also has to enable positive change in organizational operations.

Appropriate performance criteria should be used to evaluate IT-enabled innovations. It is imperative that managers analyze carefully their organizational problems and needs before introducing IT into organizational operations and processes. Reality does not consist of sets of independent problems, but as a system of interrelated problems. Understanding the context of their unique problems managers will be able to recognize opportunities and customize technological solutions accordingly. The proposed framework will help managers and practitioners see the whole picture of their organizations when adopting IT/IS to become organizational innovations; consequently, improving the decision-making capabilities of the organization.

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