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Abstract

Recent literature has emphasized the pivotal role of knowledge integration in Enterprise Systems (ES) success. This research-in-progress paper, building upon Knowledge Based Theory of the firm (KBT), examines the efficiency of knowledge integration in the context of ES implementation and identifies the factors contributing to its enhancement. The proposed model in this paper suggests that the efficiency of knowledge integration in an ES implementation process depends upon the level of common knowledge and the level of coordination in the ES adopting organization. It further suggests that the level of common knowledge can be enhanced by proper training, improving ES users' intrinsic and extrinsic motivations and business process modeling and the level of coordination can be improved by articulating a clear unified organizational goal for the ES adoption in the organization, forming a competent ES team, enhancing interdepartmental communication and the cross-functionality in the organization structure.

Keywords: Enterprise Systems, ERP, Knowledge integration, Knowledge Management

1   INTRODUCTION

Since mid-1990s Enterprise Systems (ES) have been considered as the de facto standard replacement for the old legacy systems in the organizations (Parr & Shanks 2000). The fundamental idea of ES is integrating data and business processes throughout an enterprise (Häkkinen & Hilmola 2008; Markus & Tanis 2000) and providing integrated functionality for business processes and functions such as human resource management, financials, manufacturing, sales and distribution (Ng & Gable 2010; Strong & Volkoff 2010). As a result they have been diffused and adopted in different industries and received a lot of attention from both academics and practitioners. In parallel, the importance of Knowledge Management (KM) and its strong effect on ES success have been acknowledged (Lee & Lee 2000; McGinnis & Huang 2007; Sedera & Gable 2010). Nevertheless, to date the majority of studies on KM in ES deployment have been on knowledge transfer phase of the KM life cycle (Ebrahimi 2012; Sedera & Gable 2010) and other phases especially knowledge application, which is the most value adding phase of KM (Alavi & Tiwana 2002) have been mostly neglected.

Knowledge integration, a key facet of knowledge application, is the synthesis of individuals' specialized knowledge into situation-specific systemic knowledge (Alavi & Tiwana 2002). Recently Zakaria and Sedera (2013) demonstrated the strong association between knowledge integration and ES success. While ES literature posits that the knowledge gap between individuals is the main cause of unsuccessful adoption of an ES (Pan et al. 2007; Soh et al. 2000), there is still dearth of studies on how knowledge integration can be enhanced in ES implementation process. To shed some light on how to enhance knowledge integration in ES context we build on Knowledge Based Theory of the firm (KBT) (Grant 1996a, 1996b) and discuss the factors and practices, which enhance the efficiency of knowledge integration in ES implementation process.

The rest of the paper is organized as follows. In the next section, the theoretical foundation of the paper is described. This is followed by the research model and hypotheses on different factors and sub-factors contributing to enhancing the efficiency of knowledge integration in ES implementation process. Finally the conclusion and future works conclude the paper.

2   THEORETICAL FOUNDATION

Originating from the need for differentiation and integration, Knowledge Based Theory of the firm (KBT) emphasizes the economic value of specialization and the effectiveness of integration. It posits that an organization's competitiveness depends on the diversity of its specialized knowledge and its capability to integrate the specialized knowledge effectively (Huang & Newell 2003). Three main mechanisms for integrating knowledge are rules and directives, routines and self-managing teams (Grant 1996a). Self-managing teams are most suitable for integration of knowledge for non-routine and complex organizational tasks that include uncertainty and novelty (Alavi & Tiwana 2002).

Grant (1996a) posits that three factors determine the organization's competitiveness derived from knowledge integration: (i) efficiency of integration, (ii) scope of integration, and (iii) flexibility of integration. He argues that efficiency of integration is dependent on three factors: the level of common knowledge, the level of coordination and organizational structure.

In this paper, we focus on efficiency of knowledge integration in the context of ES implementation process. We identify sub-factors and processes contributing to enhancing each factor of efficiency of knowledge integration in ES implementation context.

3   RESEARCH MODEL AND HYPOTHESES

Figure 1 depicts the research model illustrating the hypothesized relationships, which is discussed in this paper. It proposes a model in which efficiency of knowledge integration in ES implementation process depends upon two factors of level of common knowledge and level of coordination. For each of these factors a set of sub-factors and processes are identified, which can enhance their effectiveness in ES implementation project.
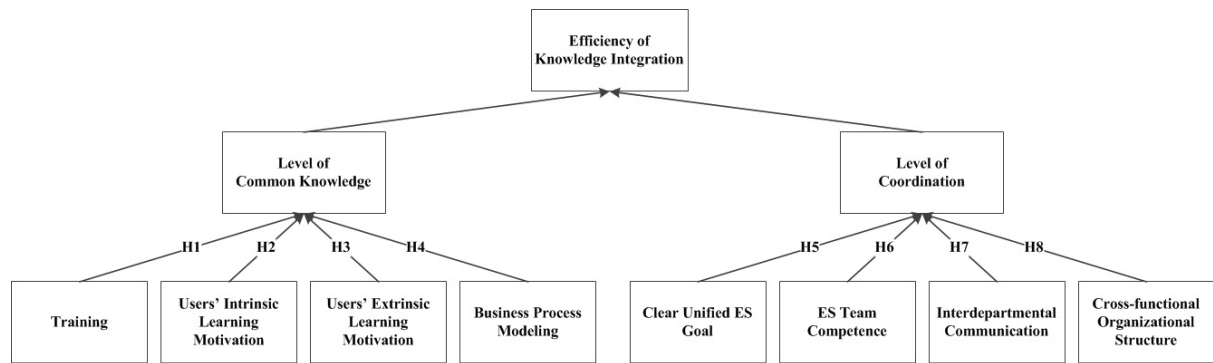
Figure 1.   *Research Model*

3.1   **Level of Common Knowledge**

Common knowledge (Grant 1996a) or knowledge redundancy (Nonaka & Takeuchi 1995) is the common understanding about a subject, which is shared by organizational members (Demsetz 1991). Common knowledge is pivotal for knowledge integration and is needed for sharing and integrating knowledge, which is not common (Grant 1996a; Maaninen-Olsson et al. 2008). Common knowledge is in different forms of common language, other forms of symbolic conversation, commonality of specialized knowledge, shared meaning, and recognition of individual knowledge domains (Grant 1996b), which in complex environments, removes barriers to understanding and promotes interdependence (Schrage 1990). In ES context, users need a broader range of knowledge including both business knowledge (e.g. cross-functional knowledge of the business processes) as well as system knowledge. IT specialist need to gain information about business processes and business process specialists have to know more about IT systems (Baskerville et al. 2000; Vandaie 2008). Moreover since ES data is standardized across all functions and departments of the organization, users should learn new data standards such as definitions and codes in order to be able to use the system, share and integrate their individually held knowledge (Gattiker & Goodhue 2005).

In light of the importance of common knowledge in achieving knowledge integration in ES adoption context, we will discuss the contributing factors in next sections, namely training, ES users' intrinsic and extrinsic learning motivations and business process modeling.

3.1.1   *Training*

Enterprise Systems (ES) are complex, cross-functional and integrated applications. Thus by their very nature they bring new terminology to the adopting organizations. Even a rudimentary ES training encompass teaching this terminology to users, which can be a "common ground" (Clark & Marshall 1981) for users in their future communications. An effecting ES training, however should embrace more sophisticated aspects of the system and its related business processes in the organization. According to Kang and Santhanam (2003-4) IS training programs should deliver application knowledge about tools and commands in the IS application, business context knowledge about the use of IS application for performing business task effectively and collaborative task knowledge comprising how other users utilize the application to do their organizational tasks. Applying this argument to ES context, scholars assert that an effective ES training program should have 2 main facets: technical training with focus on individual training and technology-related aspects; and inter-individual training with focus on task-related and collaborative task knowledge (Al-Mudimigh et al. 2001; Avital & Vandenbosch 2000; Gupta 2000; Robey et al. 2002; Sharma & Yetton 2007). Training on business processes helps users have a broad view of the cross-functional processes. This broad view is in common for users in different business units, which are business related or linked through a common workflow and forms a common context for exchanging knowledge (Saraf et al.2012).

Joint training is one of the methods that make common knowledge among trainees (Alavi & Tiwana 2002). Group training provides users with knowledge about what other members of the team know and do not know. Argot (2005) argues that groups who are trained together outperform groups that their members have been trained separately. Hence, it is more effective to train users who share task

interdependence together (Sharma & Yetton 2007). Joint training fosters knowledge sharing among ES trainees (Irani et al. 2005). It helps ES users to develop transactive memory about what other people know and do in the organization. This knowledge of task-expertise-person is the fundamental foundation for group shared mental models (Brandon & Hollingshead 2004). Therefore we posit that

H1: *In ES implementation process, training is positively associated with level of common knowledge.*

3.1.2   Users' Learning Motivation

Motivation is what evokes a person to move toward a goal and is usually categorized into intrinsic and extrinsic categories. In using IS both of these motivation facets have been investigated (Davis et al. 1992; Venkatesh 2000). Intrinsic motivation happens when the activity is valued for the activities' own sake (Calder & Staw 1975). In ES context, some scholars argue that intrinsic motivation is a better incentive for system adoption and learning (Bagchi et al. 2003; Hwang 2005). They argue that intrinsic motivation is based on one's goals and values, thus is a stronger determinant for adoption and learning of the system. Since the majority of ES-based knowledge within an organization is tacit and tacit knowledge cannot easily be observed, employees with higher intrinsic motivation are more effective in knowledge sharing which subsequently leads to creation of common knowledge (Osterloh & Frey 2000). Lee and Lee (2000) state that during ES adoption, employees seek knowledge about what others do in the organization. This leads to the creation of transactive memory, which is the fundamental foundation for group shared mental models (Brandon & Hollingshead 2004).

Extrinsic motivation, on the other hand, occurs when satisfaction is not about the activity itself but is brought to the employee by factors artificially tied to the activity. In other words in extrinsic motivation, the satisfaction is not provided by the activity itself (Calder & Staw 1975). Some ES scholars argue that extrinsic motivation such as bonus and rewards makes great contribution to knowledge sharing and knowledge integration within the organization (e.g. Bock & Kim 2002). Huang and Newell (2003) argue that the effectiveness of creating common knowledge is strongly influenced by individuals' attitudes toward learning. They claim that the most important motivation for an individual to learn is availability of objective measures and tangible benefits. When individuals see no or little value in learning the common knowledge, they are reluctant to learn it. Researchers have emphasized that many individuals participate in ES implementation process in their organizations to acquire opportunities for career advancements (e.g. Bagchi et al. 2003). In a case study of knowledge sharing and integration during ES life cycle, Pan et al., (2007) observed the efficiency of participation policy among the employees. In this case the participation of employees in ES adoption and knowledge sharing processes was included in their performance evaluation.

The above analysis shows that, intrinsic and extrinsic motivations have a significant effect on level of common knowledge in ES context. Thus we hypothesize that:

H2: *In ES implementation process, users' intrinsic learning motivation is positively associated with level of common knowledge.*

H3: *In ES implementation process, users' extrinsic learning motivation is positively associated with level of common knowledge.*

3.1.3   Business Process Modeling

Business process models visually depict how operations are conducted in a business (Bandara et al. 2005). They delineate how the ES system will work in the organization and how the business processes will be done to accomplish organizational tasks (Al-Mudimigh et al. 2001). Business process modeling will enhance the level of common knowledge in the organization in two ways. First, during business process modeling there is need for stakeholder participation (Bandara et al. 2005). This is due to the fact that business processes in an organization are mostly cross-functional, thus during the process of modeling them there is need for intensive knowledge sharing among ES team members from different departments of the organization as well as between team members and users from across the organization (Akkermans & van Helden 2002; Pan et al. 2007). This intensive knowledge sharing brings about learning for all people involved in this process about the overall processes of the organization and how their task fit with others in the organization. This learning will lead to make common knowledge about the business processes among ES team members and users

from various departments of the organization. Alavi and Tiwana (2002) assert that joint development and problems solving leads to creation of common knowledge among involved people.

Second, business process models transform the informal knowledge of different processes in the organization to formal knowledge; therefore enlarge the community that can share the knowledge (Kalpic & Bernus 2006). Business process models help better understanding and uniform representation of entities and processes across organization (Vernadat 1996) and can serve as boundary objects (Volkoff et al. 2004). Boundary objects, in joint problem solving, are shared and sharable objects across different problem solving contexts, which work to establish a shared syntax, language and context for individuals with different knowledge bases and backgrounds (Carlile 2002; Star 1989). The skills needed for interpretation of business process models are generic, thus people from distant groups can understand and share them uniformly (Kalpic & Bernus 2006; Morimoto 2008). These two reasons suggest that business process modeling enhances the level of common knowledge in ES adopting organizations.

H4: *In ES implementation process, business process modeling is positively associated with level of common knowledge.*

3.2 Level of Coordination

The Oxford English Dictionary defines "coordination" as the organization of the different elements of a complex body or activity so as to enable them to work together effectively. The second contributing factor to knowledge integration, according to Grant (1996a) is coordination, which is referred as frequency as well. This factor happens through repetition and continuous practice to improve the quality of coordination. Grant (1996a) argues that the efficiency of knowledge integration "depends upon the sophistication of the system of signalling and responsiveness which develops between team members as a result of repetition and improvement" (p. 381). He asserts that the efficiency of knowledge integration depends on the ability of the organizational members to receive, interpret and response appropriately to a stream of incoming messages.

Coordination is the process of managing interdependence of different activities of organizations to achieve a common goal. In ES implementation project, as Akkermans and van Helden (2002) state, the core process leading to a successful implementation is mutually reinforcing communication and collaboration between different departments and business functions. Gosain et al. (2005) argue that this core process is achieved through cross-functional coordination, which has a pivotal role in making an ES implementation project successful. In the following sections of this paper we will discuss the factors, which contribute toward achieving coordination in ES implementation context as clear unified ES goal, ES team competence, interdepartmental communication and cross-functional organizational structure.

3.2.1 Clear Unified ES Goal

Specialization and departmentalization in organizations, occurred due to environmental and competitive pressures, have a negative by-product, which is goal misalignment among different departments (Lawrence & Lorsch 1967). Many researches have underlined the pivotal role of clear organizational goals and objectives for adopting the ES in order for the ES success in the organization. These goals should be in line with the organizational vision and fit to its strategy (Bancroft et al. 1998). Grant (2003) in a case study of ERP implementation, states that failing to articulate ES vision which is in line with organizational business objectives is a source of major difficulties in low buy-in to the project at business unit level. He asserts that senior managers should articulate a clear vision about the role of ES in the enterprise and subsequently make sure that it is diffused throughout the enterprise. Elbanna (2006) conceptualizes ES implementation effort as a practice of network building and alignment of different actors to pursue the network builders' goals. However, since the ES adoption process involves many people from different business units and various cognition biases, there is a possibility that they hold divergent views (Davis et al. 2009; Grant 2003; Wagner and Newell 2007), which if is not managed properly will cause problems in collaboration and coordination during ES adoption process. Goal articulating and sharing are of the main tasks of senior managers during an ES adoption project. They may use both formal and informal

methods to ensure that the articulated goal is disseminated throughout the organization (Dong et al. 2009; Staehr 2010). By doing so, senior managers, galvanize the efforts of business and IT managers toward the main objectives and goals of the organization (Grant 2003). Clear goals and objectives during an ES adoption process lead to interdepartmental collaboration (Akkermans & van Helden 2002; Worley et al. 2005). EI Amrani et al. (2006) argue that cross-functional coordination provided by ES systems, depends on the organizational vision of the ES process to be defined by senior managers before the ES implementation starts. Therefore we posit that

H5: *In ES implementation process, clear unified ES goal in the organization is positively associated with level of coordination.*

3.2.2   ES Team Competence

ES team is usually comprised of internal ES stakeholders from various business units in the organization and external ES consultants. ES team members, selected by senior managers of the organization, are the core group responsible for the ES adoption project.

The pivotal role of a competent team has been acknowledged by many researchers, both in general (e.g. Katzenbach & Smith 1993) and in ES context (e.g. Akkerman & van Helden 2002; Parr & Shanks 2000; Sumner 2000). Team performance does not only rely on what team members do individually, but rather it is a function of both individual and mutual accountability. Katzenbach and Smith (1993) define team as "a small number of people with complementary skills who are committed to a common purpose, set of performance goals, and approach for which they hold themselves mutually accountable". Thus team members usually hold different yet complementary skills, knowledge and expertise and require mutuality. Lewin defines a group as "a dynamic whole based on interdependence rather on similarity" (Lewin 1951). This concept in ES context is emphasized by the importance of having best people from different departments of the organization in ES team. These best people should be highly knowledgeable and have strong communication skills. For choosing ES team members there is always need to handpick individuals from different functional areas of the organization with knowledge of their functional area (Bagchi et al. 2003). Knowledgeable people from different business units of the organization in ES team guarantees awareness of the implication of the relationship and interdependence between business units of the organization in the team (EI Amrani et al. 2006). Gosain et al. (2005) emphasizing the importance of managing interdependencies, argue that there is need to a project team with members knowledgeable about the business processes in their functional areas in order to reach coordination in ES projects.

Presence of knowledgeable people from different business units in the ES team is necessary for reaching coordination but is not enough. These people should be able to develop powerful relationships among themselves and with other individuals in the user base to be able to mange the interdependencies and coordination, which will bring about knowledge integration. The concept of developing these relationships is called social capital, which Nahapiet and Ghoshal (1998) define as "the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit. Social capital thus comprises both the network and the assets that may be mobilized through that network". In the context of this research, the resource, which is available through developing social capital, is knowledge. Pan et al. (2007) discuss the concept of social capital in ES context and assert that the ability of ES team members in developing strong ties among themselves and weak ties with other ES stakeholders in the user base is essential for overcoming the problems in knowledge sharing and integration among them. Huang and Newell (2003) discuss this further and argue that the strong ties should be developed among team members and then be expanded to a broader network of users in the organization. They assert that these ties are important antecedents of level of coordination in the project, which leads to efficiency of knowledge integration. Many researchers have emphasized the importance of this concept by asserting that ES team members should have long length of service, ability to share information (EI Amrani et al. 2006), effective communication skills (Sumner 2000) and learning ability (Bagchi et al. 2003; Sumner 2000).

The above analysis shows that, the competence of ES team members has a significant effect on the level of coordination in ES context. Thus we hypothesize that:

H6: *In ES implementation process, ES team competence is positively associated with level of coordination.*

3.2.3 Interdepartmental Communication

Enterprise Systems aim at integrating data and business processes throughout an organization. In order for the ES to meet the goal of supporting integrated cross-functional business processes different business units of the organization must be in continuous communication and cooperation.

Many scholars in the context of IT implementation have emphasized the importance of communication between different business units and departments in an organization. Communication is the oil that keeps everything working properly (Schwalbe 2000). In ES context the cross-functional communication becomes even more vital due to the fact that the main goal of ES is integrating business functions (Davenport 1998). Each business unit working in its silo without acknowledging necessary relationships and communication with other business units will lead to deep problems in the ES adoption process (Elbanna et al. 2006; Gosain et al. 2005; Staehr 2010).

Since in the ES adoption process, the core ES team is comprised of staffs from different business units of the organization, the communication and problem resolution among these members can enhance the coordination. According to Gosain et al. (2005) there are 2 main ways for this purpose. The first method is the empowered teams in which team members are empowered to make decisions. The second method is communication between functional units; in this method once the problem occurs the communication is initiated between members of the ES team and then is escalated to the functional units.

Enterprise Systems (ES) by their very nature enhance the cross-functionality in the organization (EI Amrani et al. 2006). Thus during the ERP implementation and usage, the formal barriers between the users of different functions should be broken down and they must be encouraged to share and integrate their knowledge between functions and business units to be able to work in accordance and coordinated (Pan et al. 2007). The focus of the relationship is not on the one-to-one based, but rather on the communication across the organization. This leads to forming different communities and social networks within the organization, which is mainly a virtue for inter-departmental communication and problem resolution (Pan et al. 2007; Srivardhana & Pawlowski 2007; van Fenema et al. 2007).

In light of the importance of interdepartmental communication in achieving coordination during ES implementation process as discussed above, we posit that:

H7: *In ES implementation process, interdepartmental communication is positively associated with level of coordination.*

3.2.4 Cross-functional Organizational Structure

Efficiency of knowledge integration depends on organizational structure (Grant 1996a). Although Grant argues that organizational structure is an independent factor and not a sub-factor of coordination; we believe that in the ES adoption context, organizational structure affects efficiency of knowledge integration through enhancing the level of coordination. This is due to the fact that adopting ES in an organization is a non-routine project and is different from performing routine organizational operations. The only knowledge integration mechanism, which is compatible with hierarchy, is integration through rules and directives for performing routine tasks in an organization (Grant 1996b). Huang and Newell (2003) in a study of Knowledge Integration practices in cross-functional teams assert that organizational structure, influence efficiency of knowledge integration through enhancing the level of coordination in ES implementation project. They assert that when an organization is not used to cross-functional teams, tasks performed in different business units lead to developing group-specific subcultures. They conclude that organizational structure must encourage cross-functional communication and collaboration to enhance the level of coordination.

Enterprise Systems are socio-technical changes rather than merely software applications installed in the company. They impose their logic on the organization (Davenport 1998) and change how individuals work and interact with each other. Thus if the embedded practices in an organization are not in accordance with the adopted ES, conflicts are inevitable. Due to the fact that business processes

embedded in ES packages are cross-functional by their nature, ES adopting organizations need to move from a function-based organizational structure to an integrated, process-oriented structure (Al-Mashari 2003; Davenport 1998). Rigid hierarchical organizational structure limits the interaction between different functional areas in the organization (Mohamed et al. 2004).

Lower levels of business integration in an ES adopting organization will lead to higher resistance and lower level of coordination in ES adopting organization (Gattiker & Goodhue 2004). The higher the level of cross-functionality in the structure of an organization, the higher will be the level of accordance between practices of an organization and the ones embedded in the ES application (Morton & Hu 2008). ES adopting organizations should value cross-functional information flows. In other words information bypassing the hierarchy should be able to flow between business units. El Amrani et al. (2006) argue that for adopting ES, organizations should follow final customer-orientated objectives for structuring activities rather than task or skill-based structuring. They assert that organizations cannot reap benefits from their ES if they cannot visualize this interdependence and coordination and remain stuck in the functionally separated structure. Decentralized organizations with autonomous functions face serious problems in coordinating activities in the cross-functional ES adoption process (Gosain et al. 2005; Morton & Hu 2008; Pan et al. 2007).

The process of adopting ES in the organization is an arduous task, which needs individuals from across the organization work in harmony (Akkermans & van Helden 2002; Gosain et al. 2005; van Fenema et al. 2007). Jones et al. (2006) argue that organizations, to be successful in ES adoption, must value working in groups and collaboration among individuals. They assert that ES adopting organizations must believe that collaboration is more efficient and effective comparing to individual effort; thus encourage collaboration and teamwork. In an organization valuing collaboration, individuals cooperate with each other and are willing to help their colleagues (Ke & Wei 2008).

As a result of above discussion, we posit that

H8: *In ES implementation process, cross-functional organizational structure is positively associated with level of coordination.*

4   CONCLUSION AND FUTURE RESEARCH

The goal of this study is to examine the efficiency of knowledge integration in ES implementation process. This research-in-progress paper reports our preliminary findings. Building upon Knowledge Based Theory of the firm and through a thorough review of the literature, a research model is proposed, which identifies the factors contributing to enhancing the efficiency of knowledge integration in ES implementation process. Efficiency of knowledge integration in ES implementation context is mainly dependent on two factors: level of common knowledge and level of coordination. In this study we elaborated these two factors and identified and discussed the sub-factors, which can improve their status.

We believe that this study is the first quantitative research on factors contributing to knowledge integration in ES implementation process. It will extend the current research on knowledge integration in ES context, which is mostly qualitative and descriptive (e.g. Huang & Newell 2003; Pan et al. 2001, 2007), by thoroughly examining each factor of efficiency of knowledge integration and providing quantitative empirical validation. Future steps of this research are currently underway. A survey focusing on the factors of efficiency of knowledge integration and their contributing sub-factors is currently in progress; its results will be incorporated in the later publications.

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