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Knowledge Integration in ERP Project Success: A Hermeneutic Focus

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ABSTRACT

ERP projects often include a complex array of tasks and roles that require highly skilled, well-managed teams to overcome issues that arise during implementation. Project teams tend to be the strongest horizontal linkage mechanism for coordinating members and integrating specialized knowledge. This study engages the hermeneutics philosophy concerning the dynamic and situated nature of knowledge to provide a series of concepts encouraging individual and group interpretive processes associated with knowledge integration. A cross-sectional field survey has begun to collect data from project managers and end-user managers from manufacturing companies that have implemented an ERP system. Expectations are that individual interpretation, collective interpretation, and flexible interpretation contribute to knowledge integration, which in turn, has a significant effect on project implementation success and organizational impact.

Keywords

Hermeneutics, Group processes, IS implementation, IS project teams, Knowledge integration.

RESEARCH QUESTIONS

Enterprise resource planning (ERP) software helps companies by integrating both business processes and data across functional areas (Barki and Pinsonneault, 2005). Such integration provides support for a more uniform organizational structure, firmwide knowledge-based management processes, a unified technology platform, more efficient operations, and customer-driven business processes (Laudon and Laudon, 2004). However, appropriate organizational knowledge must be incorporated into an ERP system so that it has a sufficient underlying knowledge structure (Jones, Cline and Ryan, 2006). Both external and internal knowledge must be incorporated and shared (Tiwana and McLean, 2005). The need for knowledge integration in an ERP implementation project is therefore important (Huang and Newell, 2003).

ERP projects include a complex array of tasks and roles that require highly skilled, well-managed project teams to overcome implementation issues. Problems in complex software projects can be rooted in the inability of team members to share and integrate their component knowledge (Walz, Elam and Curtis, 1993). With ERP implementation, organizations generally use project teams as knowledge integrating mechanisms in order to facilitate the transfer of existing knowledge to different areas of the organization, to accumulate knowledge from outside its boundaries, and to stimulate the creation of collective knowledge (Matusik and Hill, 1998). Project teams tend to be the strongest horizontal linkage mechanism for coordinating members and integrating specialized knowledge. Informal integration, occurring through unstructured communication, may help in building bridges and exchanging ideas. Formal integration, through coordinators and managers, may ensure more systematically distributing knowledge (Tiwana, 2001).

However, communication by itself is not enough. Knowledge integration goes beyond the basic information level and needs deeper forms of interaction (Nelson and Cooprider, 1996). Traditional integrative mechanisms, such as project teams, can have false illusions of consensus in spite of channels and routines for communication (Dougherty, 1992). It is essential to pay attention to how knowledge integration might actually take place (Tenkasi and Boland, 1996).

Prior research contends that the core process of integrating knowledge is the conversion of knowledge (Nahapiet and Ghoshal, 1998). This recognizes that it is possible and desirable to integrate tacit knowledge by converting it into an explicit form which can then be shared between participants or combined with other knowledge. However, a simplistic preoccupation with converting tacit into explicit knowledge leads to a poor understanding of the multifaceted and situated character of organizational knowledge practices (Marshall and Brady, 2001). Both individual team member task knowledge,

and team processes for recognizing and valuing associate team member expertise are important factors in group problem solving and decision making (Faraj and Sproull, 2000).

This study attempts to move beyond the problem of communication and conversion in knowledge integration to consider the hermeneutic character of knowledge. This is based on an argument that even when the problem of communication structure has been solved, there is no assurance of shared understandings among team members. Consequently, it is essential to consider the conditions promoting shared understandings. This study engages the hermeneutics philosophy concerning the dynamic and situated nature of knowledge to provide a series of concepts encouraging individual and group interpretive processes associated with knowledge integration. This overall issue addresses two primary research questions: (1) What is the relationship between knowledge integration and project success in terms of project-level, system-level, and organization-level success? (2) How do individual and group interpretations influence an ERP project team's knowledge integration?

THEORETICAL FOUNDATIONS AND PROPOSITIONS

Knowledge has been described as a state of knowing; With knowing being a condition of understanding gained through hermeneutic methods (Alavi and Leidner, 2001). In hermeneutic philosophy, one important approach to build correct knowledge is through the process of a hermeneutic circle. The hermeneutic circle refers to the dialectic between the understanding of the context as a whole and the interpretation of its parts. Interpretation always occurs in a circle in which the parts are interpreted within some understanding of context, which in turn is understood by coming to grips with the constituent parts (Thachankary, 1992). "The harmony of all the details with the whole is the criterion of correct understanding. The failure to achieve this harmony means that understanding has failed" (Gadamer, 1976: p.117). The end result fits all important parts into a consistent, coherent whole within the current context (Myers, 2004).

Although the hermeneutic circle provides a framework of iterative examination leading to expanded understanding (and discarding) of preconceived stereotypical notions, it is potentially open to infinite interpretation and reinterpretation because understanding is continuously shaping and being shaped by the social practices of individuals (Schultze and Leidner, 2002). However, critical hermeneutic philosophers suggest that individuals can judge between alternative interpretations, even though that judgment may be faulty and malleable (Habermas, 1984).

Although the interpreting process is likely to be richer and more robust with others, the formation of shared knowledge is more problematic than that of individual knowledge (Crossan, Lane and White, 1999). Knowledge is subject to multiple interpretations which are related to the social context surrounding the generation and use of knowledge and each participant may have their own interpretation of organizational situations and events based on their established cognitive maps (Sahay and Robey, 1996). Thus, the same context can induce a different or equivocal understanding for different people (Crossan, et al., 1999). Equivocal situations must be resolved through organizational interpretation if equivocality interrupts the development of shared understanding (Weick and Van Orden, 1990).

Organizations preserve knowledge, behaviors, mental maps, norms, and values over time as interpretation systems for developing shared understanding among multiple and potentially conflicting individual interpretations (Walsh and Ungson, 1991). Organizational interpretation is the process of translating events, developing shared understanding, bringing out meaning, and assembling conceptual schemes among participants. Reaching convergence among participants characterizes the act of organizing and enables the organization to interpret as a single system (Daft and Weick, 1984).

Organizational interpretation in general provides a way to obtain collective knowledge about the context. Tenkasi and Boland (1996) further indicate that knowledge "integration is not meant as an act of smoothing over differences and arriving at one single, unified understanding. Rather, it is a way of sharing unique understandings that can result in expansion of a meaning structure's frame of reference. … a process of surfacing and examining interpretations allows a shaking of the background of consensus and opens the possibility of mutual interpretation that enables the achievement of a new definition of the situation in which all participants can share" (p.86). Developing a comprehensive knowledge base among a group of highly differentiated yet dependent specialists requires a continual process of mutual interpretation, where individual knowledge and meaning structures are surfaced, reflected on, exchanged, evaluated, and integrated with others in the organization.

Based on the previous discussion, knowledge integration is the process of reaching a shared understanding among multiple and potentially conflicting individual interpretations through inter-subjective interpretation of communicative action (Marshall and Brady, 2001). It entails taking personally constructed understandings and integrating them in a way that develops a shared understanding among the individuals. Hermeneutic tradition has provided useful insights into the conditions that make possible the formation of shared understanding. For legitimate communicative action to be possible, participants must be sincere or authentic about their interests, they must comply with inter-subjective norms of discourse, and

the communicative action must take place in a setting that is fair and open to interested participants (Dillard and Yuthas, 2006). By examining the necessary conditions of communicative action, three concepts particularly salient to knowledge integration effectiveness can be identified: individual interpretation, collective interpretation, and flexible interpretation.

Individual interpretation refers to the extent to which individuals develop understandings about their operating various domains. A person with a very rich and complex understanding of a domain will be able to see things and act in ways that others cannot. Individual interpretation is related to the condition that participants in interaction must be sincere or authentic about their interests. Collective interpretation refers to the extent to which individual understandings are made visible and accessible to others. Collective interpretation avoids equivocality through interpreting, sharing observations, and discussion (Daft and Weick, 1984). Collective interpretation must take place in a setting that is fair and open to interested participants and in which actors can access shared linguistic and interpretative resources (Gadamer, 1976). Finally, flexible interpretation refers to the extent to which individuals recognize and value divergent understandings. Interpretations are flexible because individuals need to recognize and value more than just personal subjective interpretation if they turn their attention toward integrating the divergent interpretations which are distributed among group members. Flexible interpretation corresponds to the condition that participants must comply with inter-subjective norms of discourse and then they can reach a satisfactory interpretation of each other's position.

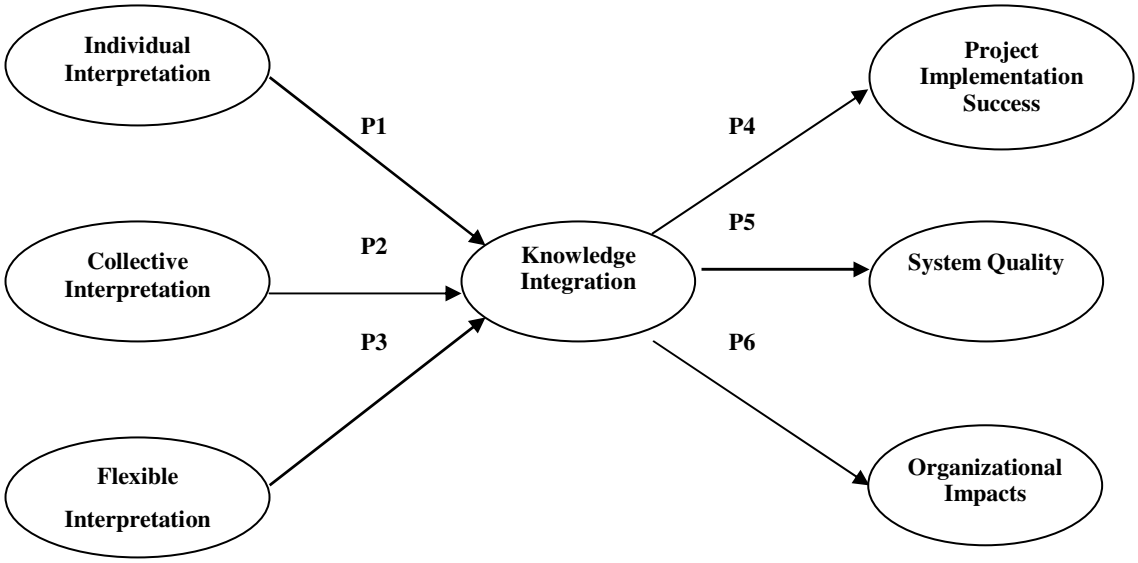

Figure 1. Conceptual Model

Applying these concepts, this study examines the antecedents and consequences of knowledge integration in the context of an ERP implementation. ERP implementation necessarily involves the participation of multiple, interdependent social members, typically representing specialized perspectives related to departmental or professional affiliations. End users, IS personnel, project managers, consultants, and vendors all participate in the ERP implementation project. These members differ in their motivations for implementation, political and social interests, educational backgrounds, occupational culture, and power in the organization. These differences lead members to develop different interpretations impinging on each member's behavior during implementation. It is through the integration of various subjective interpretations that project stakeholders can arrive at mutual agreement about how an ERP system's functionality and configuration can best support the business objectives. Specifically, individual interpretation, collective interpretation, and flexible interpretation are proposed to influence knowledge integration. The levels of knowledge integration, in turn, contribute to various dimensions of ERP system success including project implementation success, system quality, and organizational impacts as shown in Figure 1.

Individual interpretation and knowledge integration

The human brain is a structurally and dynamically complex device, and thus is a hermeneutic system that helps team participants represent and exchange their individual understandings (Erdi, 1996). The first step to develop a shared

understanding among team members is that individuals need to communicate, through words and actions, their own understandings. Since many aspects of understandings are tacit, communicating them requires a process of surfacing and articulating ideas and concepts. Individual interpretation is the process whereby individuals develop and strengthens their own knowledge domains and practices. As understanding strengthens, it adjusts to complexities and fosters better knowledge work (Boland and Tenkasi, 1995). If the team members have a very rich and complex understanding of a context, integrating them in a way that develops a shared understanding will be simpler because the process of surfacing and articulating make tacit understandings explicit. This leads to the first proposition.

P_1: *Knowledge Integration is a positive function of Individual Interpretation.*

Collective interpretation and knowledge integration

Knowledge integration requires the willingness of project members to contribute their knowledge to the project. Strong collective interpretation increases the motivation for cooperative knowledge sharing and enhances the development of shared understanding among the project members (Alavi and Tiwana, 2002). Additionally, strong collective interpretation is associated with higher levels of shared mutual understanding (Crossan, et al., 1999). Such shared understanding establishes implicit rules and mechanisms for coordinating the inputs to the project from the team members, thus facilitating the integration of project members' knowledge (Faraj and Sproull, 2000). In summary, collective interpretation opens opportunities to share and integrate knowledge that is dispersed across various external and internal groups. This leads to the second proposition.

P_2: *Knowledge Integration is a positive function of Collective Interpretation.*

Flexible interpretation and knowledge integration

Project members do not share the norms and language for integrating knowledge since they embed in different social and professional networks. Flexible interpretation enhances absorptive capacity, the capacity of team members to interpret each others' domain and expertise (Tiwana, Bharadwaj and Sambamurthy, 2003). This facilitates integration of new knowledge that emerges during the implementation process forming cognitive overlaps among project members. Flexible interpretation serves as a cognitive linkage among team members enhancing the ability of the members to communicate their specialized knowledge to other members. Flexible interpretation requires some cognitive overlap, with a higher expectation to share and exchange knowledge. In summary, flexible interpretation opens opportunities to exchange and absorb knowledge that are dispersed across various external and internal groups. This leads to the third proposition.

P_3: *Knowledge Integration is a positive function of Flexible Interpretation.*

Knowledge integration and ERP system success

Three dimensions of ERP system success were selected to reflect project, system, and organization issues: project implementation success, system quality, and organizational impact.

Project implementation success is defined as the implementation-level success in completing the project on time, on budget, and with the proper functionality. Knowledge integration has been seen as a determinant of superior project performance by reducing problem solving time and achieving faster results (Alavi and Leidner, 1999). Knowledge integration directly and positively influences an IS project's fit with business needs, IS development flexibility, and facilitates effective project implementation processes by helping project tasks adapt to changing scope and requirements (Tiwana, et al., 2003). Nelson and Cooprider (1996) contend that shared knowledge contributes to the IS group performance. This leads to the fourth proposition.

P_4: *Project Implementation Success is a positive function of Knowledge Integration.*

System quality is meeting the desired features and functions of the system. System quality is particularly important for infrastructure-based systems, such as ERP systems, because the engineering-oriented performance characteristics of these systems will influence current and future application architectures in the organization (Gable, Sedera and Chan, 2003). In an ERP implementation, knowledge integration is difficult as most knowledge is embedded in the various organizational systems, structures, and relational processes. The problems of knowledge integration may emerge at various points during an ERP project, such as when many functional-based processes must be combined and when new knowledge embedded in the ERP system must be fitted into knowledge embedded in existing legacy systems. These integrating problems may preclude the project team from creating a high-quality system as flexible and integrated as the organization requires. This leads to the fifth proposition.

P_5: *System Quality is a positive function of Knowledge Integration.*

Shared understanding (Miles, Snow, Mathews, Miles and Coleman, 1997) has been found to be important to organizational effectiveness. An ERP system displaying high knowledge integration can lead to net benefits for various stakeholders, including individuals, groups, and organizations (Shang and Seddon, 2002). The literature recognizes the positive effect of an ERP system on organizational performance (Markus and Tanis, 2000). From the business manager's perspective, organizational impacts arise when the use of an ERP benefits an organization in terms of operational, managerial, strategic, IT infrastructure, and organizational dimensions. This leads to the sixth proposition.

P_6: Organizational Impact is a positive function of Knowledge Integration.

RESEARCH METHODOLOGY

The target sample of this study is manufacturing companies that have implemented an ERP system. A cross-sectional field survey has begun to collect data from project managers and end-user managers from 1000 companies across Taiwan. Our study focused on large and medium-size manufacturing companies to avoid surveying small firms less likely to be ERP adopters. The 1,000 largest manufacturing companies in Taiwan listed in the 2006 edition of *Common Wealth* serve as the sampling frame.

Data Collection

Data are being collected from two types of informants at each participating company to measure the knowledge integration factors and the success factors, respectively. This approach ensures that appropriate persons provide the perceptions for the study (Hufnagel and Conca, 1994); otherwise, "halo effects" or other biases can result if one person provides the information for both the independent and dependent constructs. Two questionnaires, the ERP Project Manager Questionnaire and the ERP Major User – Manager Questionnaire, were designed for data collection. The first questionnaire is to be completed by the in-house managers administratively responsible for the ERP implementation. This questionnaire requests data on individual interpretation, collective interpretation, flexible interpretation, knowledge integration, and project implementation success. The second questionnaire is to be completed by senior managers whose department is the major user of the ERP system. This questionnaire requested data on system quality and organizational impacts.

Measures and Hypotheses

We measure the construct of individual interpretation with the interpretive capability of team members. Four items measure average team score of the members' interpreting capability of carrying out the ERP implementation (Bontis, Crossan and Hulland, 2002). Collective interpretation was measured by the sharing of interpretations using a three-item scale which reflected average team score of the propensity of sharing personal interpretations within the context of ERP projects (Reich and Benbasat, 2000). Flexible interpretation was measured by the openness of interpretations using a three-item scale which reflected average team score of the capability to recognize and value the divergent interpretations for project implementation (Bontis, et al., 2002). Knowledge integration was operationalized by cognitive knowledge integration capability using five items to capture the social cognitive capability required to successfully integrate team members' knowledge (Tiwana et al., 2003). Project implementation success was measured by project management success which includes questions that asked how well the project was completed on time, on budget, while delivering the right requirements (Wixom and Watson, 2001). System quality was measured by satisfaction of the system which contains four items that asked about the level of satisfactions of the ERP system (Gable, et al., 2003). Organizational impact was measured by operational efficiency using six questions that capture the improved business processes and operations. Each construct was measured as on a Likert-type scale anchored from (1) 'strongly disagree' to (5) 'strongly agree.' The items of the measures and the testable hypotheses derived form the propositions are listed in Tables 1 and 2 respectively.

Interpretive Capability
Team members are aware of the critical success factors that affect ERP implementation.
Team members are able to scan and understand the trend of ERP implementation.
Team members are able to grow through their work.
Team members propose innovative solutions to ERP implementation issues.
Sharing of Interpretations
We share our success experiences within the project team.
We share our failure experiences within the project team.
Team members compile information for everyone to use.
Openness of Interpretations

Team members are able to break out of traditional mind-sets to see ERP in new ways.
In meetings, team members seek to understand everyone's point of view.
Different points of view are encouraged in team work.
Cognitive Knowledge Integration Capability
Team members have effective conflict resolution when working in a team.
Team members have consensus about the project objective.
Team members are prepared to rethink decisions when new information incoming.
Project ideas come from discussion.
The team has the right people involved in addressing the issues.
Project Management Success
The ERP project met its critical project deadlines (e.g., rollout deadline).
The cost of the ERP did not exceed its budgeted amount.
The ERP project provided all of the ERP functionality that it was supposed to provide.
System Satisfaction
ERP users satisfy with the system accuracy.
ERP users satisfy with the system sophistication.
ERP users satisfy with the system integration.
ERP users satisfy with the system customization.
Operational Efficiency
ERP has improved our business processes
ERP has increased the department interactions.
ERP has improved our order management/order cycle.
ERP has enhanced our inventory forecast.
ERP has fastened the information response time.
ERP has lowered our inventory levels.

Table 1. Variable items

H_1: Average team scores on the "cognitive knowledge integration capability" instrument will be higher for teams with higher average scores on the "interpretive capability" instrument that for those with lower average scores.
H_2: Average team scores on the "cognitive knowledge integration capability" instrument will be higher for teams with higher average scores on the "sharing of interpretations" instrument that for those with lower average scores.
H_3: Average team scores on the "cognitive knowledge integration capability" instrument will be higher for teams with higher average scores on the "openness of interpretations" instrument that for those with lower average scores.
H_4: The scores on the "project management success" instrument will be higher for teams with higher average scores on the "cognitive knowledge integration capability" instrument that for those with lower average scores.
H_5: The scores on the "system satisfactions" instrument will be higher for teams with higher average scores on the "cognitive knowledge integration capability" instrument that for those with lower average scores.
H_6: The scores on the "operational efficiency" instrument will be higher for teams with higher average scores on the "cognitive knowledge integration capability" instrument that for those with lower average scores.

Table 2. Testable Hypotheses

CURRENT STATUS OF THE PROJECT

The first wave of data is complete, a follow up round is still underway. On the data received, the full model was estimated using PLS. This model was used for testing the key hypothesized relationships after controlling the team size, implementation duration, and project complexity. Preliminary results show individual interpretation, collective interpretation, and flexible interpretation contributed to knowledge integration, thus supporting Hypotheses 1, 2, and 3 at the .05 level. As hypothesized, knowledge integration had a significant effect on project implementation success and organizational impacts, so Hypothesis 4 and 6 were supported at the .05 level. The relationship between knowledge integration and system quality was significant at the $p < 0.10$ level.

The primary contribution of this study will be that of investigating the relationships between team's interpretive capabilities and knowledge integration and the relationship between knowledge integration and ERP system success. The influence of knowledge integration on ERP system success has thus far been assumed but not empirically tested. Second, a team-level model for knowledge integration is proposed. This is believed to be the first model that links the interpretive capability of project teams to knowledge integration and eventually to ERP success. Third, the relationship between hermeneutics and knowledge integration was proposed. If shared interpretations do not emerge out of the process of implementation; even the most advanced technologies may be implemented without significant consequence (Sahay and Robey, 1996).

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