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Organizational Learning Stages of Assimilation, Integration and Optimization and their Relationship with User Satisfaction of Enterprise Resource Planning Systems

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ABSTRACT

Literature on organizational learning suggests that various processes have to occur in order for an organization to learn. This study provides empirical evidence for measuring organizational learning in three stages: assimilation, integration and optimization. A path model of organizational learning was tested establishing the significance and magnitude of the total effect of assimilation, integration and optimization on the satisfaction level of top information executives in firms with Enterprise Resource Planning systems. The model indicates that the optimization-satisfaction path is the strongest, followed by the integration-satisfaction path. Measuring and improving the factors composing organizational learning is essential for successful implementation of complex information technology such as enterprise resource planning systems.

INTRODUCTION

Organizational knowledge is not the sum of its member's individual knowledge, nor is one user's perception and knowledge an adequate measure of the knowledge of a whole organization. Organizational learning involves the transference of knowledge among its members. Knowledge travels formally through procedures and policies and informally through the organization's culture, and although an organization is composed of individuals, individuals in an organization cannot act alone. Organizations learn only when individual insights and skills become embodied in organizational routines, practices, and beliefs (Attewell, 1992). Organizational learning, therefore, is the very essence in the evolution of organizations (Jacko *et al.*, 2002). A technology is adopted because the firm is expecting to improve the performance of the firm, and in order to exploit a technology, organizational learning must take place (Argote, 1999). In other words, when organizations are asked to adopt new technologies, they are asked to learn (Levine, 2001). Organizational learning is not merely the aggregation of individual learning, but rather, the creation of knowledge and its distribution through communication channels across the organization (Gangopadhyay & Huang, 2004; Kim, 1998; McManus & Snyder, 2003).

Adaptation, as a behavioral aspect of processing new information, experience and knowledge, prevails in the organizational learning literature (Attewell, 1992). This branch of the literature views learning as the result of behavioral changes reflected as changes in policies, programs, goals and routines. Adaptive processes involve both exploration and exploitation where exploration is the search for new opportunities which includes refinement, choice, production, efficiency, selection, implementation and execution (March, 1991) while exploitation is the maturation of an existing process or technology. Organizations balance the two to varying degrees at different points in time. Foregoing exploitation to exploration does not allow a company to benefit from their investments in exploration however organizations that do not engage in exploration find themselves outdone by companies with new technologies. This becomes particularly difficult when companies are called upon to abandon what has long been successful (Nonaka & Takeuchi, 1995). The balancing of exploration and exploitation becomes a challenge as one hinders the other. Exploration reduces the speed of exploitation while improvement in skills of an existing process or technology makes experimentation less attractive (March, 1991).

A second branch in the organizational learning literature is the cognitive view in which organizations are seen as learning through interpretation and understanding of a new concept through reflection and interaction with their environment (Attewell, 1992; Gangopadhyay & Huang, 2004). This approach to organizational learning regards learning as a procedure during which learners question, direct, arrange and examine their evolution so that learning becomes a rational, sensible outcome (Abrami, 2001; McManus & Snyder, 2003). To attempt to capture an understanding of the environment organizations develop information processing mechanisms that detect trends, events, competitors, markets and technological developments (Daft & Weick, 1984). An organization has cognitive systems and memories within its structure that preserve knowledge over time. Organizations can be conceptualized as a series of nested systems of continuous interpretative activity, and individual members within an organization are socialized to these organizational interpretations (Attewell, 1992; Gangopadhyay & Huang, 2004).

Organizational learning takes place through the interaction of two dimensions of knowledge: tacit and explicit knowledge. Tacit knowledge is deeply rooted in an individual's mind. It is hard to codify and communicate and can be expressed only through action, commitment and involvement in a specific context. Tacit knowledge is the core of a firm's prior knowledge base (Kim, 1998; Nonaka, 1991; Osterloh & Frey, 2000). Explicit knowledge is knowledge that can be codified and transmittable in formal, systematic language. The four knowledge conversion processes are presented as follows:

1. Tacit to Tacit- socialization or training interaction where one individual shares information with another individual.
2. Explicit to Explicit- gathering and synthesizing information from many sources, creating one new whole document such as a financial report
3. Tacit to Explicit- externalization of tacit knowledge in the form of a new approach.
4. Explicit to Tacit- internalization of explicit knowledge as it is shared throughout the firm to other individual members. It is used to broaden and reframe an individual's own tacit knowledge until the new approach is taken for granted.

The literature indicates that several processes have to occur in order for organizations to learn and draws on both procedural and declarative organizational memory (Baker *et al.*, 2003). For the purpose of this study, these processes are organized into stages of organizational learning, extending the research accomplished by Lane *et al.* (2001) and Lyles and Salk (1996) where the transference of best practices in international joint ventures is investigated. The Lane *et al.* (1996) study was adapted to measure the organizational learning stages of companies that have acquired enterprise resources planning software (ERP). The purpose of this study is to confirm the scales used for organizational learning in international joint ventures to the field of information technology adoption. A path analysis using structural equation modeling measures the relationships between the stages of organizational learning and the general satisfaction level of the Chief Information Officer (CIO) within companies with ERP software.

THE RESEARCH FRAMEWORK AND HYPOTHESES

The three stages in organizational learning, as proposed in this study, are assimilation, integration, and optimization. Assimilation refers to the stage beginning after the acquisition or purchase of a new technology. A firm in this stage is in the imitation phase of organizational learning. Organizations have to acquire knowledge by eliciting knowledge (Argote, 1999) in the assimilation stage (Lane *et al.*, 2001; Lane & Lubatkin, 1998)

H1: The first stage of organizational learning, assimilation, has a positive impact on the satisfaction rating of the adopted technology.

The assimilation stage is followed by a second stage called internalization or integration (Kim, 1998; Lyles & Salk, 1996). Integration is the actual using of the technology in the learning-by-doing phase including problem solving. Exposure to relevant external knowledge is insufficient unless an effort is made to integrate that knowledge

(Kim, 1998). Internalization comes from developing experience over time with explicit knowledge that eventually becomes part of the orientation procedures and general routines (Lyles & Salk, 1996). This stage characterizes learning by doing and learning by using (Kim, 1998). As the use of the technology increases, the organizational learning stage of integration is marked by improved efficiency making the primary goal of this stage, efficiency. Capacity, response time, throughput rate, overhead percentage, software time measures, reliability measures, system utilization measures, raw speed, and availability are the most common variables used for operationalizing the efficiency of information systems (IS) implementation efforts (Huber, 1990; 1991; Wixon & Watson, 2001). From the above the following hypothesis is drawn:

H2: The second stage of organizational learning, integration, has a positive and significant impact on the satisfaction rating of the adopted technology.

The third stage, optimization, is where an organization reaches the point of exploitation of a *learned* technology (Cohen & Levinthal, 1990; 1994).

In order for a company to qualify as a knowledge creating company, it must have the organizational capability to acquire, accumulate, exploit and create new knowledge continuously and dynamically, and to recategorize and recontextualize it strategically for use by others in the organization (Nonaka & Takeuchi, 1995).

Optimization is the innovation stage where new knowledge is created.

The essence of innovation is to re-create the world according to a particular vision or ideal. To create new knowledge means quite literally to re-create the company and everyone in it in a nonstop process of personal and organizational self-renewal (Nonaka, 1991).

Group learning involves the processes through which members share, generate, evaluate and combine knowledge (Argote, 1999). Optimization, defined as the ability to apply external knowledge, is comparable to Kim's improvement/ application stage of incremental improvements and the application to other areas (Kim, 1998), and to Venkatraman's (1994) upper levels of IT enabled transformation. Venkatraman (1994) argues that performance will improve as a firm is categorized into higher levels of transformation. However, the improved performance comes at a price. Potential greater profits require a proportional degree of organizational change in routines and procedures (Venkatraman, 1994). This organizational evolution is affected by deliberate choices made by managers who can alter the direction and scope of change (Fedorowicz *et al.*, 2004).

Lane *et al.* (2001) measured optimization through the variables of business strategy, and training competence. In addition to the variables used in Lane *et al.* (2001), this research includes sharing of information through networks. Because network ties provide access to resources, the role of the network is to provide an efficient screening and distribution process for members of the network (Gangopadhyay & Huang, 2004; Nahapiet & Ghoshal, 1998). The value of a network increases exponentially as all parties involved combine and exchange knowledge in anticipation of increased value (Chen *et al.*, 2004; Nahapiet & Ghoshal, 1998). Therefore, inter-unit links and networks are an important part of a learning process in which organizational units discover new opportunities and obtain new knowledge through interacting with one another (Hansen, 1999). Aiding the flow of information and exchange of each other's experiences is the standardization of technology and procedures (Majumdar & Venkatraman, 1998). Renko *et al.* (2001) state that knowledge sharing routines are important for knowledge acquisition and for exploitation.

The high importance of the final stage of organizational learning leads to the formulation of the following hypotheses:

H3: Optimization, the third stage of organizational learning will have a positive and significant impact on the satisfaction rating of the adopted technology.

H4: The optimization stage will have the highest impact of the three stages on the satisfaction rating of the adopted technology.

RESEARCH METHODOLOGY

Sample

The population in this study is top-level Information Systems (IS) executives in the US or Canada employed in firms who have implemented enterprise resource planning (ERP) software as indicated in the Directory of Top Computer Executives. Enterprise resource planning has the capability to join disparate data sources and make them available across enterprises in an organized, personalized, secure, and searchable fashion. ERP integrates key business and management processes to provide a comprehensive view of an organization, and therefore, includes financial, human resources and manufacturing information. The unique idea behind ERP is that the software needs to communicate across functions on a real time basis. Data flows unperturbed to all functional areas, integrating them into one system. ERP is, therefore, considered a complex information system.

Top-level executives are considered ideal for studies dealing with strategic, organizational and managerial issues because they are involved with planning on a broad scope (Segars *et al.*, 1998). The Chief Information Officer (CIO) perspective is important because it provides an overall view and not a biased view of one functional area over another. The CIO has intrinsic knowledge of the intended project goals and has been significantly involved with the implementation process in all areas of the organization. In order for complex enterprise systems to be successful a holistic strategy must be defined at the highest level to support and facilitate a new way of operating (Garcia, 2004)

Survey Methods

The instrument used in this study was a questionnaire sent by mail and made available through the internet, for those wishing to reply in an electronic fashion. The full research questionnaire is included in Appendix A. There were a total of 264 top level executives, each from different companies, who agreed to participate in the survey. The sample size is large enough to meet the requirements for using structural equation modeling. Table 1 lists the scales used for the assimilation construct. The ability to assimilate external knowledge is measured through the variables flexibility and adaptability, management support, training, and formal goals (Lane *et al.*, 2001; Lyles and Salk, 1996). The table reveals the standardized Cronbach Alpha's and in some cases the benchmark alpha's reported in previous studies. The Alpha attained for the flexibility and adaptability scale in this study was .8294; for management support: .8924, and formal goals, a score of .6236 was achieved. These items were added to create a summated score to test correlations, to use for independent t-tests to determine non-response bias.

Table 1. Assimilation Scales.

Construct: Assimilation			
<i>Uses a six point scale (0=No Extent; 1=Little Extent; 1.5=Some Extent; 2=Fair Extent; 2.5= Above Average Extent and 3 =Great Extent)</i>			
Variable Name	Question(s)	Reference	Alpha
Flexibility and Adaptability	To what extent is the organization flexible? To what extent is the organization adapting to change? To what extent is the organization creative?	Lyles and Salk, 1996 Benchmark Alpha .67	.8294

Management Support	To what extent do superiors know about project team's performance? To what extent do superiors contribute managerial resources to project? To what extent do superiors contribute administrative support? To what extent do superiors contribute emotional support? To what extent do superiors provide for training for the project team? To what extent do superiors provide time to the project team?	Lyles and Salk, 1996 Benchmark Alpha .82	.8924
Formal Goals	Does the ERP project have written objectives? (yes/no)	Lyles and Salk, 1996	
Training	To what extent was the prior year's training effective?	Lane <i>et al.</i> , 2001	

Table 2 shows the measurement items for the integration construct. The characteristics of knowledge integration are measured by three variables: efficiency, scope and flexibility (Grant, 1996; Van den Bosch *et al.*, 1999). Efficiency refers to how firms identify, assimilate and exploit knowledge from a cost and economies of scale perspective. Scope is defined as the breadth of component knowledge a firm draws upon. Flexibility is the extent to which a firm can access additional, and reconfigure existing, explicit and tacit knowledge within an organization. Scope is comprised of multiple questions including one question that identifies economies of scale and a two measuring integration of data sources and the integration of functional areas. These items were added to create a summated score to test correlations, to use for independent t-tests for determining non-response bias. The Alpha score for data quality was .9121, for flexibility of the technology, the score was .8583 and for the scope of the technology the reliability score was .6630.

Table 2. Integration Scales.

Construct: Integration			
<i>Uses a six point scale (-3= Strongly disagree, -2=Disagree, -1=Slightly Disagree, 1=Slightly Agree, 2=Agree, 3 =Strongly Agree)</i>			
Variable	Question	Reference	Alpha
Data Quality	The new ERP technology provides more accurate data. The new ERP technology provides more comprehensive data. The new ERP technology provides more correct data. The new ERP technology has improved the consistency of data.	Wixom and Watson, 2001 Benchmark Fornell: .84	.9121
Flexibility	The new ERP technology can flexibly adjust to new demands or conditions. The new ERP technology is versatile in addressing needs as they arise.	Wixom and Watson, 2001	.8583
Scope	There is sufficient scale in our operations to perform ERP efficiently in-house. The new ERP technology integrates data from systems servicing different functional areas. The new ERP technology integrates data from a variety of data sources within organization.	Poppo and Zenger, 1998 Wixom and Watson, 2001	.6630

Table 3 displays the questions used to operationalize the optimization construct. It is measured by the variables: training competence, new knowledge, and sharing of information. The Cronbach Alpha measure of reliability for the optimization construct shows the values of .7100 for training competence and .8830 for new knowledge.

Table 3. Measurement Items for Optimization.

Construct: Optimization			
<i>Uses a six point scale (0=No Extent; 1=Little Extent; 1.5=Some Extent; 2=Fair Extent; 2.5= Above Average Extent and 3 =Great Extent)</i>			
Item Name	Question	Reference	Alpha
Competence	The necessary skills to implement ERP exist. There is technological competence to absorb ERP To what extent does the firm have highly trained personnel in the IT department?	Lane <i>et al.</i> , 2001 Benchmark Alpha .72	.7100
New Knowledge	To what extent are ERP skills among users improving? <i>To what extent are users adapting to new knowledge learned by using ERP?</i> <i>To what extent are users disseminating new knowledge learned by using ERP?</i> <i>To what extent are new ERP skills improving the competitiveness of the firm?</i>	Lane <i>et al.</i> , 2001 <i>New Questions</i>	.8830
Sharing of Information	To what extent has the sharing of information between departments increased through ERP?	Boyton <i>et al.</i> , 1994	

All the reliability scores have shown content validity of the scales above the .60 Cronbach Alpha benchmark recommended for exploratory factor analysis, and above .70 for confirmatory factor analysis (Nunnally, 1978).

Sample Characteristics

Table 4 shows the industry classification of the respondents. The majority of the respondents (63.3%) were from the manufacturing sector.

Table 4. Industry Classifications from Study

Industry	Frequency	Percent
Banking and Finance	8	3.0
Manufacturing	167	63.3
Retail	14	5.3
Service	35	13.3
Transportation	14	5.3
Utilities	11	4.2
Other	13	4.9
Missing	2	.8
Total	264	100.0

Table 5 provides characteristics of the respondent's country of origin and gender. The table includes the average tenure of the executives within their organization as well as the average number of desktops in the firm. In regards to response medium, 30% decided to complete the survey online while 70% completed the survey by hand and returned it through postal mail. The Canadian online/mail ratio for the medium of response was 49/51, while the

ratio for the US was 73/27. There were 41 (18%) respondents from Canada and 223 (88%) respondents from the US. The US/ Canada proportion of responses mirrored that of the population: 85% were from the US and 15% from Canada.

Table 5. Respondent Characteristics.

<i>Country</i>	<i>Gender</i>	<i>N</i>	<i>Tenure (in years)</i>	<i># of PCs in firm</i>
Canada	Male	38	7.06	2378
	Female	3	4.00	800
USA	Male	201	7.01	1356
	Female	22	7.73	1075

Dependent Variable

The dependent variable was measured by a Likert-like 6-option satisfaction rating in which the executive was asked to determine a general “satisfaction rating of the ERP project”. The satisfaction rating is a direct measure of a project’s performance as perceived by the top level IS executives surveyed in the study. Literature in the field provides insight into the high importance of studying the psychological aspects of performance such as user satisfaction, a notable success factor in ERP implementation (Aladwani, 2002; Haines & Godhue, 2003). The frequency ratings from the responses gathered in the study are presented in Table 6. In addition, the IS executives reported data about the ERP adoption dates, which ranged from 1984-2003. There were 8 respondents in the pre-90’s range, 26 from 1990-1994, 19 in 1995, 22 in 1996, 30 in 1997, 53 in 1998, 17 in 2000 and 24 adopters in the new millennium.

Table 6. Satisfaction Rating Means and Frequency Distribution.

<i>Rating</i>	<i>Frequency</i>	<i>Percent</i>
0-Not Satisfied	2	.8
1-Minimal	10	3.8
2- Moderate	35	13.3
3-Fair	70	26.5
4-Above Average	117	44.3
5-Superior	20	7.6
Missing	10	3.8
Total	264	100.0

The scale was coded using the following system: Not Satisfied=0; Minimal=1; Moderate=2; Fair=3; Above Average=4; Superior=5. The mean for the study is 3.38 and the standard deviation is 1.00.

Statistical Analysis

Structural Equation Modeling (SEM) using AMOS 5.0 was used to test the relationships in the hypotheses. SEM provides a confirmatory factor analysis, a confirmation test of the scales already provided in the literature and a measure of internal consistency reliability of each construct assessed. The goodness of fit measures for the measurement models are shown in Table 7. The practical significance of the model is a contribution because it provides empirical support for the constructs of assimilation, integration and optimization. The goodness-of-fit indices, shown in Table 7, indicate the absolute and incremental fit measures for the constructs which are considered very good for all three constructs. The RFI for the assimilation construct, however, is slightly below the .90 recommended for a very good fit. The RMSEA for the constructs are well within the recommended level. According to Joreskog (1990), a normed chi-square ratio of 5 is acceptable, especially when taking the high values of the other indices into consideration. With the normed chi-square scores of 1.940 for the assimilation construct, 2.709 for the integration construct and 2.239 for the optimization construct, the measurement models for the constructs were

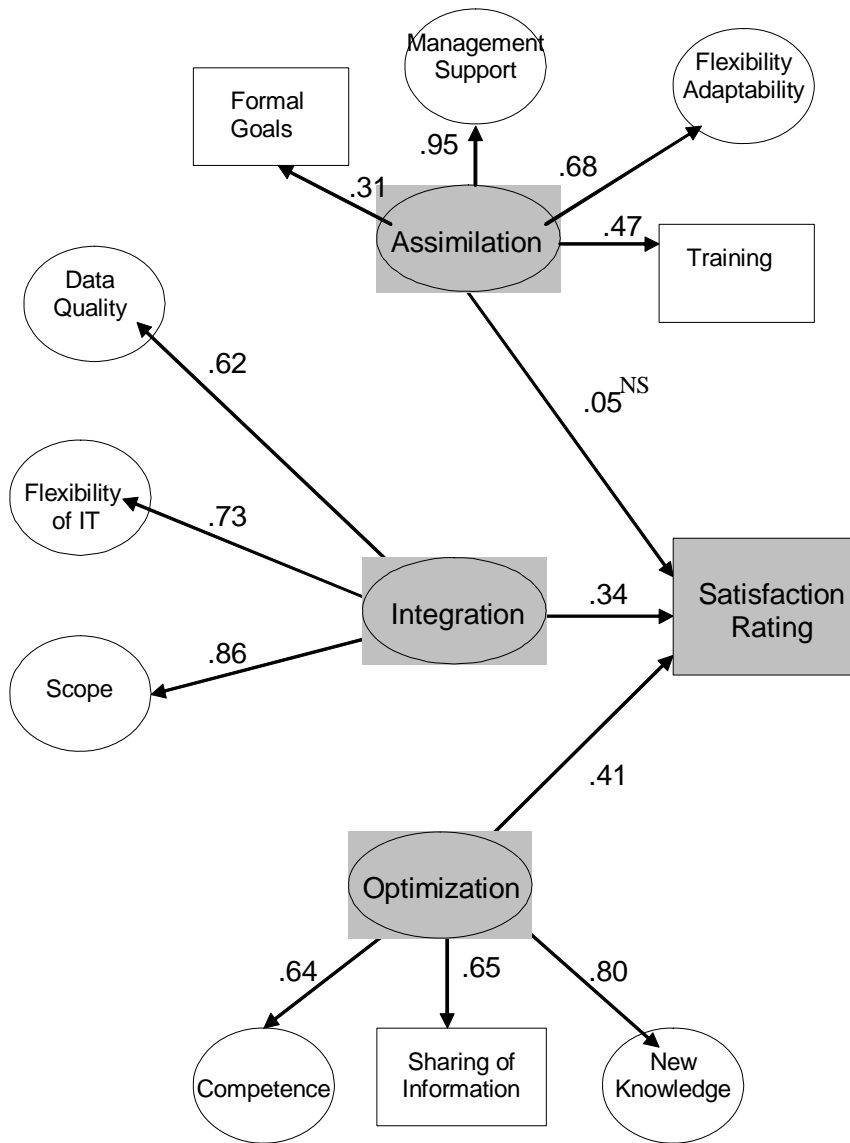
considered very good. The parsimonious fit measures are low, but show a marked improvement when placed together in the organizational learning model.

Table 7. Goodness of Fit Measures for Assimilation, Integration and Optimization.

Goodness-of Fit Measure	Assimilation	Integration	Optimization
Absolute Fit Measures			
Likelihood-ratio chi-square (χ^2)	106.946	67.717	36.673
Degrees of freedom	42	25	18
P	.000	.000	.006
Normed fit index (NFI)	.924	.949	.962
Relative fit index (RFI)	.881	.909	.924
Root mean square error of approximation (RMSEA)	.077	.081	.063
Incremental Fit Measures			
Incremental fit index (IFI)	.953	.967	.980
Tucker-Lewis index (TLI) or (NNFI)	.924	.940	.960
Comparative fit index (CFI)	.952	.967	.980
Parsimonious Fit Measures			
Parsimonious fit index (PNFI)	.588	.527	.481
Parsimony adjusted CFI (PCFI)	.606	.537	.490
Normed chi-square	2.546	2.709	2.037

The measurement models were combined to form the Estimated Model shown in Figure 1. Each of the three components of organizational learning form a path towards the IS satisfaction variable, and the loadings of each of the variables show the strength of the relationships. Table 8 shows the goodness of fit measures for the complete model for organizational learning. The model has good absolute fit measures with the Bentler-Bonnet Normed Fit Index (NFI), which indicates the proportion in the improvement of the overall fit of the absorptive capacity model to a null model is .773 and a relative fit index (RFI) of .733. The NNFI or Tucker-Lewis index, which is less affected by sample size, is .809. A score of 1 for the indices indicate a perfect fit and these scores are adequate. A standardized summary of the average covariance residuals (RMSEA) is .084 below the .10 range deemed acceptable (Hair *et al.*, 1998). The measurement model's incremental fit measures are .840 and .838 and, therefore, good. The parsimony fit measures are fair at .656 and .711 and are comparable to the adjusted r-squared values in regression, where the number of coefficients is considered. The normed-chi-square of 2.843 is within the recommended level and better than the generally accepted ratio of 3 and the more liberal ratio of 5. Because numerous fit indices are favorable, the model fit is considered good.

Figure 1. Estimated Model for Organizational Learning.



NS = Not Significant

**All paths are significant p-value <.01, except for the Assimilation-Satisfaction Rating path.

Table 8. Statistical Measures for Goodness-of Fit Measures.

Goodness-of Fit Measures	
Absolute Fit Measures	
Likelihood-ratio chi-square (χ^2)	1048.888
Degrees of freedom	369
P	.000
Normed fit index (NFI)	.773
Relative fit index (RFI)	.733
Root mean square error of approximation (RMSEA)	.084
Expected cross-validation index (ECVI)	4.711
Incremental Fit Measures	
Incremental fit index (IFI)	.840
Tucker-Lewis index (TLI) or (NNFI)	.809
Comparative fit index (CFI)	.838
Parsimonious Fit Measures	
Parsimonious fit index (PNFI)	.656
Parsimony adjusted CFI (PCFI)	.711
Normed chi-square	2.843

FINDINGS

The literature in the information systems field highlights various constructs that are represented in this framework. Managerial support, for example, is widely accepted to influence the success of IS projects (Chen *et al.*, 2004; Gangopadhyay & Huang, 2004; McManus & Snyder, 2003; Ragu-Nathan *et al.*, 2004). Other constructs well represented in the IS literature and also included in this study are training, data quality and data integration as measures of efficiency. The construct of strategic planning is present in the construct of formal goals. The contribution of this study is the organization of these constructs into learning stages. The optimization stage empirically tests the variables of new knowledge and sharing of information, important elements in the optimization stage. This study is innovative in that it provides empirical evidence to support that the optimization stage has the strongest relationship with the overall satisfaction rating given by chief information officers.

Standardized path coefficients with values less than .10 show a small effect; values in the .30 range indicate a medium effect while values larger than .50 suggest a large effect (Kline, 1998). As Figure 2 indicates effect-size of the assimilation, IS satisfaction rating path, is small (.05) supporting Hypothesis 1. The integration, IS satisfaction, rating path is in the medium range (.34) thereby finding support for Hypothesis 2. The direct effect of optimization on the IS satisfaction rating is significant (.40) and the effect size is greater than the effect size for integration supporting Hypotheses 3 and 4. The total effect of organizational learning on the IS satisfaction rating is considered in the large range and is statistically significant.

DISCUSSION

Research shows that the implementation efforts for ERP systems are not always successful, leading to heavy financial losses. ERP infrastructure has been implemented in 74% of the manufacturing industry and 59% of the service industry (AMR Research, 2002). For 2005, Forrester Research (Hamerman & Wang, 2005) confirms that ERP applications remain the number one priority for IT spending. As ERP projects continue to grow in number and the implementation challenges become more evident, the need for research in this area has become critical. ERP systems are critical organizational resources reaching an annual sales level of \$30 billion in 2004 (Ko *et al.*, 2005). With this degree of financial commitment to the industry determining possible areas for increased success of ERP projects is essential (Haines & Godhue, 2003; Zviran *et al.*, 2005).

The success of complex software and leading edge IT infrastructure does not depend on its sophistication but rather on how well an organization can learn. Organizational learning is marked by dynamic knowledge capabilities which according to King (2005) include “complex, integrated and internally consistent set of capacities to acquire/create, store, transfer and share knowledge to business process and practices,” (King, 2005, 34). An

organization can go through assimilation and even integration, but as this study suggests optimization requires a social structure that integrates training, sharing of information and the creation of new knowledge. This finding is supported by the comments made by Chen *et al.* (2004), Gangopadhyay and Huang (2003), and McManus and Snyder (2003) in each of their articles concerning performance, improved decision making and knowledge management. Knowing that three-fourths of the manufacturing industry and more than half the service industry utilize ERP systems, the fact that optimization is the key to successful implementation should be very valuable to managers. The measurement model confirms the Lane *et al.* (2001) scales showing different variables are significant at different stages. For the assimilation stage, this study provides evidence for management support, training and an organizational culture that is not resistant to change, but rather is flexible, creative, and ready for change (Hong and Kim, 2002) without the added problems of uncertainty of implementation that internal conflicts bring to a project (Chen *et al.*, 2004). Tiwana and McLean (2005) point out the need to study organizational creativity for it has been as yet narrowly studied in the IS literature. Organizational creativity is increased by finding innovative connections of ideas, perspectives, and expertise in finding different alternatives and solutions (Tiwana & McLean, 2005).

Following the assimilation stage, the integration stage places attention on efficiency, which for an IS project is measured by data quality, flexibility of the IS system and the scope of functional area participation that create economies of scale. The third stage in organizational learning is the optimization stage where people react, interpret and learn creating organizational shifts in policies and procedures. The exchange of information or sharing of information is the catalyst in the process of attaining optimization (McManus & Snyder, 2003).

MANAGERIAL IMPLICATIONS

One of the most important contributions of this study is the realization that organizational learning occurs in stages: assimilation, integration and optimization. The organizational activity that most contributes to a successful assimilation stage, according to this study, is management support. Top management must be cognizant of how the ERP project progresses, providing resources and administrative support, and even emotional support. Management must spend sufficient time and energy in support of the ERP project team. Luarn *et al.* (2005) indicate that in the interviews carried out for their study, all employees made mention of the value of senior management support, emphasizing that senior management support is a vital condition for the IS project. Another important element in this stage is the firm's flexibility and adaptability in preparation for change. Change processes require creativity and adaptation. Training in this stage is essential where each member of the organization, at least each user of the ERP system, is learning to use the new ERP system. A final element that is important in this stage is to have formal written objectives of the ERP project.

A second stage in the organizational learning process is integration where there must be sufficient scope in the scale of operations for the ERP project. In other words, the more departments and modules that are added to the ERP system the more successful the integration stage of the process. The second element to ascertain in this stage is in the ERP system itself in that it must be flexible and versatile. Finally the integration stage is marked by improved data quality that is provided by the ERP system. These steps to integration are important for managers implementing ERP systems.

Though the assimilation and integration stages are important, the stage that produces the highest satisfaction or that has the greatest potential for improved organizational performance is the optimization stage. A firm that reaches this stage has successfully trained its personnel and is technically skilled. However, this knowledge or skill set does not rest in individual professionals but is widely shared among departments. As this information is shared, new knowledge is produced synergistically. Users continue to adapt and disseminate new knowledge thereby improving the competitiveness of the firm. This study reveals that a firm need not rest with positive data quality results. The fact that there is more accurate, consistent and comprehensive data does not necessarily improve satisfaction. The firm needs to promote the sharing and dissemination of new knowledge to achieve the optimization stage. It is possible for firms to reach this stage and achieve success when adopting a technology such as ERP when organizations realize that the process involves stages: assimilation, integration and optimization and that they require different focal points of emphasis as a firm progresses from one stage to another.

In conclusion, the results emphasize the prominent role of organizational learning as it examines the different influences of each component of organizational learning. This study tested a model of organizational

learning in the specific frame of ERP projects. While the constructs and model used in this study have been empirically tested in the context of international joint ventures (Lane *et al.*, 2001; Lyles and Salk, 1996), this model provides empirical evidence to support the model in an IS context.

The findings also suggest other areas of future research. This study was designed to measure performance of an ERP project as perceived by a top level IS executive with a bird's eye view of the project. The perception of other system users can also be surveyed. In addition, the performance of IS systems can be measured through different indices including, for example, return on investment with actual increases in sales and profits. An extension of this study could incorporate a longitudinal perspective measuring the impact in profit margins over an extended period of time.

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APPENDIX

Full Research Questionnaire

Industry Classification	Position in the Company	ERP Vendor	Purchase Date	ERP Modules	Satisfaction Rating of ERP Project					
<input type="checkbox"/> Banking/ Financial Services <input type="checkbox"/> Transportation/ Logistics <input type="checkbox"/> Manufacturing <input type="checkbox"/> Utilities <input type="checkbox"/> Retail <input type="checkbox"/> Write in Other	<input type="checkbox"/> Chief Information Officer <input type="checkbox"/> Software Development Mgr. <input type="checkbox"/> Data Communications Mgr. <input type="checkbox"/> IT Manager <input type="checkbox"/> Write in Other Years in Office: <input type="text"/>	<input type="checkbox"/> SAP <input type="checkbox"/> People Soft <input type="checkbox"/> Oracle <input type="checkbox"/> Siebel <input type="checkbox"/> JD Edwards <input type="checkbox"/> Write in Other	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="checkbox"/> Customer Relations <input type="checkbox"/> Manufacturing <input type="checkbox"/> Human Resources <input type="checkbox"/> Purchasing <input type="checkbox"/> Accounting <input type="checkbox"/> Write in Other	<input type="checkbox"/> Not Satisfied <input type="checkbox"/> Minimal <input type="checkbox"/> Moderate <input type="checkbox"/> Fair <input type="checkbox"/> Above Average <input type="checkbox"/> Superior					
<input type="checkbox"/> Check here to obtain an abstract of survey results					<input type="text"/> <input type="text"/> <input type="text"/>					
					Strongly Disagree					
					Disagree					
					Slightly Disagree					
					Slightly Agree					
					Agree					
					Strongly Agree					
Users have a common understanding of the technical language used by the ERP project team.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is a vision of what is trying to be achieved with ERP.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Users have been given information of state-of-the-art technology involving ERP.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is a clear division of roles and responsibilities to implement ERP.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The necessary skills to implement ERP exist.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is technological competence to absorb the ERP.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is managerial competence to absorb ERP.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is well known who can exploit new information provided through ERP.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is well known who can help solve problems in the ERP implementation.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The underlying skills associated with the IS function are rapidly changing.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The optimal configuration of hardware/software required to perform ERP is rapidly changing.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The project team is composed of people from diverse areas of expertise.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
R&D efforts are being conducted in ERP technology.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Departments are cooperating in the ERP implementation effort.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ERP project team has good relationships with outside experts in ERP.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The organizational structure in this firm is best characterized as formal.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The firm's compensation policies provide motivation for the adoption of ERP.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The new ERP technology provides more accurate data.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The new ERP technology provides more comprehensive data.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The new ERP technology provides more correct data.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The new ERP technology has improved the consistency of data.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The new ERP technology can flexibly adjust to new demands or conditions.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The new ERP technology integrates data from systems servicing different functional areas.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The new ERP technology is versatile in addressing needs as they arise.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The new ERP technology integrates data from a variety of data sources within organization.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is sufficient scale in our operations to perform ERP efficiently in-house.					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
					No Extent	Little Extent	Some Extent	Fair Extent	Strong Avg Extent	Great Extent
To what extent is the organization flexible?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent is the organization adapting to change?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent is the organization creative?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent do superiors know about the ERP project team's performance?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent do superiors contribute managerial resources to the ERP project?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent do superiors contribute administrative support to the ERP project?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent do superiors contribute emotional support?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent do superiors provide for training for the project team?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent do superiors provide time to the project team?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent has the new ERP technology brought added in-house expertise?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent has the sharing of information between departments increased through ERP?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent has management emphasized new products?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent has management had promotion and advertising expenses above industry average?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent does the firm have extensive customer service capabilities?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent does the firm have highly trained personnel in the IT department?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent is the prior year's user training effective?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent does the firm have an influence over the channels of distribution?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent are ERP skills among users improving?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent are users adapting to new knowledge learned by using ERP?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent are users disseminating new knowledge learned by using ERP?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To what extent are new ERP skills improving the competitiveness of the firm?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Measured in years, to what extent does the ERP project have long-term plans?					<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Does the ERP project have written objectives? <input type="checkbox"/> yes <input type="checkbox"/> no					0	1	2	3	4	5

