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ERP in Practice: A Snapshot of Post-Installation Perception and Behaviors

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Abstract:

An examination of ERP in six organizations (survey and focus groups) several years after the initial installation is presented. Findings indicate that much of the installed ERP functionality goes unused and that only a small percentage of users have actively sought new ways to make use of the functionality. In addition, a sizeable gap exists between what management originally expected from ERP and what has been achieved. This study thus offers a profile of the post-installation reality that contributes to an understanding of the difficulties associated with ERP assimilation.

I. INTRODUCTION

Enterprise resource planning (ERP) systems are estimated to represent the largest portion of the applications budget in large and medium size firms today, with over $80 billion spent annually for ERP initiatives [Gefen and Ragowsky 2005]. Firms estimate that they devote about one-third of their information technology (IT) budgets to support ERP capabilities [Seewald 2002]. Many firms have been quite successful with their ERP installations, driving down costs and realizing substantive organization-wide change [Herbert and Oppenheim 2004; Swanton 2004b; Thibodeau 2004]. However, it is well documented that many other firms have been unable to realize the expected benefits from their ERP investments even after a successful configuration and installation [Barker and Frolick 2003; Songini 2003a; 2003b; Swanton 2004b]. Having successfully installed a system does not ensure that assimilation success will as well occur [Fichman and Kemerer 1999].

Implementation is defined as the process that begins with the initial analysis of organizational processes and data (often referred to as the "as is" stage), includes the planning of organizational process and data changes the ERP is used to bring about ("to be"), extends through training users and installing the completed package for use [Jones et al. 2006], and continues through a period of adjustment or stabilization that can take several months or years [Markus et al. 2000a; Ross 1999]. There is very little empirical evidence of how well ERP has been assimilated after installation and the immediate stabilization time period. Although anecdotes regarding ERP successes and failures are widely reported in both academic and practitioner publications, research is just emerging that examines post-adoptive ERP behaviors and outcomes [Gattiker and Goodhue 2004; 2005; Liang, et al. 2007]. There is still much to be learned about the extent to which organizations are using ERP functionalities and the extent to which they have achieved and/or maintained benefits after the initial implementation [Sarkis and Sundarraj 2001; Hitt, et al. 2002; Hoffman 2004; Markus, et al. 2000a; Swanton 2004a]. The primary purpose of this paper is to provide an assessment of the extent to which ERP has been assimilated in a limited sample of adopting organizations at least three years after the initial installation.

Figure 1a. Contextual Post Adoptive Model

II. THEORETICAL FRAMING

In this section, we present antecedents to and outcomes (results) of ERP assimilation. Antecedents include software training interventions, work process[1] training interventions, software understanding, work process understanding,

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[1] We use the term "work process" in this study rather than the broader term "business process." The latter term is usually used to refer to a set of interrelated activities to achieve a particular goal and is often used in business research to represent a fairly broad set of activities. The term

and experiential interventions. Outcomes of assimilation are operationalized as system benefits. Assimilation itself is operationalized in terms of installed ERP system functionality as well as extent of system usage. A general contextual overview of these variables and their relationships is provided in Figure 1a. A more detailed conceptual model is given in Figure 1b to provide an overview of the major variables and relationships that are discussed in the paper. Conceptual models introduce key variables and relationships to help the reader develop a mental model within which to interpret the manuscript [Zmud 1995]. Our study applies these well understood variables and well-recognized relationships to surface insights into the current state of post-adoptive ERP implementations. Variable definitions are provided in Table 1a and research supporting noted relationships between variables is provided in Table 1b. It is important to emphasize that our aim is not to rigorously develop and empirically assess these relationships. Instead, we used the conceptual model shown as Figure 1b in developing and contextualizing the survey questions and in interpreting survey results.
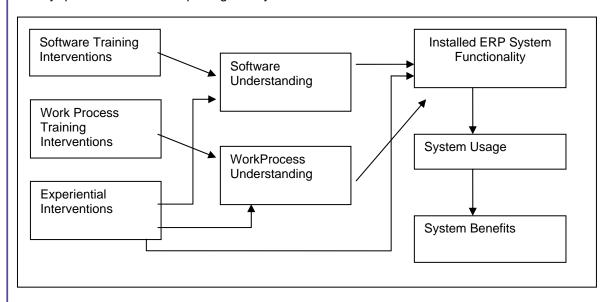

Figure 1b. Conceptual Post Adoptive Model

Table 1a. Variable Definitions		
Variable	**Definition**	**References**
Software training interventions	The extent of formal training received on how to use the ERP software after the system was implemented. Interventions could include vendor supplied, in-house, computer-aided instruction, or any form of formal instruction.	Brown and Vessey 2003; Carte et al. 2005; Compeau et al. 1999; Nelson and Cheney 1985; Scott 2005; Yi and Davis 2003
Work process training interventions	The extent of formal training received on how the work processes are different with the ERP implementation and how these processes relate to other key work processes.	Al-Mashari and Zairi 2000; Caldwell and Stein 1998; Kawalek and Wood-Harper 2002; Hong and Kim 2002; Lee and Lee 2000; Roberts et al 2003; Robey et al. 2002
Experiential interventions	The technology sense-making efforts of users to learn about their new work environments (both software and work processes) through using and experimenting with the ERP system.	Baskerville et al 2000; Griffith 1999; Jasperson et al. 2005; Karahanna et al 1999; Nelson and Cheney 1985; Orlikowski 2000; Robey et al. 2002
Software understanding	The extent to which users are able to use and navigate through basic features and commands in the ERP software package.	Bradford and Florin 2003; Brown 1998; Griffith 1999; Karahanna et al 1999; Nelson and Cheney 1985; Newell et al 2003; Venkatesh et al 2003; Yi and Davis 2003
Work process understanding	The extent to which users understand how to perform their own work activities in the ERP environment and	Barley 1986; Barley and Tolbert 1997; Henfridsson and Soderholm 2000; Jones

"work process" is more narrowly used to refer to skills and competencies of work performed by individuals. A given user's work process may form a small portion of the business process within which it is performed.

	how their work activities fit into other work processes.	2005; Lee and Lee 2000; Newall et al. 2003 Robey et al. 2000; Tyre and Orlikowski 1994
Installed ERP System Functionality	The actual ERP functionality that a firm has implemented.	Bhattacherjee 1998; Baskerville et al. 2000; Fichman and Kemerer 1997, 1999; Gattiker and Goodhue 2002, 2004; Hitt et al 2002; Ranganathan and Brown, 2006; Venkatesh et al. 2002; Venkatesh et al. 2003
System usage	The extent to which users use installed ERP functionalities.	Bhattacherjee 2001; Burton-Jones and Gallivan, 2007; Markus and Tanis 2000; Nicolaou 2004; Robey et al. 2002; Venkatesh et al. 2002
System benefits	Manager perceptions of the extent to which they have realized operational efficiency and strategic effectiveness through the use of ERP.	Fox-Wolfgramm et al 1998; Gattiker and Goodhue 2002, 2004; Gefen and Ragowsky 2005; Hitt et al. 2002; Hunton et al. 2003; Markus et al. 2000b; Nicolaou 2004; Poston and Grabski 2001; Ranganathan and Brown 2006; Scott and Kaindl 2000; Shang and Seddon 2002

Table 1b. Relationships among Variables		
Relationship	**References**	**What We Know**
Software training interventions are associated with increased software understanding	Bajwa et al. 2004; Bhattacherjee 2001; Compeau et al. 1999; Markus et al. 2000a; Nelson and Cheney 1985; Yi and Davis 2003	Software training has been shown to increase software understanding. Most research has involved training prior to or immediately after system installation.
Work process training interventions are associated with increased work process understanding	Bajwa et al. 2004; Gattiker and Goodhue 2005; Holsapple and Sena 2001; Jones 2005; Jones et al. 2006; Newell et al. 2003; Robey et al 2000; Ross 1999; Scott 2005	Empirical research about work process training is sparse and limited to whether or not it occurred. Work process training is thought to increase work process understanding. Very limited empirical work about post-installation work process training.
Experiential interventions are associated with increased software understanding	Bradford and Florin 2003; Brown 1998; Griffith 1999; Jasperson et al. 2005; Karahanna et al 1999; Nelson and Cheney 1985; Orlikowski 2000; Robey and Boudreau 2000	Very limited empirical work on software-related experiential interventions. Experiential interventions in the form of feature-related exploratory behaviors are prompted when users sense more can be done with the system.
Experiential interventions are associated with increased work process understanding	Baskerville et al 2000; Jasperson et al. 2005; Newall et al. 2003; Robey et al. 2002; Tyre and Orlikowski 1994	Very limited empirical work on work process-related experiential interventions. As users explore software features, it is thought that their work process understanding will increase as well.

Experiential interventions are associated with greater installed ERP system functionality	Bhattacherjee 1998; Fichman and Kemerer 1997; 1999; Robey et al. 2002; Tyre and Orlikowski 1994; Venkatesh et al. 2002	Very limited empirical work on the impact of experiential interventions (software or work process) on features implementation. As users explore software features, it is thought that increased software or work process understanding will promote the implementation of more and/or new features.
Software understanding is associated with greater installed ERP system functionality	Bradford and Florin 2003; Brown 1998; Griffith 1999; Karahanna et al 1999; Nelson and Cheney 1985; Newell et al 2003; Venkatesh et al 2003; Yi and Davis 2003	ERP software has many more features than are typically mandated for use; Empirical research indicates that exploring and experimenting with software increases users' understanding of the software; as software understanding increases, the assimilation of its features increases.
Work process understanding is associated with greater installed ERP system functionality	Barley 1986; Barley and Tolbert 1997; Henfridsson and Soderholm 2000; Lee and Lee 2000; Newall et al. 2003; Robey et al. 2000; Tyre and Orlikowski 1994; Yi and Davis 2003	ERP interrupts established patterns of behavior and causes work processes to change. As users better understand their work processes in the new ERP context, it is thought that they will surface new ERP system features to better support these processes.
Installed ERP system functionality is associated with increased system usage	Bhattacherjee 1998; Baskerville et al. 2000; Fichman and Kemerer 1997; 1999; Gattiker and Goodhue 2002; 2004; Hitt et al 2002; Ranganathan and Brown, 2006; Venkatesh et al. 2002; Venkatesh and Davis 2000	ERP requires users to understand a broader, more divergent set of work activities. The greater the functionality scope provided to users, the greater the system usage.
System usage is associated with increased system benefits	Al-Mashari and Zairi 2000; Bhattacherjee 2001; Fox-Wolfgramm et al. 1998; Markus and Tanis 2000; Markus et al. 2000b; Nicolaou 2004; Robey et al. 2002; Scott and Kaindl 2000; Venkatesh et al. 2002	Empirical evidence suggests that users' perceptions of ERP benefits increase as users learn more about the ERP system through system usage. Without ERP system usage, benefits are unlikely to accrue.

III. METHODOLOGY

Data were collected in two stages: a survey administered in five organizations followed by a set of focus groups in a sixth organization. With the survey, a total of 52 operational users and 52 unit managers, across multiple divisions/units of five chemical/energy firms that had implemented enterprise-wide ERP systems, completed surveys (provided in appendices A and B). Thus, the targeted manager respondents directed the work units from which targeted users were drawn. Three primary criteria were used in selecting survey firms: (1) that each was far enough into their ERP implementations to have achieved a steady state of operations [Gattiker and Goodhue 2005]; (2) that each had implemented a broad range of ERP functionality; and (3) that variation existed in the ERP system used.

Within each of the five survey firms, the ERP implementation had achieved a steady state of operations (the initial implementations had occurred three to seven years earlier) applying a wide range of ERP functionality. Two of the firms had installed PeopleSoft ERP, two had installed SAP, and one had installed Oracle ERP. Tables 2a and 2b provide descriptive data on the survey responders. On average, users had worked in their work areas for 12 years and had used the installed ERP system for 4 ½ years.

Two surveys were used and are provided in Appendices A and B. The user survey addressed software and work process training and understanding, other interventions to facilitate usage, and the depth of use of installed features. The manager survey addressed desired ERP benefits and how well these benefits had been achieved. The manager survey in Appendix B was based on items developed to measure perceptions of ERP success by Shang and Seddon [2002]. There is limited empirical work, however, that taps the constructs we wanted to measure in the

user survey in an ERP context. Thus, the user survey in Appendix A was developed from our own synthesis of existing qualitative and quantitative research on the constructs we wanted to measure and our adaptation of this research into the ERP context. To illustrate, we provide three examples: Question 10 which measures ERP work process understanding was adapted from qualitative research on ERP [Jones 2005; Jones et al. 2006]; Question 9, which measures ERP software understanding, was adapted from components of ERP software training; and, Question 8, which measures installed ERP system functionality used was based on the key modules of ERP and the scale was adapted from Fichman and Kemerer's [1997; 1999] work on software assimilation. Finally, when developing measures of experiential interventions (questions 1 -5), we varied the scales and intermingled the questions (for example, peer and self initiated questions were intermingled in question 1) to help control for order effect and response bias. To help control for memory bias, questions that potentially tapped past behavior were framed in the prior three months.

TABLE 2a. Breakdown of Respondents in Each Company		
Company	Number of User Respondents	Number of Manager Respondents
A	4	0
B	4	1
C	15	4
D	14	17
E	15	30

TABLE 2b. User Respondent Work Areas	
Which best describes the area in which you work? (select all that apply)	Number of User Respondents
financial accounting	15
controlling	8
asset management	4
project management	14
sales and distribution	15
production planning	2
materials management	5
purchasing	5
service management	1
human resources management	3
strategic management	5
data warehousing	4

To provide more in-depth information than could be gained from survey responses alone, five focus groups (one held within each of three areas: marketing, human resource management and procurement and one held in each of two different production areas) were conducted within another large energy firm that had implemented an enterprise-wide ERP system across the organizational units and had also achieved a steady state of operation. Focus group participants first completed the relevant (user or manager) survey. Then, a facilitated discussion was led in each focus group by a member of the firm's information services group. Finally, for reasons of confidentiality, we received a summary briefing from a senior information services manager on the results of the surveys and focus groups.

IV. DATA ANALYSIS AND RESULTS

Software and Work Process Training Interventions

Software training interventions and work process training interventions are precursors to software understanding and work process understanding. Table 3 provides findings regarding the extent and perceived effectiveness of training

interventions. It seems reasonable to expect that users who had received limited training would be less likely to explore the functionality of the ERP software as a means to stimulate broader and/or deeper usage. These data suggest that users are not being provided with sufficient post-adoptive training and that the training that is provided is just sufficient for them to do their jobs. Very consistent feelings were expressed in the focus groups, with focus group members indicating that the training received was geared at interpreting standard reports and learning what additional data was now available for *ad hoc* reporting. A desire for more extensive training was clearly evident. For example, one individual stated that he/she would have "liked to have seen more courses on how to get data in and out of the system," and another stated "… we run a complex business, thus it takes time to learn…" to use ERP in the business. Two of the operating areas in which focus group sessions were conducted had developed their own instructional training and had produced internal "cheat sheets," and the other areas indicated that their formal training materials had not been adequately tailored to their work processes.

Table 3. Post-Adoptive Training		
Items	Mean*	Std. Dev.
Engaged in formal training opportunities beyond the initial training offered	2.00	1.56
Engaged in formal training on the way work processes have changed in ERP	2.00	1.19
Perceived effectiveness of software training	3.04	1.40
Perceived effectiveness of work process training	2.90	1.43

* Scales are Appendix A questions 6a, 6b, 7a, 7b; response values from '1' (low) to '5' (high)

In summary, our learnings regarding post-adoptive training are:

- Limited post implementation training with both ERP software and work processes
- Received training perceived as "just effective enough" to perform work assignments
- Received training focused largely on "how to" and "what" regarding ERP software rather than how work processes have changed in ERP or how to best leverage ERP for more effective work processes
- More extensive training, when it occurred, was localized and informal

Experiential Interventions

Experiential interventions are carried out by the users themselves or are initiated by peers, (technology or process) experts, and managers [Jasperson, et al. 2005]. Table 4a provides user assessments of the extent to which informal ERP-related learning was initiated by users, peers, experts and managers.   Table 4b provides user assessments of the influence of more formal policies and incentives initiated by managers. Results suggest that, at best, experiential intervention was moderate with peer influence being most evident. Management incentives were the least influential.

Table 4a. Experiential Interventions				
	Self	Peer Initiated	Expert Initiated	Manager Initiated
Software Behavior	2.46 (.89)*	3.14 (1.02)	2.54 (1.01)	2.67 (1.17)
Work Process Behavior	2.37 (.93)	2.88 (.96)	n/a	2.51 (1.16)

*mean (standard deviation); scales are Appendix A questions 1 - 4; response values from "1" (low) to "5" (high)

Table 4b. Influence of Other Experiential Interventions		
	Management Policy	Management Incentives
Mean	2.65*	1.63
Standard Deviation	1.16	1.01

* Scales are Appendix A question 5; response values from "1" (low) to "5" (high)

Focus group findings lend support to the idea that very little emphasis was placed on inducing experiential learning. Users indicated that management had not had much discussion with them on how ERP would impact their work processes, even though management had provided statements of benefits that the organization hoped to achieve by installing the ERP system. Few incentives or rewards were provided either for using the software or for finding new ways to perform work processes or tasks. One person indicated that the tactic taken was "… a carrot and stick approach, but without the carrot. " Another indicated that the "metrics (for effectiveness) are set at a high level with no idea of whether they are attainable." While peer pressure may influence behavior, it is unclear how effective it can be in the absence of management directives about how the metrics established for effectiveness will be realized through specific work process improvements.

In summary, our learnings about post-adoptive experiential interventions are:

- Limited software or work process engagement via experiential intervention
- Most influential peer interventions are targeted at ERP software
- Management expectations regarding the nature of expected ERP benefits, at the level of the operating area, are not communicated effectively
- Limited management follow-up from initial statement of benefits
- Users feel pressure to use the ERP software but possess limited understanding of why or how to effectively do so

Software and Work Process Understanding

As can be seen from Table 5a, users' understanding of new work processes was substantively higher than that of software (t=-2.815, p =.007). Users perceive their understanding of both software and work processes to be 'more than effective enough' to do their jobs.   Table 5b reports correlations providing insights on the relationships of the effectiveness of training and experiential interventions with user understanding of the ERP software and their new work processes.

Table 5a. Understanding of ERP Software and New Work Processes		
Item	**M***	**SD**
Software understanding (average of questions 9a-9f)	3.46	1.26
Work process understanding (average of questions 10a-10f)	3.82	1.14

Scales are Appendix A questions 9 – 10; response values from "1" (almost none) to "3" (just enough to do my job) to "5" (very high)

Table 5b. Correlations between Training/Experiential Interventions and Software/Work Process Understanding		
Interventions	ERP Software Understanding	New Work Process Understanding
Training Effectiveness		
ERP Software	.262 (.061)*	.297 (.032)
New Work Processes	.360 (.009)	.340 (.014)
Experiential		
Self - Work Process	.583 (.000)	.484 (.000)
Self - Software	.023 (.871)	.062 (.664)
Peer - Work Process	.481 (.000)	.393 (.004)
Peer - Software	.015 (.919)	.075 (.598)
Expert - Software	.053 (.707)	.027 (.848)
Manager - Work Process	.389 (.004)	.359 (.009)
Manager - Software	.377 (.006)	.352 (.011)

* correlation (p-value)

These results suggest that learning-focused interventions that are focused on work processes have a greater influence on users' ERP software understanding and work process understanding than learning-focused interventions focused on ERP software. Taking these correlations into consideration, one possible interpretation of the observed relationships is that a minimal level of formal ERP software training is needed in order for users to begin to grasp the nature of their new work practices. However, once this initial training on ERP software has occurred, training investments (formal and, especially, experiential) focused on work processes are much more effective than those focused on the ERP software. A subtle but complex and important dynamic seems to be present involving the exercise of appropriate levels of and appropriate sequencing of formal and experiential learning interventions.

In summary, our learnings about ERP software and new work process understanding are:

- Users seem comfortable in carrying out their job assignments in their new ERP-enabled work environments.
- Users seem less satisfied with their perceived understanding of installed ERP software than with their understanding of the new work processes.
- Work process learning interventions appear more effective than do ERP software learning interventions.
- A minimal level of ERP software understanding is likely necessary for users to engage in learning regarding their new work process.
- The dynamic interplay between training interventions focused on ERP software and on work processes appears to be an important factor in ERP system functionality assimilation.

Installed ERP System Functionality

Users were asked to report on the extent to which they made use of the installed ERP system features (functionality) with regard to the work activities with which they were familiar. As depicted in Table 6, bit less than half of what users understand to be the installed features appear to be applied (this might be far less than the actual installed functionality). The results seem relatively consistent across work functions suggesting that the extent of functionality being used is neither ERP module nor work function dependent.

Table 6. Use of Installed Features			
Work Function	**Mean**	**Std Dev**	**Number of Respondents***
Financial Accounting	2.21	1.26	38
Controlling	2.07	1.15	26
Asset Management	2.09	1.16	21
Project Management	1.95	1.15	20
Materials Management	1.89	0.97	27
Sales and Distribution	2.61	1.31	21
Production Planning	1.60	0.83	15
Purchasing	2.04	1.21	25
Plant Maintenance	1.92	1.26	13
Service Management	1.86	1.17	14
Human Resources Management	1.35	0.88	20
Strategic Management	1.60	0.97	10
Data Warehousing	2.15	1.13	27
Aggregate	**1.95**	**1.14**	

*Number of respondents who indicated they were using the specific functionality. Scales are Appendix A question 8. Responses of "not applicable" were removed for the calculation, therefore the means are based on a 4-point scale: "1" = < 25% of functionality utilized, "2" = 25 to 50%, "3" = 50 to 75%, "4" = > 75%.

These findings are quite consistent with the relatively low levels of software and work process understanding observed with these surveyed users.   Given strong correlations between the extent of ERP features implementation and both work process understanding (0.456, p =.001) and software understanding (0.343, p = .017), it is likely that users' understandings of the ERP software and their new work processes influence their willingness to engage in efforts to broaden or deepen their use of ERP system features. Thus, a picture is emerging whereby ERP system features are used when and where job requirements or pressures dictate but where the broad range of available features are generally not well understood and where few users are actively engaged with formal or informal initiatives to broaden or deepen their use of available features. Given such an observation, viewing system usage as a collective phenomenon, i.e., an attribute of a work unit, rather than the sum of the use by individuals because of the interdependencies among the members of the collective [Burton-Jones and Gallivan 2007] seems very

appealing. Such a perspective is particularly relevant for ERP usage given that an underlying premise of ERP systems is that they help unify and integrate various views of the organization and result in more tightly knit links among various processes in the organization [Baskerville et al. 2000]. Deeper usage, i.e., the rich assimilation of ERP system functionalities into work processes, may be very difficult to attain where exploration of ERP system features is seen as an individual responsibility rather than the responsibility of 'user collectives.'

In summary, our learnings about ERP software and new work process understanding are:

- Less than half of recognized, available ERP system functionality is being used.
- Lack of sufficient ERP software understanding and/or new work process understanding may very well explain stagnation in post-adoptive ERP system features use.

System Usage

We obtained responses from managers and users about different aspects of system usage. We were particularly interested in managers' perceptions of users' aggressiveness in leveraging ERP functionality. Responses indicate that the majority of managers believe that less than 30 percent of their users are aggressively leveraging ERP functionality, which leaves a large portion of users who are making limited or perfunctory use of the system (Table 7a).

Table 7a. Manager Perceptions of Utilization	
% of users aggressively leveraging ERP	**Number of Responses**
<=10%	12
>10 to <=20%	7
>20 to <= 30%	6
>30 to <= 40%	2
>40 to <= 50%	3
> 50 to <= 60%	1
> 60 to <=70%	0
> 70 to <= 80%	2
> 80 to <= 90%	0
> 90 to <= 100%	3
Did not know	4
Total respondents	**40**

Open- ended questions (Appendix B, questions B and C.)

To further probe system usage, we asked users how useful they believed the ERP software to be in supporting their work tasks and activities [Venkatesh, et al. 2003]. These findings, provided in Table 7b, indicate that users feel quite favorable regarding the usefulness of the ERP system. This is interesting to note, given manager indications of limited pursuit by users of deeper ERP functionality.

Table 7b. Perceived Usefulness		
ERP Software gives me:	**M***	**SD**
Good control of my data	3.56	1.09
Good access to operational data	3.44	1.02
Good access to summary data	3.65	.93
Good understanding of tasks	3.38	.89
Timely information	3.54	1.11
Accurate information	3.42	1.09
Concise information	3.33	1.11
Reliable information	3.37	1.14
Relevant information	3.46	1.09
Understandable information	3.33	1.08
ERP Makes my job easier to do	3.56	1.23
ERP makes my job more efficient	3.65	1.17
Aggregate	**3.47**	**.90**

Scales from Appendix A question 11 (values of 1 correspond to low perceived usefulness; 5 corresponds to high perceived usefulness)

We also asked users about the extent to which they are still exploring ERP functionality. The results of this question are provided in Table 7c. Results suggest that, in fact, usage has stabilized with curtailed user aggressiveness in exploring ERP functionality or new ways to perform work tasks with ERP functionality. This is consistent with the earlier discussed findings about limited feature use and limited user aggressiveness in leveraging ERP, and with theory that suggests that as usage become routine over time, users' exploration of the system tapers off in the absence of disruptive interventions to stimulate new exploration [Jasperson et al. 2005; Newall, et al. 2003; Tyre and Orlikowski 1994]. Given these findings in conjunction with our other findings, the conjecture of a fairly stagnant post-adoptive ERP environment is strengthened.

Table 7c. Continued Exploration		
Compared to when I first started using ERP, I now	**M***	**SD**
Ask questions about navigating the ERP software	1.85	1.26
Ask questions about potential functionality in ERP	2.46	1.29
Look for new functionality in ERP	3.12	1.35
Look for new ways to use ERP	3.25	1.30
Look for new ways to do my job	3.12	1.34
Talk to others in my area about the ERP software	2.96	1.24
Talk to others in my area about the work process changes that ERP has brought about	2.92	1.27
Focus on the ERP software more than the tasks I perform using the software	2.52	1.23
Aggregate	**2.77**	**1.00**

*Scales from Appendix A question 12 (values of 1 correspond to much less activity; 5 corresponds to much more activity)

These observations are consistent with comments made in the focus groups. For example, several users indicated that usage has become routine, and as one said, "Lethargy has set in." While some users did indicate that they are still asking questions about additional functionality and new ways to use the ERP system, these comments came largely from people in units where management had placed a continued emphasis on cost reduction leading users to ask more of the ERP system in supporting a quest to drive down costs. In this instance, thus, a strong management intervention is present.

In summary, our learnings regarding system usage are:

- Roughly 30 percent of users are aggressively leveraging ERP three or more years after initial implementation.
- Users find ERP useful, yet not useful enough to engage in further exploration.
- Specific, deliberate management interventions are likely required to initiate broader and/or deeper usage.

System Benefits

We surveyed managers' perceptions of ERP benefits with regard to the initial purposes of their firms' ERP implementations as well as their perceptions of the extent to which their initial expectations regarding the ERP implementation has been realized. Managers' responses, rather than users, were sought because managers were expected to be more aware of both their organizations' objectives for installing an ERP capability and the relative success that had occurred. Although the perceptions of other stakeholders are important, we wanted a broad yet grounded perspective that unit managers could best provide. After adapting an instrument that was developed to easure manager perspectives on ERP benefits [Shang and Seddon, 2002], five benefit categories were used: operational (for example, reduced cycle time, increased productivity), managerial (for example, improved asset management, improved decision making), strategic (for example, support business growth, lower cost structures), IT infrastructure (for example, faster response to environmental changes, reduced IT costs), and organizational (for example, enhanced cross-functional coordination, increased focus on business processes).

Table 8a provides results at the level of each of the five benefit categories. As might be expected, these organizations' benefit expectations centered on achieving gains regarding the firms' operations and IT infrastructures. Even so, the averages 'priority' scores for operations and IT infrastructure indicate that even these benefits were not primary objectives across each of the implementation sites. This suggests that clearly stated (and, hence, universally understood) implementation objectives had either not been articulated or had not been effectively communicated. Of course, there are alternative explanations, (e.g., if benefits are not realized, their perceived importance may be revised downward) [Scott and Kaindl 2000; Markus, et al. 2000b].   And, as indicated from these

managers' responses regarding the extent to which expected benefits are perceived to have been achieved, these ERP implementations have not achieved their expected benefits. The most success in realizing expected benefits has occurred with regard to IT infrastructure, the most "direct" and "immediate" of the benefit categories. It is also interesting to note that the benefit category having the second highest perceived success (though well below expectations) is the organizational category, which involves effecting change in employees' views of the nature of organizational processes, capabilities, roles and responsibilities.

Table 8a. Benefits Priorities and Relative Success		
Benefit Categories	Priority Level	Relative Benefits Realization
Operational	3.52*	2.88**
Managerial	3.16	2.76
Strategic	2.90	2.67
IT Infrastructure	3.53	3.21
Organizational	3.18	3.05

*response scales in Appendix B questions 1 – 5: 1 = not an expected benefit at all, 2 = a secondary benefit in some units, 3 = a secondary objective across the site, 4 = a primary objective in some units, 5 = a primary objective across the site.

**response scales in Appendix B questions 6-10: 1 = achieved not at all, 2 = achieved to very little extent, 3 = achieved to some extent but not as much as expected, 4 = achieved to about the extent expected, 5 = achieved beyond expectations.

Table 8b provides a more detailed examination of each of these benefit categories. In Table 8b, we interpret those benefit items with a priority level average greater than 3.6 to be primary benefits. We interpret benefits having a relative realization greater than 3.0 as having been achieved to a reasonable extent. The paragraphs that follow focus, sequentially, on each of the benefit categories.

Table 8b. Benefit Priorities and Relative Success*		
Benefit Categories	Priority Level	Relative Benefits Realization
Operational		
labor costs	3.07	2.43
reduced administrative expenses	2.90	2.59
reduced cycle time in customer support activities	3.17	2.66
reduced cycle time in supplier support activities	3.40	2.95
reduced cycle time in employee support activities	4.02	3.48
increased productivity of employees	3.76	2.82
improved quality (errors, data reliability)	4.14	3.16
improved customer service via improved employee response	3.67	2.96
Managerial		
improved asset management	3.36	3.19
improved inventory management	2.65	2.70
improved production management	2.53	2.39
improved workforce management	3.07	2.93
improved middle level management decisions	3.49	2.83
improved operational decisions	3.67	2.79
improved financial performance	3.52	2.98
improved manufacturing performance	1.95	2.35
Improved overall managerial efficiency and effectiveness	4.19	2.69

Strategic		
support business growth	3.49	2.93
support business consolidation	3.70	2.93
build business innovation	2.67	2.68
build cost	3.58	2.90
generate product differentiation	1.98	2.61
enable worldwide expansion	1.95	2.30
enable e-commerce actives	2.56	2.18
generate or sustain competitiveness	3.30	2.83
IT Infrastructure		
provide a broader range of options in responding to environmental changes	3.40	2.68
reduced cost of system maintenance	3.93	3.03
reduced IT staff	3.27	3.23
more efficient hardware	3.55	3.29
year 2000 compliance	3.17	3.47
improved system architecture design/development	3.78	3.51
reduced cost of systems upgrades	3.49	3.24
easier system modification and future change	3.71	3.03
reduced cost of technology research and development	3.05	3.13
better alignment of IT with business goals	3.67	3.26
more reliable infrastructure	3.73	3.34
more flexible infrastructure to respond to business needs	3.63	3.37
Organizational		
greater coordination among interdisciplinary matters	4.19	3.45
greater harmonization of interdepartmental processes	4.09	3.43
broadened employee skills	2.52	3.27
more value-added responsibility and accountability among employees	3.27	3.30
more proactive employees in terms of problem solving	2.79	3.09
greater employee involvement in business management	2.49	2.91
more consistent vision across different levels of the site	3.83	2.95
increased work as a common unit across the site	2.67	2.95
greater focus on the customer and market	3.89	3.05
greater focus on business processes	3.93	3.38
greater focus on overall performance	1.85	2.73
increased employee morale/satisfaction	3.14	2.43
improved employee work efficiency	3.35	3.09
improved employee problem solving skills	2.74	2.89
improved business knowledge among employees	2.90	2.77

*Response scales described in Table 8a.

These organizations' managers perceived that the top operational priorities focused on enhancing the efficiency and effectiveness of employees in performing their day-to-day work roles (reduce cycle times in supporting employees, increase employee productivity, reduce errors, respond more effectively to customers, etc.). In fact, improvements were observed in these performance areas though the improvements have, generally, not yet met initial expectations.

Similarly, the top managerial priorities focused on improving managerial efficiency and effectiveness. Far less progress was observed here than was seen with employee-related operational efficiency. Interestingly, the managerial area characterized by the highest relative success was that of asset management, possibly because of the increased visibility of assets across an enterprise (another "direct," "immediate" ERP benefit).

Overall, the strategic category was not seen to be a priority with these ERP implementations. The only strategic benefit item regularly identified as a priority was supporting business consolidation, which meshes well with the early noted operation and managerial attention to operational efficiency and effectiveness. Little progress was observed in meeting these benefit expectations.

The key IT infrastructure benefit areas involved reducing costs, increasing reliability and adaptability, and, overall, enhancing the architecture in order to enable the IT infrastructure to be much better aligned, on an ongoing basis, with business needs. Generally, good progress was being made with regard to the IT infrastructure benefit areas.

Finally, the organizational benefits of greatest priority involved synchronizing work processes across the enterprise and enriching employees' contributions to the enterprise and its customers. Some progress was perceived as having been made with regard to these expectations, as well as with improving employees' morale, but again still below expectations.

It is important to note what apparently has not been achieved via these ERP implementations. Two of the most commonly touted reasons for implementing ERP systems center on enhancing firms' abilities to facilitate intra-organizational coordination and to increase productivity/effectiveness [Jones et al. 2006]. Respondents indicated that though objectives relating to these reasons were among their highest priorities, realization of the benefits fell short of expectations. For example, *increased employee productivity* has been realized to a very little extent (Table 8b), and although *improved quality of work* has been achieved to some extent, it still falls short of what was expected. Similarly, *improved customer service via employee response* was a high priority, yet has been realized to a very little extent. Research indicates that productivity often falls for a period of time initially after installation, and that it may take more than a year to reach some stabilization [Markus et al. 2000a; Ross 1999]. These firms, however, are several years past initial implementation, and yet productivity improvements still fall short of what had been sought. Similarly, respondents reported that managerial productivity in terms of *improved overall managerial efficiency and effectiveness* has been achieved to a very little extent. Finally, although *greater coordination among interdisciplinary matters*, *greater harmonization of interdepartmental processes*, and a *more consistent vision across different levels of the site* were high priorities, these, too, had fallen short of expectations. Thus, a picture emerges of implementations that held high expectations for productivity gains and increased intra-firm coordination, and of post-implementation realities in which these expectations have not been met.

Managers in the focus groups also indicated that overall actual benefits achieved from ERP were somewhat below what they had expected. Some, however, indicated that they were still "moving up the maturity curve" of use and knowledge, and they expected actual benefits to increase. Such a view, however, is incongruent with the findings that users for the most part are neither exploring new ERP capabilities nor aggressively leveraging ERP functionalities. As discussed earlier, there appears to be rather sizeable disconnects between managers' expectations, users' behaviors and realized benefits. It also appears that these disconnects widen for benefits requiring more active mediation by users or managers (for example, intra-firm coordination or productivity increases).

In summary our learnings about system benefits are:

- Considerable variability existed across the implementation sites with regard to primary benefit expectations, with none of the benefit areas seen as a top priority across all the sites.
- Generally, more progress toward achieving expected benefits was observed with the higher priority benefit areas.
- None of the benefit areas had yet met pre-installation expectations.
- Benefit areas observed to be making progress, though still below expectations, included: improving operational and managerial efficiency; reducing IT infrastructure cost; improving IT infrastructure reliability and adaptability; improving work coordination and harmonization across organizational work units; and, instilling an enterprise perspective in the way that employees across the organization approached assigned work responsibilities.
- Some of the highest priority benefits are among those not achieved to the extent expected.
- There appears to be a gap between manager perceptions that progress toward meeting benefit expectation will continue and user perceptions of stabilization or inertia with regard to their use of and learning about ERP functionalities.
- There appears to be a gap between manager expectations of benefits and manager interventions to realize these benefits.

V. DISCUSSION AND IMPLICATIONS

Our findings contain some good news as well as some bad news and, more importantly, suggest two areas for future research that might be particularly fruitful in enhancing our collective understanding of how to improve ERP assimilation. First, there is some good news. In these implementation sites in which an ERP implementation effort has stabilized, ERP users are comfortable in their new ERP-enabled work roles and have found the installed ERP functionality to be useful. Further, managers report that overall employee morale has improved since the ERP

installation. While this might be attributed to a variety of non-ERP factors, it may reflect the improvements noted by management that (1) users, generally, have increased their skills and broadened their perceptions of how they are contributing to the organization as a whole; and (2) work activities and work processes have become more synchronized across work units. In terms of organization outcomes, gains are reported with work efficiency and productivity and with IT infrastructure cost, reliability and adaptability. Overall, then, organizational benefits have been realized through these ERP implementations, and both managers and employees are comfortable and satisfied with their new work environments.

The bad news is that these benefits have yet to approach pre-implementation expectations and, for the most part, have been limited to the early, relatively direct benefits most readily achieved from an ERP implementation (for example, work process and IT cost reductions, enhanced asset data, business asset rationalization). Generally, the realization of outcomes requiring substantial complementary investments (in employee learning, in process redesign, in role and responsibility redefinition, etc.) are proceeding much slower, if at all.

Why has progress towards realizing expected benefits been both limited and slow? Two plausible explanations arise from our findings. These two explanations as well surface what are seen as particularly valuable useful areas for future research:

First, the study's findings indicate that ERP software and work process training and understanding have stabilized at a point of being "just enough" for employees to carry out their assigned work tasks and activities. Such an objective seems to be that intended by the ERP implementation effort, and little beyond this has subsequently occurred. Generally, few orchestrated learning interventions encouraging further user explorations of ERP functionality are evident.

Our analysis regarding the relationships between ERP software training interventions, work process training interventions, experiential interventions, ERP software training and work process interventions and subsequent ERP usage suggests that the relationships among these variables are likely to be much more complex than that depicted in Figure 1b. Work process training interventions appear much more effective than ERP software training interventions in improving users understanding of both ERP software understanding and work process understanding. Experiential interventions appear most effective; however, little formal attention to induce experiential interventions was observed. Such observations lead us to suggest that future research be focused on understanding the how ERP software training, work process training and experiential interventions are best orchestrated (levels of each, intervention sequences, feedback loops) to drive the ERP software and ERP-enabled work process understanding that, in turn, drives user exploration and exploitation of installed ERP functionality.

Second, the findings regarding managers' benefit expectations and perceptions of benefits realizations along with observations regarding users' perceptions of a lack of benefit-related communication, direction and incentives suggests that much is yet to be learned about how to position and incent users to apply the largely untapped potential of installed ERP functionality. How should benefit expectations be structured (easily achievable, difficult or stretch objectives)? What are the relationships among benefit areas, and how do these relationships influence the management of benefits realization? What types of incentive structures are most effective? What types of complementary interventions are required? What factors are most important in designing effective outcome-gap feedback structures? These might include benefit types, ERP configurations, user characteristics, manager characteristics, organizational characteristics, and post-installation factors such as time, extent of ERP functionality assimilation, and extent of benefits realization.

In conclusion, this study provides a snapshot of an ERP post-installation reality that is believed to be pervasive in organizations today. We believe that the descriptive data provided as well as our identification of two areas of future research prove useful to scholars studying the complex relationships that underlie benefit realization from installed ERP functionalities, to scholars developing rich explanations for the associated behaviors and outcomes, and to managers charged with the responsibility to appropriate business value from organizational investments in ERP and related technologies.

REFERENCES

Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their work processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that:

1. These links existed as of the date of publication but are not guaranteed to be working thereafter.
2. The contents of Web pages may change over time. Where version information is provided in the References, different versions may not contain the information for the conclusions referenced.
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Al-Mashari, M. and M. Zairi. (2000). "The Effective Application of SAP R/3: A Proposed Model of Best Practice," *Logistics Information Management* (13) 3, pp. 156-166.

Bajwa, D., J. E. Garcia, and T. Mooney. (2004). "An Integrative Framework for the Assimilation of Enterprise Resource Planning Systems: Phases, Antecedents, and Outcomes," *Journal of Computer Information Systems,* Spring, pp. 81-90.

Barker, T. and M. N. Frolick. (2003). "ERP Implementation Failure: A Case Study," *Information Systems Management,* Fall, pp. 43-49.

Barley, S. R. (1986). "Technology as an Occasion for Structuring: Evidence from Observation of CT Scanners and the Social Order of Radiology Departments," *Administrative Science Quarterly* (31) 1, pp. 78-108.

Barley, S. R. and P. S. Tolbert. (1997). "Institutionalization and Structuration: Studying the Links between Action and Institution," *Organization Studies* (18) 1, pp. 93-117.

Baskerville, R., S. Pawlowski, and E. McLean. (2000). "Enterprise Resource Planning and Organizational Knowledge: Patterns of Convergence and Divergence," *Proceedings of the 21st ICIS Conference*, Brisbane, Australia, pp. 396-406.

Bhattacherjee, A. (2001). "Understanding Information Systems Continuance: An Expectation-Confirmation Model," *MIS Quarterly* (25) 3, September, pp. 351-370.

Bhattacherjee, A. (1998). "Managerial Influences on Intraorganizational Information Technology Use: A Principal-Agent Model, " *Decision Sciences* (29) 1, pp. 139-162.

Bradford, M. and J. Florin. (2003). "Examining the Role of Innovation Diffusion Factors on the Implementation Success of Enterprise Resource Planning Systems," *International Journal of Accounting Information Systems (4*), pp. 205-225.

Brown, J. S. and I. Vessey. (2003). "Leveraging ERP Learnings for the Next Wave of Enterprise System Projects," *MIS Quarterly Executive* (2) 1, pp. 65-77.

Brown, J. S. (1998). "Internet Technology in Support of the Concept of 'Communities-of-Practice': The Case of Xerox," *Accounting, Management, and Information Technologies* (8), pp. 227-236.

Burton-Jones, A. and M. J. Gallivan. (2007). "Toward a Deeper Understanding of System Usage in Organizations: A Multilevel Perspective," *MIS Quarterly* (31)4, pp. 657-679.

Caldwell, B. and T. Stein. (1998). "Beyond ERP - New IT Agenda - A Second Wave of ERP Activity Promises to Increase Efficiency and Transform Ways of Doing Business," *InformationWeek*, November, (30), pp. 34-35.

Carte, T. A., A. B. Schwarzkopf, T. M. Shaft, and R. W. Zmud. (2005). "Advanced Business Intelligence at Cardinal Health," *MISQ Executive* (4) 4, pp. 413-424.

Compeau, D. R., C. A. Higgins and S. L. Huff. (1999). "Social Cognitive Theory and Individual Reactions to Computing Technology: A Longitudinal Study," *MIS Quarterly* (23) 2, pp. 145-158.

Fichman, R. G. and C. F. Kemerer. (1999). "The Illusory Diffusion of Innovation: An Examination of Assimilation Gaps," *Information Systems Research* (10) 3, pp. 255-275.

Fichman, R. G. and C. F. Kemerer. (1997). "The Assimilation of Software Process Innovations: An Organizational Learning Perspective," *Management Science* (43) 10, pp. 1345-1363.

Fox-Wolfgramm, S. J., K. B., Boal and J. G. Hunt. (1998). "Organizational Adaptation to Institutional Change: A Comparative Study of First-Order Change in Prospector and Defender Banks," *Administrative Science Quarterly* (43), pp. 87-126.

Gattiker, T. F. and D. L. Goodhue. (2005). "What Happens after ERP Implementation: Understanding the Impact of Interdependence and Differentiation on Plant-level Outcomes," *MIS Quarterly (*29) 3, pp. 559-585.

Gattiker, T. F. and D. L. Goodhue. (2004). "Understanding the Local-level Costs and Benefits of ERP through Organizational Information Processing Theory," *Information and Management* (41) 4, pp. 431-443.

Gattiker, T. F. and D. L. Goodhue. (2002). "Software-Driven Changes to Business Processes: An Empirical Study of Impacts of Enterprise Resource Planning (ERP) Systems at the Local Level," *International Journal of Production Research* (40) 18, pp. 4799-4814.

Gefen, D. and A. Ragowsky. (2005). "A Multi-level Approach to Measuring the Benefits of an ERP System in Manufacturing Firms," *Information Systems Journal,* Winter, pp. 18-25.

Griffith, T. L. (1999). "Technology Features as Triggers for Sensemaking, " *Academy of Management Review* (24) 3, pp. 472-488.

Guadagnoli, E. and W. Velicer. (1988). "Relation of Sample Size to the Stability of Component Patterns," *Psychological Bulletin* 103, pp. 265-275.

Hair, J. F., R. E. Anderson, R. L. Tatham, and W. C. Black. (1992). *Multivariate Data Analysis*. 3rd ed., MacMillan Publishing Co: New York.

Hebert, D. and D. Oppenheim. (2004). "Conflicts between ERP Systems and Shared Services Can Inhibit ROI," http://www.erpreports.com/AnswerThink%20wp_erp_050704.pdf (current April 12, 2008).

Henfridsson, O. and A. Söderholm. (2000). "Barriers to Learning: On Organizational Defenses and Vicious Circles in Technological Adaptation," *Accounting, Management, and Information Technologies* (10), pp. 33-51.

Hitt, L. M., D. J. Wu, and X. Zhou. (2002). "Investment in Enterprise Resource Planning: Business Impact and Productivity Measures," *Journal of Management Information Systems* (19) 1, pp. 71-98.

Hoffman, T. (2004). "Saturation Stalls Enterprise Software Market," *ComputerWorld,* July 22, http://www.computerworld.com/softwaretopics/crm/story/0,10801,94672,00.html (current April 12, 2008).

Holsapple, C. W. and M. P. Sena. (2001). "Beyond Transactions: The Decision Support Benefits of ERP Systems," *Journal of Decision Systems* (10) 1, pp. 65-85.

Hong, K. K. and Y. G. Kim. (2002). "The Critical Success Factors for ERP Implementation: An Organizational Fit Perspective," *Information and Management* (40), pp. 25-40.

Hunton, J. E., B. Lippincott, and J. L Reck. (2003). "Enterprise Resource Planning Systems: Comparing Firm Performance of Adopters and Nonadopters," *International Journal of Accounting Information Systems* (4), pp. 165-184.

Jasperson, J., P. F. Carter, and R. W. Zmud. (2005). "A Comprehensive Conceptualization of the Post-Adoptive Behaviors Associated with IT-Enabled Work Systems," *MIS Quarterly*, (29) 3, pp. 525-558.

Jones, M. C. (2005). "Tacit Knowledge Sharing in ERP Implementation: A Multi-Site Case Study," *Information Resource Management Journal* (18) 2, pp. 1-23, 2005.

Jones, M. C., M. Cline, and S. Ryan. (2006). "Exploring Knowledge Sharing in ERP Implementation: An Organizational Culture Framework," *Decision Support Systems* (41) 2, pp. 411-434.

Karahanna, E., D. W. Straub, and N. L. Chervany. (1999). "Information Technology Adoption across Time: A Cross-Sectional Comparison of Pre-Adoption and Post-Adoption Beliefs," *MIS Quarterly* (23) 2, pp. 183-213.

Kawalek, P. and T. Wood-Harper. (2002). "The Finding of Thorns: User Participation in Enterprise Systems Implementation," *The DATA BASE for Advances in Information Systems* (33) 1, pp. 13-22.

Lee, Z. and J. Lee. (2000). "An ERP Implementation Case Study from a Knowledge Transfer Perspective,"*Journal of Information Technology* (15), pp. 281-288.

Liang, H., N. Saraf, Q. Hu, and Y. Xue. (2007). "Assimilation of Enterprise Systems: The Effects of Institutional Pressures and the Mediating Role of Top Management," *MIS Quarterly* (31) 1, pp. 59-87.

Markus, L. M., S. Axline, D. Petrie, and C. Tanis. (2000a). "Learning From Adopters' Experiences with ERP: Problems Encountered and Success Achieved," *Journal of Information Technology* (15), pp. 245-265.

Markus, L. M., C. Tanis, and P. C. van Fenema. (2000b). "Multisite ERP Implementations," *Communications of the ACM* (43) 4, pp. 42-46.

Markus, L. M. and C. Tanis. (2000). "The Enterprise Systems Experience - From Adoption to Success" in R. W. Zmud, ed., *Framing the Domains of IT Research: Glimpsing the Future Through the Past*, Pinnaflex Educational Resources, Inc.: Cincinnati, OH, pp. 173-207.

Nelson, R. R. and P. H. Cheney. (1985). "Training End Uses: An Exploratory Study," *MIS Quarterly,* December, pp. 547-559.

Newell, S., J. Huang, R. D. Galliers, and S. L. Pan. (2003). "Implementing Enterprise Resource Planning and Knowledge Management Systems in Tandem: Fostering Efficiency and Innovation Complementarity," *Information and Organization* (13), pp. 25-53.

Nicolaou, A. I. (2004). "Quality of Post implementation Review for Enterprise Resource Planning Systems," *International Journal of Accounting Information Systems* (5), pp. 25-49.

Orlikowski, W. J. (2000). "Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations," *Organization Science* (11) 4, pp. 404-428.

Poston, R. and S. Grabski. (2001). "Financial Impacts of Enterprise Resource Planning Implementations," *International Journal of Accounting Information Systems* (2), pp. 271-294.

Ranganathan, C. and C. V. Brown. (2006). "ERP Investments and the Market Value of Firms: Toward an Understanding of Influential ERP Project Variables," *Information Systems Research* (17) 2, pp. 145-161.

Roberts, B., S. Jarvenpaa, and C. Baxley. (2003). "Evolving at the Speed of Change: Mastering Change Readiness at Motorola's Semiconductor Products Sector, " *MIS Quarterly Executive* (2) 2, pp. 58-73.

Robey, D. and M. Boudreau. (2000). "Accounting for the Contradictory Organizational Consequences of Information Technology: Theoretical Directions and Methodological Implications, " *Information Systems Research* (10) 2, pp. 167-185.

Robey, D., M. Boudreau, and G. M. Rose. (2000). "Information Technology and Organizational Learning: A Review and Assessment of Research," *Accounting, Management, and Information Technology* (10), pp. 125-155.

Robey, D., J. W. Ross, and M. Boudreau. (2002). "Learning to Implement Enterprise Systems: An Exploratory Study of the Dialectics of Change, " *Journal of Management Information Systems* (19) 1, pp. 17-46.

Ross, J. (1999). "Surprising Facts about Implementing ERP," *IT Pro,* July/August, pp. 65-68.

Sarkis, J. and R. P. Sundarraj. (2001). "A Decision Model for Strategic Evaluation of Enterprise Information Technologies, " *Information Systems Managemen*, (18) 3, pp. 62-72.

Scott, J. E. (2005). "Post-Implementation Usability of ERP Training Manuals: The User's Perspective, " *Information Systems Management,* Spring, pp. 67-77.

Scott, J. E. and L. Kaindl. (2000). "Enhancing Functionality in an Enterprise Software Package, " *Information and Management* (37), pp. 111-122.

Seewald, N. (2002). "Enterprise Resource Planning Tops Manufacturers' IT Budgets, " *Chemical Week* (164) 35, p. 34.

Shang, S. and P. B. Seddon. (2002). "Assessing and Managing the Benefits of Enterprise System: The Business Manager's Perspective, " *Information Systems Journa,* (12), pp. 271-299.

Songini, M. L. (2003a). "Goodyear Hits $100M Bump with ERP System, " *ComputerWorld,* November 3, http://www.computerworld.com/industrytopics/manufacturing/story/0,10801,86744,00.html. (current April 12, 2008).

Songini, M. L. (2003b). "J.D. Edwards User Wins Nearly $2M Over ERP Rollout Gone Bad, " *ComputerWorld,* December 18, http://www.computerworld.com/softwaretopics/erp/story/0,10801,88383,00.html. (current April 12, 2008).

Sterman, J. D. (2000). *Business Dynamics*, Boston, MA, Irwin McGraw Hill.

Swanton, B. (2004a). "Phase III ERP Benefits: The Art of the Formerly Impossible, " *AMR Research Outlook,* April 29, http://www.amrresearch.com/Content/View.asp?pmillid=17244 (current April 12, 2008).

Swanton, B. (2004b). "Consistent Process Execution Yields Millions in ERP Benefits, " *AMR Research Outlook,* June 18, http://www.amrresearch.com/content/view.asp?pmillid=17344anddocid=11711andbhcp=1 (current April 12, 2008)

Thibodeau, P. (2004). "Computerworld Honors: Innovative IT Success Stories Touted," *ComputerWorld,* June 8, http://www.computerworld.com/softwaretopics/erp/story/0,10801,93719,00.html. (current April 12, 2008).

454

Tyre, M. J. and W. J. Orlikowski. (1994). "Windows of Opportunity: Temporal Patterns of Technological Adaptation in Organizations, " *Organization Science* (5) 1, pp. 98-118.

Venkatesh, V., M. G. Morris, G. B. Davis, and F. D. Davis. (2003). "User Acceptance of Information Technology: Toward a Unified View, " *MIS Quarterly* (27) 3, pp. 425-478.

Venkatesh, V., C. Speier, and M. G. Morris. (2002). "User Acceptance Enablers in Individual Decision Making about Technology: Toward an Integrated Model," *Decision Sciences,* (33) 2, pp. 297-316.

Yi, M. Y. and F. D. Davis. (2003). "Developing and Validating an Observational Learning Model of Computer Software Training and Skill Acquisition," *Information Systems Research* (14) 2, pp. 146-169.

Zmud, R. W. (1995). "Role of Theory in Scholarly Manuscripts," *MIS Quarterly* (19) 3, pp. xxxviii-xi.

APPENDIX A: USER SURVEY ITEMS

Which best describes the area in which you work? (select all that apply)
   financial accounting (e.g., general ledger, accounts receivable, etc…)
   controlling (e.g., profitability analysis, product costing, etc…)
   asset management (e.g., depreciation, planning and acquisition of capital assets, etc…)
   project management (e.g., project planning, project tracking, etc…)
  sales and distribution (e.g., customer order management, product/service pricing data,
      etc…)
   production planning (e.g., master scheduling, bill-of-materials, etc…)
   materials management (e.g., master inventory data, materials tracking, etc…)
   purchasing (e.g., requisitions, purchase orders, goods receipt, etc…)
   plant maintenance (e.g., maintenance schedules, equipment histories, etc…)
   service management (e.g., service contracts, warranty coverage, etc…)
   human resources management (e.g., time accounting, payroll, employee evaluation,
      etc…)
   strategic management (e.g., strategic planning and simulation, balance scorecard, etc…)
   data warehousing (e.g., central storage of business data, etc…)
   other (please specify)

1. How much have relied on the following to help you use ERP within the last 3 months?[2]	not at all	not much	somewhat	quite a lot	almost completely

a. I read the documentation when I didn't understand something about the software (ssw)
b. I sought additional functionality in the ERP software (for example, addition of more project
    tracking capabilities or more audit trail capabilities) (ssw)
c. I experimented with new approaches to doing my work tasks using ERP (swp)
d. I read publications about how other companies are using ERP (swp)
e. I talked to people in other companies about how they use ERP (swp)
f. I found ways to do things in ERP that no one else seemed to know about (swp)
g. I relied on the people initially designated as Power Users or Super Users for help with the ERP
    software (psw)
h. I went to my colleagues for help solving problems or finding answers to questions about the
    ERP software (psw)
i. I talked to others in my area about how our work processes or tasks are different in ERP (pwp)

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[2] Questions 1 – 5 measure experiential interventions. Four types of experiential interventions were measured: self initiated, peer, manager, and expert. All four were captured for experiential interventions related to software, and the first three were captured for experiential interventions related to work processes. Questions for each time were intermingled to help control for question order bias. Abbreviations beside each question indicate what it was designed to measure. SSW = Self initiated about Software; PSW = peer initiated about software; MSW = manager initiated about software; ESW = expert initiated about software. SWP = self initiated about work processes; PWP = peer initiated about work processes; MWP = manager initiated about work processes. Question 5, while manager driven, taps whether the driving force was from manager established policies (Mgr Pol) or from incentives provided by managers (Mgr Inctv).

j. I talked to people in other areas about how their work processes or tasks are different in ERP(pwp)

k. People in my area meet to discuss work process or task changes brought about by ERP (pwp)

2. Please answer the following about the ERP "help desk" or support group within the last 3 months	Never	Almost never	Sometimes	Often	Almost always

The ERP "help desk" or support group

a. is where I turn when I have questions about the ERP software (esw)

b. is good at answering questions about how to use the software (for example, which menu options or which buttons do I use for certain tasks) (esw)

c. has made suggestions to me about how to make my use of the ERP software easier or better (esw)

d. has worked with me to identify problems and/or solutions to problems in the ERP software (esw)

3. Please respond to the following questions about your manager's support of ERP in the last 3 months **My manager**	Never	Almost never	Sometimes	Often	Almost always

a. allows me the time to attend in-house ERP training sessions (msw)

b. encourages me to attend training sessions that address broader ERP issues than the software itself (for example, sessions on changes in work processes or where my job fits in the overall work process) (msw)

c. talks to me about how ERP impacts my work processes or tasks (mwp)

d. talks to me about where my tasks fit in the "big picture" in the ERP environment (mwp)

e. personally uses ERP software (msw)

4. Please indicate your level of agreement with the following over the last 3 months	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree

a. Others in my area expect me to personally use the ERP software (psw)

b. Others in my area expect me to look for ways to improve our work processes using ERP (pwp)

c. Others in my area expect me to share with them new things I find in the ERP software (psw)

d. My manager expects me to personally use the ERP software (msw)

e. My manager expects me to find new ways to use ERP (msw)

5. Please indicate how much each of the following have influenced your use of ERP in the last 3 months	none exist	exists but not much influence on how I use ERP	some influence on how I use ERP	extensive influence on how I use ERP	almost completely determines how I use ERP

a. Specific policies or rules that govern ERP usage issued by management (MgrPol)

b. A statement(s) of goals for ERP usage issued by management (MgrPol)

c. A statement(s) of benefits the organization hopes to achieve through ERP usage issued by management (MgrPol)

d. Incentives or rewards for findings new ways to do work processes or tasks using ERP (MgrInctv)

e. Reprimands from management for failure to use ERP for the tasks that are supposed to be done in ERP (MgrInctv)

How much have relied on the following to help you use ERP within the last 3 months?	not at all	not much	somewhat	quite a lot	almost completely

6 a. I engaged in formal training opportunities for ERP beyond the initial training offered.
6 b. I have attended formal training on the way my work processes or tasks are different in ERP.

Please answer the following 2 questions with regard to how effective you feel your training was overall.	very ineffective	somewhat ineffective	just effective enough for me to do my job	somewhat effective	very effective

7a. Overall, I feel that my training on how to use the ERP software was
7b. Overall, I feel that my training on how my job changed after ERP was

8. Approximately what percentage of the full functionality for each of the following functionality areas do you personally feel you are utilizing?	not applicable	less than 25%	25% to less than 50%	50% to less than 75%	75% or more

a. financial accounting
b. controlling
c. asset management
d. project management
e. materials management
f. sales and distribution
g. production planning
h. purchasing
i. plant maintenance
j. service management
k. human resources management
l. strategic management
m. data warehousing

9. Please choose your level of understanding of the following:	almost none	some	just enough to do my job	more than enough to do my job	very high

a. navigation of the ERP software
b. what is meant by organizational units in the ERP software
c. what is meant by master data in the ERP software
d. performing transactions in the ERP software
e. what is meant by workflow in the ERP software
f. producing reports in the ERP software

10. Please respond to the following questions about your level of understanding of your own work processes and tasks.	almost none	some	just enough to do my job	more than enough to do my job	very high

a. How the task(s) I do feed into the next task(s) in the work process
b. How the task(s) I do fit into the overall work process
c. The task(s) that feed into the task(s) I do
d. The tasks(s) that my task(s) feed into
e. The overall work process that my task(s) is part of

11. ERP software gives me	strongly disagree	disagree	neutral	agree	strongly agree

a. good control of my data
b. good access to operational data
c. good access to summary data
d. good understanding of tasks
e. timely information
f. accurate information
g. concise information
h. reliable information
i. relevant information
j. understandable information
k. ERP makes my job easier to do
l. ERP makes my job more efficient

12. Compared to when I first started using ERP, I now	much less than when I first started using ERP	less than when I first started using ERP	about the same as when I first started using ERP	more than when I first started using ERP	much more than when I first started using ERP

a. ask questions about navigating the ERP software
b. ask questions about potential functionality in ERP
c. look for new functionality in ERP
d. look for new ways to use ERP
e. look for new ways to do my job
f. talk to others in my area about the ERP software
g. talk to others in my area about the work process changes that ERP has brought about
h. focus on the ERP software more than the tasks I perform using the software

APPENDIX B: MANAGER SURVEY ITEMS

Question A: Which ERP functionality has your site implemented? (select all that apply)

financial accounting (e.g., general ledger, accounts receivable, etc…)

controlling (e.g., profitability analysis, product costing, etc…)

asset management (e.g., depreciation, planning and acquisition of capital assets, etc…)

project management (e.g., project planning, project tracking, etc…)

sales and distribution (e.g., customer order management, product/service pricing data, etc…)

production planning (e.g., master scheduling, bill-of-materials, etc…)

materials management (e.g., master inventory data, materials tracking, etc…)

purchasing (e.g., requisitions, purchase orders, goods receipt, etc…)

plant maintenance (e.g., maintenance schedules, equipment histories, etc…)

service management (e.g., service contracts, warranty coverage, etc…)

human resources management (e.g., time accounting, payroll, employee evaluation, etc…)

strategic management (e.g., strategic planning and simulation, balance scorecard, etc…)

data warehousing (e.g., central storage of business data, etc…)

other (please specify)

Question B: Approximately how many ERP users does your site have?

Question C: Approximately what percentage of users at your site are aggressively leveraging ERP functionality?

Remaining questions adapted from Shang and Seddon 2002:

The measurement scale for questions 1– 5 was as follows:

not at all	as a secondary objective in some work units	as a secondary objective across the site	as a primary objective in some work units	as a primary objective across the site

1. We implemented ERP at this site in order to achieve the following operational outcomes:
a. labor costs
b. reduced inventory costs
c. reduced administrative expenses (e.g., reduction in printing, business supplies)
d. reduced cycle time in customer support activities (e.g., order fulfillment, billing, delivery)
e. reduced cycle time in supplier support activities (e.g., order processing, payment processing)
f. reduced cycle time in employee support activities (e.g., month-end closings, requisitions, HR, payroll)
g. increased productivity of employees (e.g., labor hours, labor costs, increased work volume with same labor force)
h. improved quality (e.g., reduced error rate, increased data reliability)
i. improved customer service (e.g., ease of data access and response to inquiries)

2. We implemented ERP at this site in order to achieve the following managerial outcomes:
a. improved asset management (e.g., for improved cost, depreciation, relocation, custody, records control)
b. improved inventory management (e.g., shifting products, responding to changes in demand, more inventory visibility)
c. improved production management (e.g., coordinating supply and demand, meeting production schedules)
d. improved workforce management (e.g., workforce allocation, skill utilization)
e. improved strategic decision making (e.g., greater market responsiveness, faster profit analysis,

more effective strategic planning)
f. improved middle level management decisions (e.g., through more flexible resource
management)
g. improved operational decisions (e.g., faster responses to operational changes)
h. improved financial performance (e.g., by lines of business, product, customers)
i. improved manufacturing performance (e.g., monitoring, prediction, quick adjustments)
j. improved overall operational efficiency and effectiveness management

3. We implemented ERP at this site in order to achieve the following strategic outcomes:
a. support business growth (e.g., in new markets, with increased number of employees, with
increased transaction volume)
b. support business consolidation (e.g., consolidating acquisitions into the business, integrating
resources with acquired companies)
c. build business innovation (e.g., enable new market strategies, new process chains)
d. build cost leadership (e.g., leaner structure, shared services)
e. generate product differentiation (e.g., providing leaner production with make-to-order
capabilities, customized billing, differentiated service levels)
f. enable worldwide expansion
g. enable e-commerce actives
h. generate or sustain competitiveness (e.g., with faster decision making, better internal support)

4. We implemented ERP at this site in order to achieve the following IT infrastructure outcomes:
a. provide a broader range of options in responding to environmental changes
b. reduced cost of system maintenance
c. reduced IT staff
d. more efficient hardware
e. year 2000 compliance
f. improved system architecture design/development
g. reduced cost of systems upgrades
h. easier system modification and future change
i. reduced cost of technology research and development
j. better alignment of IT with business goals
k. more reliable infrastructure
l. more flexible infrastructure to respond to business needs

5. We implemented ERP at this site in order to achieve the following organizational outcomes:
a. greater coordination among different interdisciplinary matters
b. greater harmonization of interdepartmental processes
c. broadened employee skills
d. more value-added responsibility and accountability among employees
e. more proactive employees in terms of problem solving
f. greater employee involvement in business management
g. more consistent vision across different levels of the site
h. increased work as a common unit across the site
i. greater focus on the customer and market
j. greater focus on business processes
k. greater focus on overall performance
l. increased employee morale/satisfaction
m. improved employee work efficiency
n. improved employee problem solving skills
o. improved business knowledge among employees

> **Questions 6-10 were worded to capture the extent to which of each of the above were perceived as being achieved. Their wording and measurement scale are shown in the example question 6 below. Question stems 6-10 corresponded to each of the 5 types of outcomes above. Each question set contained the same items as their corresponding question set in questions 1 – 5.**
>
> **Please respond to the following questions about what you actually achieved by implementing ERP at this site:**

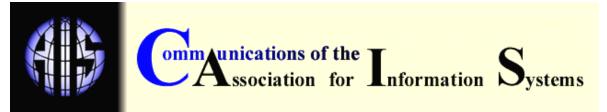| 6. We have achieved the following operational outcomes by operating in an ERP environment at this site: 6a – 6i correspond to 1a – 1i	not at all	to very little extent	to some extent, but not as much as expected	to about the extent expected	beyond expectations
7. We have achieved the following managerial outcomes by operating in an ERP environment at this site: 7a – 7j correspond to 2a – 2j					
8. We have achieved the following strategic outcomes by operating in an ERP environment at this site: 8a – 8h correspond to 3a – 3h					
9. We have achieved the following IT infrastructure outcomes by operating in an ERP environment at this site: 9a – 9l correspond to 4a – 4l					
10. We have achieved the following organizational outcomes by operating in an ERP environment at this site: 10a – 10o correspond to 5a – 5o					

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