

AN INTEGRATIVE FRAMEWORK FOR THE ASSIMILATION OF ENTERPRISE RESOURCE PLANNING SYSTEMS: PHASES, ANTECEDENTS, AND OUTCOMES

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ABSTRACT

Many organizations are in the process of assimilating Enterprise Resource Planning (ERP) systems. While traditional ERP systems integrated core business processes, the new generation ERP systems also have the potential to link suppliers, customers, and business partners, to integrate value chain activities. Despite this, the critical success factors for ERP assimilation identified in the past literature do not focus on external factors including the possible role of external stakeholders in ERP assimilation. If case studies are any indication of the outcomes in ERP investment, insights already suggest that many attempts have not delivered the expected benefits, have failed completely, or will have high probability of failure. In light of the new found scope of modern ERP systems and disappointing assimilation reports, this paper proposes an integrative framework that may enhance chances for successful assimilation of ERP in organizations. The framework identifies the phases, antecedents (technology and business, internal and external), and outcomes as they relate to ERP assimilation. The key contribution of the paper lies in synthesizing and extending ERP assimilation literature by addressing the role of critical external antecedents in different phases of the assimilation process. Implications of our framework are outlined to guide future practice and research.

Keywords: ERP, Enterprise resource planning systems, Enterprise systems, Critical success factors, ERP adoption, ERP assimilation, ERP life-cycle

INTRODUCTION

Enterprise Resource Planning (ERP) systems can be viewed as information technology (IT) based solutions that attempt to integrate core business processes. ERP products are modular in structure and early offerings aimed to integrate logistics, financial planning, sales, order processing, production, and material resources planning processes. Because of their modular structure, ERP assimilation efforts often vary in scope. Organizations may choose to implement one or few modules at a time with follow-up implementations of other modules planned in future periods.

Over the years, ERP have evolved and the new generation

of ERP products promises to extend the reach of these systems by providing back-end technology components for Supply Chain Management (SCM) and front-end components for Customer Relationship Management (CRM) (15, 35). Thus future ERP applications will be capable of integrating value chain activities and deliver mission critical IT applications. As the new generation of ERP software products proliferate, they will be able to provide greater levels of support for business computing requirements.

The market for ERP is already very lucrative. While investments in the global ERP market have been suggested to be \$300 billion in the last decade, the ERP market is predicted to be \$79 billion by 2004 (12). There are hundreds of vendors that offer ERP products. However, only a few provide modules that have extended scope. According to AMR research, the 2002 predictions suggest that SAP holds 35% of the market share followed by Oracle (13%), PeopleSoft (10%), JD Edwards (4%), and others (38%) (28). While most of the Fortune 500 organizations either have already implemented some modular form of ERP or are in the process of extending their scope, the mid-market segment remains largely untapped (24).

Why is there so much interest in ERP? When successful, the benefits brought about by their assimilation can be significant, both operationally and strategically (43). Case studies suggest that successful ERP assimilation can bring about cost savings from integrated business processes that reflect fundamentally new approaches to conducting business, savings from revamping old legacy systems and integrating IT applications, and enhanced revenues resulting from improvements in customer service, ease of expansion and growth, and better decisions (15). Empirical evidence also suggests that ERP assimilation improves availability of information and integration of business operations (32) and organizations making investments in ERP tend to have higher financial performance as well as higher market valuation than those that do not invest in ERP (25).

However, realizing benefits from ERP is another issue and it can be very costly. For larger organizations, ERP assimilation price tag can run into tens and hundreds of millions of dollars (41). A recent study of 479 manufacturing firms found that average investments in ERP can be as much as 5.6% of annual revenues. For smaller firms these figures can escalate to about

50% of their annual revenues (32), thereby adding substantial risk of failure. Moreover, ERP assimilation can take a long time, often disrupting existing business operations and constraining organizational resources. As a result many efforts are riddled with problems and despite the past and predicted growth, the ERP implementation score card is rather mixed and disappointing (20). It has been reported that 35% of the ERP implementations are cancelled, 55% of them result in cost and schedule overruns (average overruns of 178% and 230% respectively) and only 10% are successful (completed on time, on budget, as planned) (11).

Given the interest in ERP among practitioners and the disappointing results of past ERP initiatives, we make an attempt to synthesize the past and current perspective on ERP and propose an integrative framework for ERP assimilation that may enhance chances of success. In the next section we provide a brief overview of ERP assimilation literature to highlight some of the limitations of past practice and research. Following this we present our integrative framework. In the last section we discuss the implications of our framework for future research and practice.

OVERVIEW OF ERP ASSIMILATION RESEARCH

In a general sense, assimilation of an IT can be defined as the process of acquisition and deployment of the IT in organizations (19). In the context of emerging ERP system products, assimilation has a broader scope and greater strategic implications. Armstrong and Sambamurthy (4) provide a useful definition of IT assimilation that lends itself better to the notion of ERP assimilation. According to these researchers, (ERP) assimilation is "the effective application of IT in supporting, shaping, and enabling firms' business strategies and value chain activities" (pp. 306).

There is no dearth of frameworks to guide ERP efforts that have been put forth by practitioners (vendors and consultants). These are as common as the number of participants in the ERP marketplace and often differ in their approaches to success. Several books have also been written to offer insights into such large scale implementations. Although some are useful in understanding assimilation in general (31), other prescriptions are based on the assumption that a specific vendor product (SAP) is selected (9) for assimilation in the context of a large organization (6) or a global organization with multi-site facilities (51). Such insights may not be very useful for the fastest growing small and mid-size ERP markets. On the other hand, even though the research community has been somewhat slow to focus on ERP assimilation, there has been a tremendous amount of attention directed at addressing this topic in the last couple of years and many researchers have forwarded their own share of insights, guidelines, critical success factors, and approaches (for a review of 189 ERP publications between 1997-2000, interested readers should refer to Esteves and Pastor (16)).

From ERP assimilation standpoint, research on critical success factors and assimilation phases can be useful to enhance chances of success. Several researchers have identified critical success factors (CSFs) for ERP assimilation (for a list of 11 CSFs composed after a review of the ten articles on CSFs, interested readers should refer to Nah et al (37)). Recently attempts have offered an even more comprehensive list, identifying 22 CSFs for successful ERP efforts (45). However, except for the inclusion of vendor and consultant support factors, past CSF lists do not consider any other external factors that may influence ERP assimilation success. Moreover, CSFs research does not specifically address how these factors may influence specific assimilation phases.

For the most part, research has focused on the implementation stage of ERP assimilation. Some researchers have proposed stage models for specific ERP products (9, 42) and ERP assimilation life-cycle in general (1, 16, 34) without however, explicitly addressing some of the key antecedents that may influence specific phases given the extended scope of ERP and the outcomes of these phases.

While some researchers have attempted to map CSFs (identified in past research) in life-cycle phases (37), comprehensive integrative perspectives on ERP assimilation are only beginning to appear (2, 40, 46). These theoretical frameworks offer very useful in-depth insights into ERP implementation but in our view, they do have some limitations. For example, Al-Mudimigh et al (2) forward dominant ERP factors that influence overall ERP assimilation and several other critical factors in ERP implementation from strategic, tactical, and operational without specifically identifying ERP assimilation phases. Rajagopal (40) taps on innovation diffusion theory and combines a process model and a causal model to frame ERP implementation. Several strategic, competitive, efficiency, technical, and operations motives that influence firms to implement ERP are identified. While the framework offers rich insights into ERP assimilation, it does not completely address the extended scope of ERP and therefore the impact of key external stakeholders on ERP assimilation phases. Finally Somers et al (46) provide a sociotechnical view of ERP to guide future research but once again the stakeholders addressed include only the software vendors, consultants, users, and the organization. The role of other key external stakeholders (such as suppliers, buyers, business partners) is especially critical under the new industry structures that emphasize value chain integration. Moreover, as the untapped mid-sized ERP markets grow, larger external entities may play a significant role in the assimilation of ERP in smaller organizations. These insights could be very useful to steer future research and practice.

In lieu of the above limitations, research efforts are required to extend conventional wisdom as organizations attempt to enhance ERP functionality with emerging offerings and as new ERP markets are tapped. This paper takes a step forward in that direction. In the next section, we present our integrative framework.

INTEGRATIVE FRAMEWORK FOR ERP ASSIMILATION: PHASES, ANTECEDENT, AND OUTCOMES

A hybrid methodology was adopted to develop an integrative framework proposed in this paper. First, ERP books (written by practitioners), case studies, practitioner reports, and published ERP research articles were reviewed to gain insights into assimilation. Second, since transformation brought about by implementing total business solutions (such as ERP) requires integrating Organization Development (OD), Business Process Redesign (BPR), and IT development principles, we reviewed key contributions from these literatures to identify critical antecedents of assimilation. Third, our own case studies of nine ERP implementations provided further insights into ERP phases and factors critical in different phases of ERP assimilation. Finally, the third author provided first hand information based on his experiences as a key member of an ERP assimilation project team over a period of several months. The information gathered using all the above methods was then systematically mapped to identify the phases, antecedents, and outcomes as they related to ERP assimilation.

From the perspective of our framework, *phases* refer to the key segments or stages in the assimilation of ERP. While the

number (and labeling) of phases varied depending upon whose perspective we reviewed, we have tried to conceptualize ERP phases based upon logically related activities and the unique set (to the extent possible) of antecedents that influence those activities. For the most part, our phases parallel those proposed by Ahituv et al (1). The four-phase ERP life cycle identified by them included: selection, definition, implementation, and operation. There are two notable exceptions in our framework. First, the "definition" phase has been labeled as "preparation" phase in our framework to reflect the broader nature of activities performed in this phase. Second, we have identified an additional phase, namely the "awareness" phase that should precede the four phases. This is especially critical as ERP vendors target mid and small market segments. We briefly mention the activities in each phase without describing them in detail as they have been already been discussed in detail by others (1).

Antecedents relate to the key constructs and factors that may influence a particular phase, the activities undertaken in that phase, and/or the successful progression of that phase. In other words, the variations in constructs and factors in the right direction could also be viewed as predicting success or variations in the wrong direction as stagnation blocks that may prevent a successful transition from one phase to another. ERP efforts can be addressed from technical and business perspectives (34). We consider the same two categories for our constructs and factors, business (external and internal) and technology (external and internal), and expand on their impact on specific phases. Finally, *outcomes* refer to the desired outputs of each phase. The integrative framework is shown in Figure 1.

Awareness

Most ERP assimilation efforts begin with the awareness for the need to undertake such initiatives. From the IT innovation standpoint, awareness refers to the initiation stage that eventually leads to the decision to adopt a technology (ERP). This phase reflects a state of transition culminating from pressures to change from status quo. Key activities in awareness may include, evaluating the current situation both from business and technical standpoints, and gathering facts and information to identifying possible reasons to change (problems and opportunities).

Antecedents and Outcome. Several key antecedents can influence awareness. Motivations to adopt ERP can be both business and technology related. In a survey of 50 ERP experts, 36% of the respondents reported technical reasons for the decision to adopt ERP while the remaining 64% reported business related reasons for ERP adoption decision (49). From the business perspective, external antecedents that may influence awareness include: Pressures from stakeholders (suppliers, customers, and business partners) and industry trends. Empirical evidence suggests that improving interactions and communications with suppliers and customers can be the key motivations to consider ERP (32). The inability of employees to respond to informational requests of key suppliers and customers can be a convincing reason to consider ERP (13). In situations when such initiatives to improve relationships with external entities are not driven from within, the need to consider ERP may be a result of external stakeholder pressures trying to eliminate slack in value chain activities or even the competitors of the organizations who have already embraced the notion of ERP (31).

Industry trends can also lead to awareness of ERP. A large scale study of 2,647 organizations in ten European countries

found that ERP are likely to be more popular in some industries than others (17). It is likely that their manufacturing background may promote their awareness in certain related industries. Furthermore, a trend toward adoption of process-based management models brought about by ERP can increase awareness (52). In their field survey of fifty six respondents (twenty eight implementation agents and twenty-eight key users) in twenty-eight ERP implementations, the authors found that 71% of the respondents indicated "following industry trends" as one of the reasons for implementing ERP.

Similarly internal antecedents that may drive awareness include: information quality and business performance. Poor prevailing information quality can significantly inhibit an organization's ability to plan and respond to decision situations, thereby driving the need to consider integrated software package solutions (31). In short, poor information quality translates to bad decisions and the inability to learn from past mistakes and successes. In a recent survey, 61% of the CEOs indicated that improving management decision making was the key consideration to invest in ERP (15). Furthermore, declining business performance can also influence ERP awareness. Poor performance eventually translates to strategic disadvantage and for many organizations, the primary motive to implement ERP lies in their potential for enhancing competitiveness (13). As such, for many organizations, gaining a strategic advantage in the industry was the key motivation for ERP (32).

On the other hand, technology antecedents also influence awareness. Externally, aggressive marketing efforts by IT providers and integrators (vendors and consultants) can increase ERP awareness (52). Moreover, several internal antecedents provide an impetus to consider ERP. These include: technical quality of IT applications, extent of IT integration, and the compatibility/sophistication of IT applications.

Poor technical quality of applications can be characterized by huge maintenance efforts and inaccurate, unreliable, irrelevancy, and untimely nature of the information they deliver. Requirements of extensive amounts of resources for application maintenance and support can be a convincing reason to consider ERP (13). Furthermore, in a CEO survey, 67% of the respondents indicated that investments were made in ERP to improve information accuracy and availability (15). Thus technical quality of applications can be a significant driver of ERP awareness.

Poor IT integration often stems from isolated legacy systems that colonize many organizations. The inability to share data and information between these legacy systems raises compatibility issues. In their survey, Mabert et al. (32) found that the two top motivations to consider ERP were to replace legacy systems and to simplify and standardize systems. Similarly, Chen (13) also suggests that incompatible IT applications can trigger awareness of ERP. Thus poor IT integration and compatibility of existing systems influence awareness.

The outcome of the awareness process leads to the adoption decision. If the outcome is the decision to assimilate ERP, the next phase is initiated. In some cases, the decision to assimilate may be put on hold only to be evaluated at some point in the future.

Selection

While it is possible to undertake internal development of ERP, almost all organizations opt for selecting a specific vendor package or a mix of "best of breed" modules by different vendors. In most cases the selection process is carried out by an in-house team of key decision-makers, users, and internal IT

specialists (31). However, organizations can also solicit support of consultants in the selection process. Key activities in selection include: definition of project objectives, collection of vendor consultant information, need analysis, evaluation of vendor and consultant alternatives, evaluation of IT infrastructure, feasibility study, and finalizing of contracts (1).

Selection of a software package is a critical success factor from ERP assimilation standpoint (45) and it has been convincingly argued that software evaluation should be extended to include all potential impacts and consequences over the entire ERP assimilation cycle (47). As many as twenty nine different selection criteria that should be considered have been identified by researchers (8). Therefore, selection of ERP software can be complex and can take months and cost thousands of dollars. In light of this, some researchers have explored "good practice" and forwarded frameworks for ERP acquisition (50).

Antecedents and Outcome. Not only are there many criteria for ERP software selection, empirical evidence suggests that organizations differ in the importance they place on these criteria, the approaches they use to staff groups for selection, and the decision-making pattern (centralized versus decentralized) deployed in selection (8). There are several business and technology antecedents that may influence the importance of selection criteria, and therefore the selection process. From business standpoint, key external antecedents are industry norm, industry shakedown, and stakeholder (suppliers, buyers, and business partners) needs. Industry norms may influence package selection simply because the majority of the organizations in the industry have implemented software from the same vendor (for example SAP dominates the oil industry) or the software is specifically designed for the needs of the industry (15). A vendor that dominates a specific industry will protect its domain by providing better service and incorporating the needs of the organizations in future releases of the software. Industry shake-down as reflected by mergers and acquisitions can also influence selection. For example, in one of our case studies, the company acquired another organization that was running a completely different system. ERP was viewed as a solution to consolidate financials throughout the company and its newly acquired business.

For the most part, the literature has not paid much attention to the influence of stakeholder needs in ERP software selection despite there being some evidence that external stakeholder needs can influence selection. A study of European organizations conducted in early 1999 found that only 33% of the large organizations considered customer and supplier needs an important criteria for making an ERP software selection decision (8). However, recent surge of SCM and CRM applications may suggest otherwise. Arguing in favor of the potential strategic benefits of ERP in creating alliances, Stefanou (47) notes that "For achieving the full potential of ERP.....evaluators should consider the impact of ERP on external stakeholders, specially the customers, suppliers, and business partners" (pp. 207). For example, ERP selection decisions should also consider the extent that alliances enhance or hinder access to new information and the ability to relate that information to processes that impact organizational effectiveness. Following the same line of logic, one could argue that external (larger) entities (stakeholders) may influence the ERP selection process of smaller, mid-sized organizations.

The key internal business antecedents of selection include: Unique needs (specific functional requirement, desired flexibility etc.), resources (size, capital, employee skills, etc.), enabling constraints (training, BPR scope, orientation to change,

etc.), and top management support. The specific functional needs of the organization can influence package selection simply because the vendor may specialize in a particular module. PeopleSoft, for example, is popular for its HR module, SAP for financial and supply chain modules, and Baan for flexible manufacturing module.

Organizations also differ in the amount of desired flexibility in their operations. From this perspective, there is no ideal package and almost all the ERP software packages impose constraints on flexibility. This often creates misfits or gaps due to the functionality offered by the package and that desired by the adopting organization. These misfits can arise due to company-specific, industry-specific, or even country-specific requirements, posing several problems in implementation (44). As a result, desired operational flexibility can have a significant influence on the selection phase. Dell, for example, decided to develop their own ERP after abandoning SAP assimilation because the package could not give them the amount of flexibility they desired (18). Some software vendors have recognized these needs and are moving to provide packages with the best-of-breed applications suited for a specific industry (for example JDA and Richter Systems provide software specifically for the retail industry) (15).

The size of the organization is another important antecedent that can influence package selection. A recent survey of European organizations revealed that large organizations selected SAP more often, while their small and midsize counterparts preferred BAAN. Furthermore, small and midsize organizations differed significantly in their decision making criteria for ERP selection (8). From the resource-based perspective, ERP assimilation is costly and smaller organizations may simply not be able to afford the price tag of ERP. In the past, primary vendors have often targeted their products to larger organizations, although they are now quickly moving to mid-sized and smaller market segments, offering less expensive and scaled down versions of ERP. Cost considerations may even lead smaller organizations to opt for the application service provider (ASP) option, a practice that is becoming increasingly popular (7).

Furthermore, enabling constraints (amount of training required to upgrade user skills, magnitude of reengineering for ERP assimilation, and the scope of change management efforts) to assimilate a specific package may influence the selection process. The greater the gap between these constraints, given the present situation and the final state after package assimilation, the more negative is the influence on a specific package selection. Under, these conditions, organizations may benefit greatly by selecting best of the breed applications rather than a single vendor package (30, 39). Finally, because ERP software selection involves consideration of several strategic level factors, top management involvement is critical and they have "the responsibility to understand the dynamics and the integrative, permanent and strategic nature of ERP.....before proceeding into ERP software acquisition" (47) (pp. 214). Top management support is also critical in this phase from monetary standpoint and they must approve the budget necessary to acquire and deliver ERP applications.

In addition to business antecedents, technology constructs may also influence software selection. External technology constructs include: IT provider and integrator profiles and value chain integration, while the internal constructs may include: IT architecture requirements and IT integration. Typically, information about the financial stability of the vendor, market share of their product(s), geographical focus, software functionality, customization tools, vendor reputation, the extent of support that they can provide etc. must be sought and

considered in the selection phase (47). The extent to which support from system integrators (consultants) is available for a specific software package can also significantly influence choice. Since consulting options can almost never be avoided, it is imperative that consulting resources be considered for deploying the software once it is acquired. Given the extended scope of the new generation of ERP products, it is also necessary to consider the desired level of value chain integration that is required. Interfaces may also be needed to link to value chain participants. If the required interfaces for a specific ERP product are complex, it is difficult to justify their selection. Therefore value chain connectivity is likely to influence selection.

Internally, from IT infrastructure standpoint, the existing platform is probably not going to be sufficient to support a large scale ERP deployment (31). Therefore, the IT infrastructure (hardware, networks, storage etc.) required for ERP assimilation may also influence selection (47). Dependency on specific vendor IT infrastructure products should be avoided and if a complete overhaul of the IT infrastructure is required to deploy a specific ERP product, it can have a significant negative influence on choice. Finally, any ERP software selected will require developing interfaces to internal information systems to provide the necessary integration (15). Empirical evidence suggests that current ERP have low coverage of overall business IT requirements and integration of ERP with existing IT systems can be extremely problematic (49). Thus the extent of IT integration that is desired may significantly influence package selection. For example, integration can be time consuming and difficult when best of breed packages are selected versus single vendor ERP software (30).

The outcome of the selection phase leads to the final decision of either acquiring a specific vendor software package for ERP assimilation or acquiring the best of breed packages from various vendors. In a recent survey of 50 respondents, Themistocleous et al. (49) found that 72% selected a single specific vendor package versus 28% that adopted the best of breed approach, indicating a strong preference for single package option. Selection choice initiates the preparation stage.

Preparation

Empirical evidence suggests that pre-project activities can have a significant influence on project manager performance and project team effectiveness, both of which are critical for success in IT projects (27). Such activities are even more critical in ERP assimilation. Therefore, preparing for a large scale ERP project prior to implementation is absolutely critical for success (31). In addition to definition of project scope, establishment of implementation teams and timetables, training of implementation teams, and initial prototyping (1), preparation activities also focus on determining the most appropriate approach to implementation. Since ERP is an enterprise wide activity, implementation teams will need to learn about firm level issues that will affect the design of the ERP interface to end users both inside and outside the organization. This leads to a much broader view than is traditionally associated with IT implementation teams.

Antecedents and Outcome. Several antecedents can influence the preparation phase. Externally, the key business antecedent is stakeholder needs, while the internal antecedents include: management support and project management (PM).

When the scope of ERP extends beyond the organizational boundaries, the needs of external stakeholders can significantly influence project preparation. Specialized needs of more

powerful external entities (major customers, suppliers, and business partners) can create extra demands on smaller less influential organizations as they prepare for implementation. As a result, during preparation, needs of external entities must be included in defining the project scope.

Top management support has probably been the most widely investigated factor in MIS research and from preparation stage standpoint, top management must approve the implementation schedules, ensure that the best employees are assigned to the project team, and be willing to spend significant time on ERP related issues or serve on steering committee created to oversee the next phase of implementation.

Given the scope of ERP efforts, PM can have a significant impact as organizations prepare for ERP implementation. Appropriate utilization of PM tools can substantially reduce the level of risk associated with the project. In general there are four categories of project management tools. These include: internal integration tools, external integration tools, formal planning tools, and results control tools (3). Internal integration tools include devices and controls to ensure integrated operation of the project team. External integration tools, on the other hand, include organization and communication systems that link the project team's work to users so that the redesign of tasks managed by end users will result in qualitative as well as quantitative gains. While formal planning tools help to structure task sequences in advance and to estimate resources needed for execution, results control tools assist in evaluating progress and taking corrective action. From ERP preparation standpoint, appropriate formal planning tools can be useful to map out the implementation details (timelines, schedules, responsibilities etc.). Internal integration tools can ensure that the right professionals are selected to lead the team, while external integration tools can ensure that the user community has appropriate representation on project teams and user steering committees.

The technology constructs that can influence preparation include: support from IT providers and integrators (external antecedents) and competence of internal IT unit. Level of technical support from vendors and consultants is critical to overcome the knowledge barriers related to ERP software assimilation (41). However, too much reliance on consultants can be dangerous because few consultants understand their clients' business processes sufficiently (44). Overall technological competence of the in-house IT staff is critical since they are aware of existing systems. Moreover, they may have to take the responsibility of ERP maintenance once they have been assimilated. Their knowledge of compatibility of IT infrastructure during the test run is critical as any failures in simulating the ERP environment can quickly drain the motivation for its assimilation by distracting the project team members and creating doubts about ERP among key users and internal managers. Highly competent internal IT staff can significantly speed up preparation and enhance chances of success in implementation.

The outcome of the preparation phase is the "As Is/To Be" concepts that provide a roadmap for the next phase. These concepts also identify the gap that exists in where the organization is and the changes that are required to implement ERP. The preparation phase is tightly integrated with the implementation phase with fuzzy lines separating the two.

Implementation

This is probably the most crucial phase in ERP assimilation. Many efforts fail due to problems encountered during implementation. Implementation activities include:

detailed gap analysis, BRP, identification of complementary solutions, construction of prototype, data conversion, clarity of work procedures, full implementation, user training, and acceptance tests (1).

Antecedents and Outcome. Due to tight integration between preparation and implementation phases, the majority of the antecedents are common in both phases. However, their properties differ to some extent. The key external business antecedent is stakeholder support, while internal antecedents include: management support, PM, and change management.

As in the case of preparation, stakeholder support is an important external antecedent of implementation, especially when the stakeholders have had experience in assimilating ERP in their own respective organization(s) and the relationship between value-chain entities are partnership based. The role of external entities in overcoming knowledge barriers has been long recognized in the context of diffusion of complex IT innovations (5). It is plausible that larger, resource rich stakeholders may assume the role of experts and assist in overcoming knowledge barriers related to ERP implementation particularly when their smaller, resource constraint partner organizations may not be able to afford the high price tag of consultants. Moreover, if ERP scope extends beyond organization boundaries, cooperation from suppliers, business partners, and major customers is critical in designing external IT links.

Many articles have been published on the role of top management support in IT implementation and their commitment is a "recurring factor in studies examining the large-scale implementation of new process and information technologies (48) (pg. 610). From ERP implementation standpoint, top management support cannot be overlooked as important reengineering decisions regarding business processes have to be made in the implementation phase. Many jobs and tasks will change as ERP are implemented and top management support, particularly from human resources is critical to deal with end-user concerns. Most of the conflicts in ERP assimilation also take place during implementation and top management must intervene to make decisions, otherwise the process can simply come to a standstill.

ERP assimilation is extremely risky due to its large scope, unstructured nature, and complex nature of the technology. As a result, appropriate utilization of project management tools is absolutely essential for success, more so in implementation than in any other phase. Internal integration tools are absolutely critical and are deployed to coordinate the activities of the project team participants and resolve all technical problems that may be encountered with implementation. External integration tools are also critical to facilitate collaboration with all external stakeholders to ensure that user and process requirements are accurately incorporated in implementation. Planning tools and results control tools are somewhat less useful due to the complex nature of the technology and unstructured nature of the ERP implementation process. However, planning tools can ensure that all major system specifications have been addressed and milestones for major decisions/approvals have been identified while results control tools can be used to monitor the project and review the progress.

Change management can also significantly influence implementation. The importance of integrating workers in new processes that are enabled by technology has been addressed by researchers from OD (14, 26, 36, 38) and BPR perspectives (21, 22, 23, 33) and is even more important in the context of ERP, as they usually bring about significant resistance to changes in business processes and job tasks (48). Appropriate strategies

may require communication of benefits, alleviating concerns about uncertainty, and realignment of incentive systems to promote an enterprise perspective where functional, product, market segment, or task focused perspectives were dominant.

End-user training has been recognized as a critical success factor for successful implementation (31)(48). In some cases, to contain costs, training sessions may be carried out by the key users who were trained during the preparation phase. In other cases, the vendors/consultants may assume training responsibilities. Cutting corners in the level of training to end users can have dire implications for overall success.

The key external technology constructs that may impact ERP implementation include: IT provider and integrator support, and value chain connectivity. The key internal antecedent is IT unit competence.

The technical support from IT providers (software vendor(s), hardware vendor(s), network provider(s)) and consultants (integrators) is critical to overcome knowledge barriers, even more so in this phase than in the preparation phase. ERP implementation can be riddled with technical problems and support from technically qualified participants is absolutely essential. The extent of interfacing that is required between internal information systems and ERP software can prolong implementation and have direct implications for cost overruns. The extent of customization can also have a direct impact on the success of ERP implementation. Extensive customization is very expensive and at the same time destroys the integrity of the software and may even reduce the benefits that can be realized from implementing ERP. Technical skills to address interface and customization issues are critical during implementation.

The outcome of the implementation phase is what is often termed as "going live." In other words, the workable system is in place for operation.

Operation. This last phase in ERP assimilation entails system use, maintenance, and business integration. The maintenance focuses on enhancing technical efficiencies while business integration focuses on enhancing process efficiencies. Often this a crucial time as the organization adjusts itself to the new ways of doing business that are supported by ERP. Typical maintenance activities may include: fixing bugs, performance tuning, adding hardware capacity, technology upgrading/migration etc. while business integration may focus on process and procedure changes, retraining, continuous business improvement, and adding people to accommodate learning (34).

Antecedents and Outcome. Several factors can influence operation. The key external business construct includes user groups while the internal constructs include: Commitment to new process and perceived benefits of the new system. Organizations can learn a lot by attending user group meetings that are sponsored by vendors and similar interest groups (31). If internal ownership to the new processes is embraced and practiced, continuous learning is the natural outgrowth. If the perceived benefits are apparent, they can influence end-user behavior and their intentions to use the system. If the users were appropriately involved in the earlier phases and given the right amount of training, they will perceive the right fit between the new technology and their tasks, and this can create a learning environment and have a positive influence on assimilation outcome (29).

The key technology constructs that can influence operation include: Post-implementation vendor support (external) and IT support structure (internal). Unlike other IT applications, ERP

require dedicated support staff to enhance the technical efficiency of the system and to address end-user concerns during business integration. Periodic support from vendors can also be critical for ongoing operation, particularly for post-implementation reviews, software enhancements, or building additional interfaces for business integration.

The outcome of the operation process is organization learning. Much of the true success or failure to achieve the goal of learning behaviors across the organization lies in the post-implementation integration work. This is where the rubber meets the road and organizations start to build those learning behaviors. Organization learning must happen, for the organization has placed itself in a new world and embraces the internal journey to chart a successful path. Never-the-less, even if it is too early to realize the full benefits of integrated processes through ERP, the assimilation process can be an opportunity for organization learning because it involves a large number of users who undergo training and participate in implementation. Case research findings suggest that the net result is greater user awareness of IT and how it affects tasks. Moreover, the experience accumulated leads to greater effectiveness in future IT implementations (44).

DISCUSSION AND CONCLUSIONS

Our primary objective was to propose an integrative framework of ERP assimilation with intentions that a greater interest is generated in this area. Our framework builds upon recent efforts (1) and synthesizes insights from various sources. First, we tapped upon research on OD, BRP, and IT implementation to identify their contributions to ERP assimilation. Second, there has been an explosion of trade articles on ERP in the last couple of years. Many books have also appeared to offer guidance on ERP undertakings. We tapped on some of the key insights from these practitioner books and trade reports to develop our framework. Third, findings from our own case studies of ERP assimilation in nine U.S. organizations contributed to the understanding of ERP assimilation approaches. We have integrated these findings in our framework. Fourth, first-hand insights by one of the authors provided invaluable insights into current business practice of ERP assimilation. We have incorporated his experience from a consultant's perspective. Finally, we tapped upon a growing body of ERP literature in academic journals to support our insights and premises. In synthesizing the various perspectives, our integrative framework identifies the phases, antecedents, and outcomes as they relate to the assimilation of ERP in organizations. A unique direction this has taken us is to developing an approach to understanding how the potential for enhancing organizational learning capacity through ERP assimilation can occur throughout the phases of awareness, selection, preparation, implementation and operation. Thus, the primary contribution of this paper is to map, and more importantly, extend existing understanding of ERP assimilation.

The framework proposed identifies several avenues for future research and practice. From research standpoint, it is critical to empirically validate the framework so that relationships can be tested and results can be generalized across a population of organizations. Particularly interesting would be the validation of the role of external stakeholders in ERP assimilation as organizations (especially small and mid-sized) opt to implement ERP modules that cut across organizational boundaries. From practitioner standpoint, we hope that our framework provides a template for ERP assimilation efforts so as to enhance chances of success.

The proposed framework does extend conventional wisdom

on ERP and adds to the existing understanding of ERP assimilation. At the least, we hope to generate enough criticism to direct attention to this important area, which we believe has not received the kind of focus that it merits given the implications of ERP on the future viability and competitiveness of organizations.

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FIGURE 1
Assimilation of Enterprise Systems: Phases, Antecedents, Processes, and Outcomes

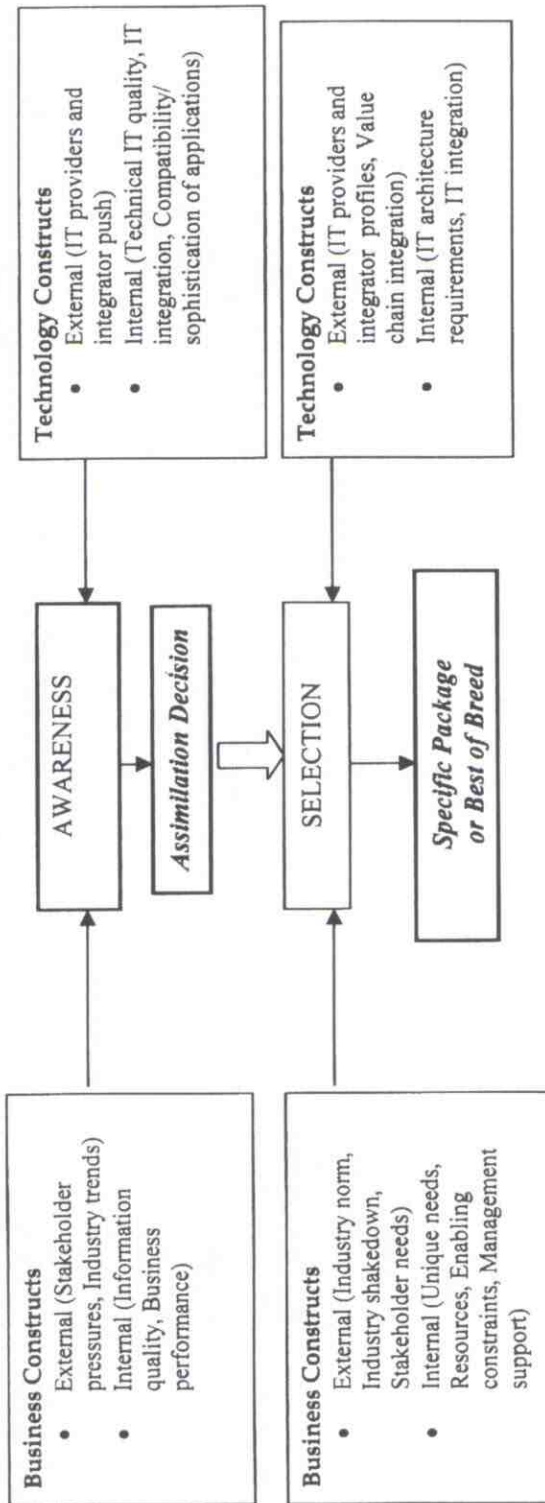
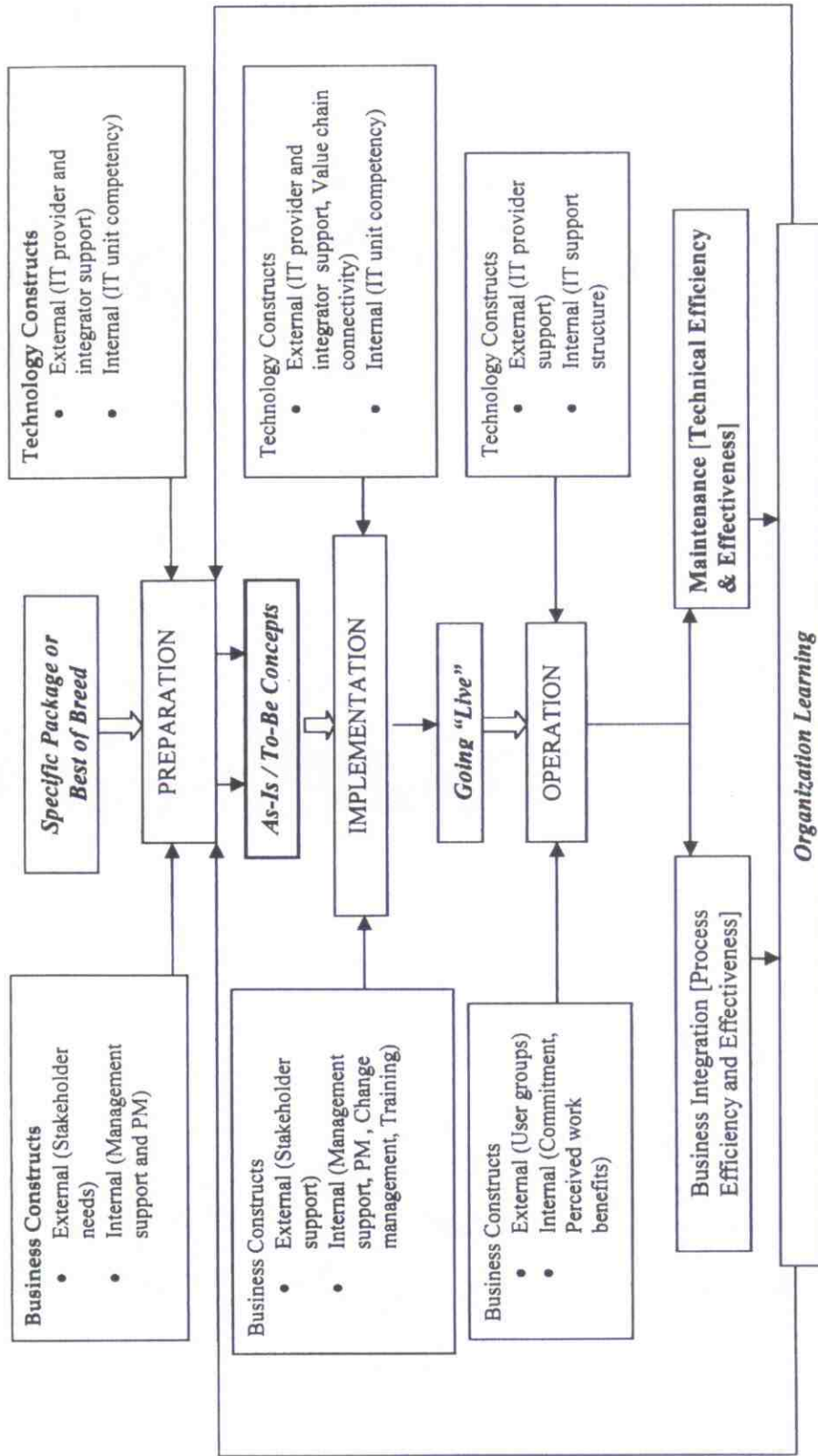


FIGURE 1 (continued)



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