

## **Chapter 2 : LITERATURE REVIEW**

The following sections first explain the knowledge-intensive nature of ERP systems and ERP system adoption; then, factors affecting ERP adoption are analyzed. This background information in turn leads to descriptions of absorptive capacity. Critical ERP post-adoption factors are organized by different dimensions of absorptive capacity. Propositions about benefit gained in post ERP implementation are then formed and explained. The last section presents propositions describing the interrelationships between the differing dimensions of absorptive capacity.

### **2.1 ERP systems and ERP systems adoption**

An ERP system is a set of packaged application software modules, with an integrated architecture, that can be used by organizations as their primary engine for integrating data, processes and information technology, in real time, across internal and external value chains (Shang and Seddon 2002). It impounds deep knowledge of business practices that vendors have accumulated from implementations in a wide range of client organizations that can exert considerable influence on the design of processes within new client organizations (Shang and Seddon 2002).

The complex system functions cover an extensive array of business areas and involve comprehensive knowledge of both the implementation and the limitations of the software, and of how to manage processes and utilize information. This is knowledge that requires a considerable time to comprehend (Shang and Seddon 2002).

ERP systems enable organizations to share common information and activities across the entire organization, automate and integrate the critical parts of business processes, and access information in a real-time environment. Since ERP systems can facilitate the productivity and efficiency of firms, the majority of organizations implement ERP systems to increase organizational competitiveness (Glover et al.1999; Davenport 1998; Pan et al. 2001). ERP systems touch on many aspects of a company's internal and external operations and provide organizations with an overall view of the business through multidimensional information (Gefen and Ragowsky 2005; Markus and Tanis 2000). Consequently, successful deployment and use of ERP systems are critical to organizational performance and survival (Markus and Tanis 2000).

Nevertheless, the bulk of research on the implementation of ERP systems focuses on firms either prior to, during, or immediately after ERP software implementation (Krasner 2000; McNurlin 2001). Conventional wisdom saw "going live" as the end of ERP implementation and ignored the second wave, the post adoptive stage, which refers to the actions that are taken after going live that help organizations achieve the full capabilities and benefits (Deloitte Consulting 1999).

Deloitte Consulting provided a useful starting point for analysis of ERP systems post adoption.

Many organizations and researchers have begun to notice pay attention to the post implementation stage (Seddon et al. 2003) in which firms begin to realize the impact of the ERP based organizational transformation (Clark et al. 2006) and continuous improvement, which in turn leads to the maximization of benefits from prior investment (Jasperson et al. 2005; Will and Wills-Brown 2002; Seddon et al. 2003). This study uses the model of Ross et al. (2003) shown in Figure 2.1 to depict the stage of the ERP post-implementation. Ross et al. (2003) proposed that after implementation, organizations may experience the stages of stabilization, continuous improvement, and transformation.

The post-adoption stage is the longest phase of the ERP project life cycle (Rosemann 2003). It explicitly implies that organizations cannot stop advancing ERP systems even after completion of the ERP project. Many firms fail in the initial implementation, but after two or three years of effort and of defining the scope of what they want to accomplish, improvements may result (Hitt et al., 2002). Furthermore, significant improvements in ERP adopter firm performance are generally not realized until some time after implementation (Hitt et al., 2002; Nicolaou 2004a). Therefore, after ERP implementation, organizations must continuously carry out change activities, including restructuring of IT systems and organizational structures, in order to obtain maximum value from the ERP system (Gattiker and Goodhue 2005). To summarize briefly, though ERP systems are designed to create advantages for organizations, organizations must not only learn how to implement systems successfully, but must also pay attention to the post-implementation period, and perform activities to achieve their expectations for the ERP system instead of just waiting for the systems to automatically reach the goals of the organization..

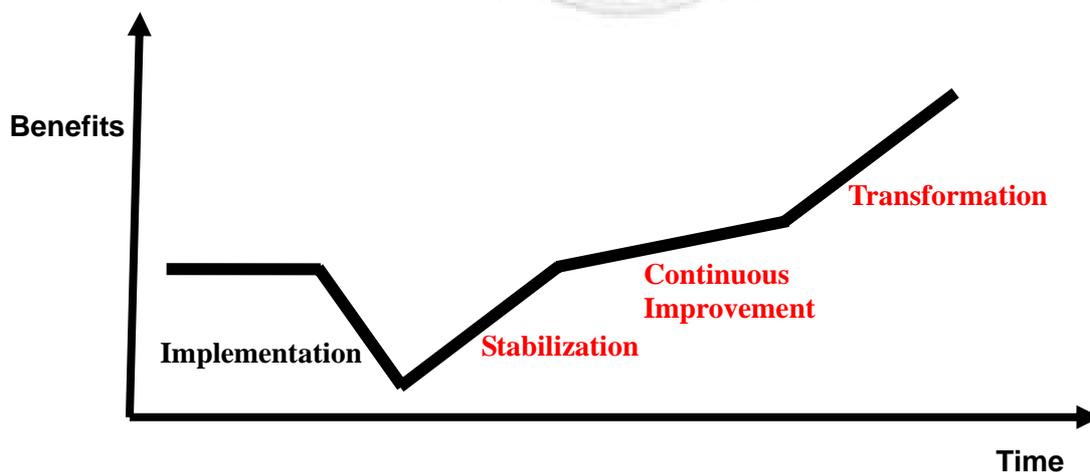


Figure 2.1 The life cycle of ERP implementation (after Ross et al 2003)

## 2.2 Critical factors for beneficial ERP implementation and use

Research has demonstrated that organizations will obtain pay offs from ERP investment. In an independent survey of multinational companies who implemented ERP, 85% said that the system had been implemented successfully but only 25% said that they achieved the intended business benefits (Markus et al. 2000). Consequently, organizations may wonder how they can maximize the value of ERP system implementation and realize the payoff. One purpose of this study is to investigate the drivers of the beneficial use of ERP systems.

Larson and Myers (1997) found that an ERP experience could be an early success and a later failure. It is also possible be an early failure but a later success (Markus et al. 2000). Further, there is little evidence that bears on how well organizations actually assimilate ERP systems beyond the initial implementation (Clark et al. 2006). Thus, going live of ERP systems is not the end point. After implementing an ERP system, if organizations want to sustain success or reverse failure, they must continuously monitor and manage ERP systems (Clark et al. 2006). Since ERP systems are complex, no matter how competent the initial implementation, it is likely that many organizations will have a less than perfect fit, implying that organizations have to do more than just maintain the systems (Seddon et al. 2003). Therefore, in order to realize the full benefits for organizations from ERP systems implementation and use, several researchers proposed factors that affect how value is obtained. Some studies (Markus 1998; Newall et al. 2003; Wills and Wills-Brown 2002) have suggested that stabilization of systems is the essential of obtaining value from ERP systems. Thus, factors this study discusses in the following section affecting beneficial use of ERP systems dose not include stabilization.

- *User training*

Many studies (Jasperson et al. 2005; Muscatello and Parente 2006; Umble et al. 2003; Wills and Wills-Brown 2002) argue that user training is critical in the ERP post-implementation context. Pre-implementation user training can make use of organizational experience, and shorten the time required to handle immediate post-go-live issues. However, the goal of user training in post-implementation is assimilating deeply and updating the knowledge needed. Post-adoption training enables users to fully understand the implications of the new system on their potential processes (Davenport et al. 2004) along with how their actions have impacted downstream operations (Nicolaou 2004). It also permits additional updating of the ERP system's knowledge base where it is concerned with the operation of new functions. Another form of user training is periodic meetings of system users which can help identify problems with the system and encourage the exchange of information gained through experience and increasing familiarity with the system (Umble et al. 2003).

- *Communication*

The ERP literature has identified communication as one of the critical success factors for system adoption (Holland and Light 1999; Ko et al. 2005). During and after implementation, key users, IS personnel, and vendors, who have different knowledge bases, need to transfer knowledge by informal and formal communication. Studies suggest that increased communication competence increases the likelihood of individuals engaging in activities with each other (Berman and Heilweg 1989) and enhances shared understanding (Ko et al. 2005). Through communication, feedback offered by the users of ERP systems can be shared for improving and modifying ERP usage (Nah and Delgado 2006).

- *Documentation*

Documentation is another source of knowledge acquisition in ERP systems. One of the most important aspects of knowledge sharing is documentation in the form of process descriptions, operating guides, and system design manuals. Users can learn how to operate ERP systems, correct errors, and seek solutions from the documentation (Scott 2005). Well-maintained documentation offers users impressive benefits, such as reductions in learning time, information overload and search effort (Rettig 1991).

- *Change management*

After implementation, it is likely that unexpected changes will occur, and organizations need to adjust to the changes to avoid user confusion. People are typically willing to adapt if they understand the need to change and accept responsibility for producing tangible business benefits (IBM 2000b). Change management is not merely an anti-resistance stance, but actively transforms obstacles in its path into new opportunities that will enhance the overall effectiveness of the organization (Orlikowski and Hofman 1997; Sieber and Nah 1999).

Orlikowski and Hofman (1997) proposed that some changes are not anticipated ahead of time but are introduced purposefully and intentionally during the change process in response to an unexpected opportunity, event, or breakdown. ERP implementation commonly involves change, including changes in processes, software/hardware, human resource and organizational structure. Since ERP implementation is treated as a continual process, not something which has a clearly defined start and finish, the technological and organizational changes made during the ongoing process should not be thought of as having a clear terminal point (Orlikowski and Hofman 1997). Therefore, researchers (Clark et al. 2006; Jasperson et al. 2005) suggest that change management is a critical factor in beneficial ERP implementation and use.

- *Process optimization*

One recent study concluded that the way to obtain greater productivity and business performance from enterprise systems over the long term is process improvement (Brynjolfsson and Hitt 1995; Seddon et al. 2003). Process optimization requires understanding the evolving capability of the software and needs of the organization, and strives to maintain a reasonable on-going level of fit between the software and changing organizational needs (Davenport et al. 2004; Shang 2001). Some organizations change processes radically in the early or pre-implementation stages, and subsequently stop improving processes. However, the initial fit between organizational processes and ERP systems will not represent the sustained fit years later because organizational processes will change over time. Thus, optimizing processes cannot cease even after the ERP systems go live. Furthermore, reengineering or process improvement should not be restricted to the back-office. Operational processes that have been the primary focus of change processes in the past. Organizations should try to improve processes such as marketing, product development, and strategic planning, to provide the full picture of process optimization and consequently maximize the benefits from ERP system implementation and use (Davenport et al. 2004).

- *Integration/ extension*

Integration is universally known for beneficial ERP use. However, implementing ERP systems does not indicate that it has successfully automatically integrated information, processes and systems of organizations (Davenport et al. 2004; Gattiker and Goodhue 2005). Hence, organizations can improve integration to realize value after ERP implementing by minimizing the number of ESs instances through consolidation and by integrating ERP systems with legacy systems (Davenport et al. 2004). Consolidating applications into a single global instance, such as integrate SCM, CRM and B2B e-commerce with ERP systems to share applications, hardware or core processes and then reduce costs of ESs' human and technical support (Davenport et al., 2004; McNurlin 2001; Wills and Wills-Brown 2002). For organizations, integration is an ongoing activity that continues long after implementation of core ERP systems functionality (Koch 2001). Thus, in order to speed up communications and improving decision-making (Weil 1998), even after ERP implementation, organizations must continually integrate and extend ERP systems.

Extension of the ERP system is another source of beneficial ERP implementation and use (Clark et al. 2006; Muscatello and Parente 2006; Wills and Wills-Brown 2002). Not all organizations need initially implement each module of their ERP systems, (Clark et al. 2006), but at some point, organizations may require additional functionalities to support new abilities or processes. ERP systems can be used to extend the organization to its suppliers, partners, and customers. Integrating ERP systems with SCM, CRM, and e-commerce, as well as adding new modules, frequently involves integrating current systems with new systems and extending the functionality of the ERP system. Therefore, this study merges two factors into one.

- *Informatate*

Informatate means transforming ERP systems' data into context-rich information and applying it to support business analysis and decision making (Davenport et al. 2004). An information processing system which is deeply embedded in a firm's informal and formal management decision-making process may hold the potential for sustained competitive advantage (Barney 1991). Many organizations acquire accurate, consistent and real-time information from ERP systems, thus gaining organizational benefits. But merely possessing the information does not guarantee proper decision-making. Organizations need to spend time in learning the information developed by the ERP systems and experiencing how it can best support their business. Hence, Davenport et al. (2004) suggest that organizations must "live with" the ERP systems for a time as managers and other users can learn what data is available and how it can best support the business. Thus, organizations must not only create high quality data from ERP systems but also provide "right" people with the "right" information to exploit data fully.

- *Enrich the use of already-installed systems*

Organizations invest huge resource in ERP systems and attempt to find many ways to exploit it to maximize the benefits, but organizations may ignore the most critical factor: usage of the systems. Existing evidence shows that most organizations underutilize the functional potential of installed IT applications (Jasperson et al. 2005). For example, users operate only low level features (Rose and Weill 2002) and rarely initial technology related extensions of the available features (Davenport 1998; Rose and Weill 2002). In addition to providing ongoing resources to support the development of ERP systems, organizations need to pay serious attention to post-adoptive behaviors to induce and enable users to enrich the use of the ERP systems after implementation (Jasperson et al. 2005; Clark et al. 2006).

This study arranges above factors of maximizing the benefits of post-ERP implementation and explanations of each factor into Table2.1.

**Table 2.1. The critical factors of beneficial ERP implementation and use**

<b>Factors of ERP beneficial use</b>	<b>Explanations</b>	<b>Researchers proposing the factor</b>
User training	Firms that address the gap in employee abilities and performance after the ERP implementation, through an ongoing analysis, will have a greater likelihood of successfully implementing ERP than those that do not (Joseph R. and Diane H., 2006).	Jasperson, Carter, Zmud (2005); Muscatello and Parente (2006); Wills and Wills-Brown (2002); Umble, Haft and Umble (2003)
Communication	Studies suggest that increased communication competence increases the likelihood of individuals engaging in activities with each other (Berman and Heilweg 1989) and enhances shared understanding (Ko et al. 2005). Through communication, feedback offered by the users of ERP systems can be shared for improving and modifying ERP usage.	Holland and Light (1999); Ko et al. (2005); Nah and Delgado (2006)
Documentation	Well-maintained documentation offers users impressive benefits, such as reductions in learning time, information overload and search effort (Rettig 1991).	Scott 2005 ; Rettig 1991
Change management	Opportunity based changes tend to lead to more opportunity based changes, which should lead the organization to greater success (Orlikowski & Hofman, 1997; Sieber & Nah, 1999).	Jasperson, Carter, Zmud (2005)
Process optimization	Studies have shown that firms that invest more heavily in business process redesign when implementing information technology have greater productivity and business performance than those that do not (Brynjolfsson and Hitt, 1995; Seddon, et al., 2003).	Davenport, Jeanne G and Cantrell (2004)
Enrich the use of already-installed systems	As ERP usage increases, ERP software and work process understanding, and extent of feature implementation, are affected concurrently.	Jasperson, Carter, Zmud (2005); Clark, Jones and Zmud (2006)

<b>Factors of ERP beneficial use</b>	<b>Explanations</b>	<b>Researchers proposing the factor</b>
Integration/ extension	<ol style="list-style-type: none"> <li>1. Integrating SCM, CRM and B2B e-commerce with ERP systems to share applications, hardware or core processes can reduce costs of ESs' human and technical support (Davenport, et al., 2004; McNurlin, 2001; Wills and Wills-Brown; 2002).</li> <li>2. Integration, and standardization of data and processes that usually accompanies it, saves money, speed ups communications, and improves decision-making (Weil, 1998).</li> <li>3. Companies in expanding and high-integration utilization states, where users have more freedom to adjust both software features and organizational processes to take advantage of high-end features, realized greater benefits than companies in standard adoption and low-integration utilization states (Lassila and Brancheau, 1999).</li> </ol>	Davenport, Jeanne G and Cantrell (2004); Clark, Jones and Zmud (2006); McNurlin, 2001; Muscatello and Parente (2006); Wills and Wills-Brown (2002)
Informate	<ol style="list-style-type: none"> <li>1. Front-line workforces can draw on ES data and analytic capabilities to improve their job performance, increase their authority for decision making, and improve communication with customers. (O'Leary, 2000)</li> <li>2. Improved data quality can lead to substantial organizational benefits. (Redman, 1995)</li> <li>3. An information processing system that is deeply embedded in a firm's informal and formal management decision-making process may hold the potential of sustained competitive advantage. (Barney, 1991)</li> </ol>	Davenport, Jeanne G and Cantrell (2004)
Enrich the use of already-installed systems	As ERP usage increases, ERP software and work process understanding, and extent of feature implementation, are affected concurrently.	Jasperson, Carter, Zmud (2005); Clark, Jones and Zmud (2006)

This body of research provides organizations with information and ideas that bear on obtaining the benefits from ERP implementation, as well as definitions and explanations of factors leading to economic benefits. These studies help organizations further understand how to obtain benefits after ERP implementation and comprehend the effects of the activities the organization has adopted. But if organizations merely view these activities as critical factors of post-implementation and follow them without deep thought, organizations may only operate according to these “guidelines,” resulting in inflexible and automatic implementation of ERP systems. Thus, this study explores why organizations are able to initiate these activities to implement and use ERP beneficially. Since different organizations can gain different value from the same applications (Shang and Seddon 2002), each organization should understand what abilities can help them exploit their ERP applications. Organizations will thus obtain value from ERP implementation and exploit ERP systems in different ways. In the next section, this study will use the concept of “absorptive capacity” to explain why organizations are able to initiate these activities.

### **2.3 Benefits of ERP implementation and use**

Since ERP systems affect so many parts of the organization, ERP systems can provide a huge range of benefits and problems, often with different benefits in different organizations (Seddon et al. 2003; Gittiker and Goodhue, 2005). Thus, organizations that have invested heavily in implementing ERP systems may want to know “Will our investment pay off?” The answer provided by several firm-level econometric studies (Anderson et al. 2003; Hitt et al. 2002) is most likely “yes”.

But after ERP implementation, what benefits can be gained by organizations? To answer this question, researchers have sought ways to evaluate investment in ERP systems. In the initial phases of this research, studies measured the benefits of ERP systems by economic revenue, yet revenue by itself cannot represent all the benefits of an ERP system. As a result, researchers began constructing more robust definitions of the benefits of adopting ERP, generally viewing them as having at least two dimensions: operational efficiency and strategic effectiveness (Jenson and Johnson 1999). In the Benchmarking Partners study (1998); respondent companies anticipated not only tangible but intangible benefits. The most significant intangible benefits related to strategic effectiveness include internal integration, improved information and processes, and improved customer service, while tangible benefits related to operational efficiency include cost efficiencies in inventory, personnel, procurement and the time needed to close books, as well as improvements in productivity, cash/order management, and overall profitability (Nicolaou 2004 ). Gittiker and Goodhue (2005), following the ideas of Barue at al. (1995), argued that organizations trying to understanding the value of the ERP investment should view it through two lenses: a fine-grained level analysis, and the intermediate benefits involved. Such intermediate benefits may include (1)

higher quality data for decision making; (2) efficiency gains in business processes; and, (3) better coordination among different units of the firm. Further, the ERP systems benefits of Shang and Seddon (2002) cover the intermediate factors and extend the two dimensions (operation and strategy) to five dimensions, including the operational, managerial, strategic, IT infrastructure and organizational benefits. Operational efficiency relates to factors such as cost reduction, increased inventory turns; managerial benefits refers to factors such as improved decision making and planning and better resource management; Strategic effectiveness refers to factors such as improved managerial decision making; IT infra-structure benefits related to IT flexibility and capability, and Organizational benefits refers to factors such as employee learning, and empowering workers. Table 2.2 shows the dimensions and sub dimensions of ERP systems benefits.

**Table 2.2 Dimensions of ERP systems benefits**

<b>Dimensions</b>	<b>Sub dimensions.</b>
1.Operational	1.1 Cost reduction, 1.2 Cycle time reduction, 1.3 Productivity improvement, 1.4 Quality improvement, 1.5 Customer services improvement
2.Managerial	2.1 Better resource management, 2.2 Improved decision making and planning 2.3 Performance improvement
3.Strategic	3.1 Support for business growth 3.2 Support for business alliance 3.3 Building business innovations 3.4 Building cost leadership 3.5 Generating product differentiation 3.6 Building external linkages
4.IT Infrastructure	4.1 Building business flexibility for current and future changes 4.2 IT costs reduction 4.3 Increased IT infrastructure capability
5.Organizational	5.1 Changing work patterns 5.2 Facilitating business learning 5.3 Empowerment 5.4 Building common visions

Markus et al. (2000) suggest three ERP system life phases, each with its own objectives, giving three checkpoints to evaluate success. Similarly, the period of time that defines the period over which benefits are measured is also critical. The model Shang and Seddon (2002)

proposed is employed in years after the ERP systems went live. Gattiker and Goodhue (2005) indicate that the benefits improve over the first year of use. Based on the foregoing, it would appear that the minimum time elapsed before measurement of ERP systems benefits is performed should be at least one year.

## 2.4 Absorptive capacity

Cohen and Levinthal (1990) provided the most widely used definition of absorptive capacity, terming it prior related knowledge conferring an ability to recognize the value of new information, assimilate it and apply it to commercial purposes. These abilities collectively constitute what we call a firm's "absorptive capacity". Researchers (Kim 1998; Mowery and Oxley, 1995; Zahra and George 2002) have defined "absorptive capacity" in different ways, but Zahra and George (2002) offered the most detailed and specific definition, defining absorptive capacity (**ACAP**) as a set of organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic organizational capability. They propose four dimensions/capabilities of ACAP: acquisition, assimilation, transformation and exploitation. Acquisition refers to a firm's capability to identify and acquire knowledge that is critical for organizations. Following Cohen and Levinthal (1990), the absorptive capacity has the character of accumulation. Thus, the prior investment and prior knowledge influence the intensity, speed and direction of newly acquired knowledge. Assimilation refers to the firm's capability to analyze, interpret and understand the obtained knowledge and information. Transformation means the capability to combine existing knowledge and the newly acquired knowledge. Exploitation is the ability to harvest and incorporate knowledge into operations. It is the explicit capability to utilize the transformed knowledge to create new systems, goods and new competencies (Zahra and George 2002). The four dimensions are organized in Table 2.3 by Zahra and George (2002).

**Table 2.3 Four dimensions of absorptive capacity**

Dimension/capability	Components
Acquisition	<ul style="list-style-type: none"> <li>● Prior investments</li> <li>● Prior knowledge</li> <li>● Intensity</li> <li>● Speed</li> <li>● Direction</li> </ul>
Assimilation	Understanding
Transformation	<ul style="list-style-type: none"> <li>● Internalization</li> <li>● Conversion</li> </ul>
Exploitation	<ul style="list-style-type: none"> <li>● Use</li> <li>● Implementation</li> </ul>

Zahra and George (2002) posit that acquisition and assimilation are dimensions of “potential ACAP” which is the capability recognizing and acquiring external knowledge but without exploiting it. They further argue that transformation and exploitation are dimensions of “realized ACAP” which is the capability internalizing and leveraging absorbed knowledge. Thus, high potential ACAP does not imply greater performance. On the contrary, realized ACAP is the primary source of performance improvement (Zahra and George 2002). Making the distinction between “potential ACAP” and “realized ACAP” can allow researchers to study why some firms fail because of changes in the external environments (Bower and Christensen 1995), while others thrive under the same conditions.

## **2.5 Absorptive capacity with ERP implementation and use**

ERP systems implementation is considered related to management, culture, and knowledge issues, instead of merely being a technological challenge. Consequently, studies have begun to explore knowledge transfer (Davenport 1998; Lee and Lee 2000). Though implemented ERP systems contain knowledge, knowledge is embedded in more than just the ERP system. Knowledge is also embedded in complex organizational processes, in legacy systems and in externally based processes (Pan et al. 2001). Since the ERP systems contain and are related to knowledge, organizations implementing and using ERP systems should try to emphasize the issue of knowledge management of ERP systems.

Knowledge barriers are a major challenge faced by large-scale ERP projects (Robey et al. 2002). Robey et al. (2002) focus on the knowledge barrier caused by users who fail to let go of what they already know and fail to learn new ways of working. Another challenge the project team faces is accessing and integrating old and new knowledge in the processes of designing and implementing ERP systems (Newell et al. 2006).

*Based on the above discussion, the challenges of implementing ERP systems may be defined as knowledge acquisition (gaining new knowledge), knowledge assimilation (learning new knowledge), and knowledge transformation (integrate new and old knowledge).*

Researchers (Parr and Shanks, 2000; Bingi et al. 1999) developed a list of critical failure factors of ERP implementation and use through analysis of case studies, identifying factors such as poor knowledge transfer, poor quality of BPR, unclear concepts of ERP systems use, and poor usage of ERP systems. If organizations could not deliver professional ERP training (poor knowledge assimilation) to users, the users did not understand the rationale for implementing the ERP system or the process of implementation. Thus, they were not prepared for ERP implementation and use, and had a high resistance to change, which led to political problems, poor quality of BPR, and a resistance to use of the system. Without

knowledge assimilation and transformation, ERP systems may not be fully exploited, leading to system failure.

Nevertheless, consideration of cases such as FoxMeyer Drug and Hershey Foods Corp., leads to the conclusion that a robust training program may not always lead to ERP system success. Thus, this study uses the concept of “absorptive capacity” to propose that assimilating the knowledge about ERP systems implementation and use and transforming it to fully exploit it is vital to obtain the benefits that organizations expect. Even after ERP systems implementation, organizations should not neglect the knowledge issue, because there is little evidence on how well ERP has actually been assimilated in organizations beyond initial implementation (Clark et al. 2006). Knowledge sharing, knowledge transference, and knowledge integration, are significant issues of ERP implementation and use, but from practical standpoint, the key is the capability to transform the knowledge absorbed into the capability of exploiting ERP systems to reap concrete benefits.

Next, Based on the feature of absorptive capacity factors affecting the success of ERP implementation are related to these two kinds of capacity (shown in Table 2.4).

**Table 2.4 Critical post-ERP implementation factors with ACAP**

<b>Potential ACAP</b>	<b>Realized ACAP</b>
<b>Acquisition/ Assimilation</b>	<b>Transformation / Exploitation</b>
<b>User training</b> (Davenport et al. 2004; Jasperson et al. 2005; Clark et al. 2006; Muscatello et al. 2006) <b>Communication</b> (ko et al. 2005; Nah and Delgado 2006) <b>Documentation</b> (Scott 2005; Rettig 1991)	<b>Change management</b> (Jasperson et al. 2005; Orlikowski and Hofman 1997) <b>Process optimization</b> (Davenport et al. 2004; Wills and Wills-Brown 2002) <b>Integration/ Extension</b> (Davenport et al. 2004; Clark et al. 2006; Muscatello et al. 2006; Wills and Wills-Brown 2002) <b>Informate</b> (Davenport et al. 2004) <b>Enrich usage</b> (Jasperson et al. 2005; Clark et al. 2006)

■ *Potential ACAP with post-ERP implementation*

In the stage of knowledge acquisition, organizations have to identify useful knowledge and attempt to obtain it. For example, organizations planning to train users may gather resources such as documentation (manuals), consultants, and classes.

Training is one of the key determinants of the long-term viability of ERP in a given organization (Markus et al. 2000a; Yi and Davis 2003; Bajwa et al. 2004; Clark et al. 2006). User training enables users to understand knowledge relevant to ERP systems in order to

operate the ERP and comprehend its potential. First, firms must (re)-train employees to address the gap between employee abilities and knowledge after ERP implementation, to maximize later exploitation. Second, firms need to gain the advanced business and technology knowledge of updated versions.

In the subsequent knowledge assimilation stage, users attend training. Through seminars, meetings, and formal and informal communication, users share and audit knowledge after training to improve their assimilation and raise their potential knowledge and capabilities.

■ *Realized ACAP with post-ERP implementation*

After ERP implementation, the business rules of the ERP systems associated with the reference models begin to conflict with the existing business fundamentals of the organizations (Lee and Lee 2000). Thus, change management is used to harmonize new and existing systems/knowledge. This balancing of the old and the new, along with the reframing of knowledge to produce stable systems, is the real meaning of business transformation.

In theory, after employees become used to the ERP system and assimilate knowledge about it, firms learn what actually they need and what is available, and then discover how to improve processes and systems. Davenport (2004) defines the process optimizations that stem from continuous examination and improvement of how the process flow fits with the system and how the system and the processes support the needs of the business. Process optimization involves transformation capacity, to record the process knowledge of both the business and the ERP system, in order to discover the combination that meets business needs.

Knowledge exploitation involves allowing firms to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations. Many studies (Davenport 2004; Jaspersen et al. 2005; Clark et al. 2006; Muscatello 2006; Wills and Wills-Brown 2002) suggest initiatives to leverage the accumulated experience, such as integration, enriching, extension, add-ons, and upgrades of the functionalities. These activities are designed to extend the existing ERP. Such initiatives involve the knowledge and the capability to operate the affected systems and decisions at different and higher levels within the company. Critical factors of post ERP systems implementation are given in Table 2.5.

**Table 2.5 Details of absorptive capacity critical factors of post ERP systems implementation**

Knowledge Acquisition	Knowledge Assimilation
<ul style="list-style-type: none"> <li>• Ability to identify needed information regarding ERP systems</li> <li>• Ability to understand where to acquire information about ERP systems</li> <li>• Ability to acquire proper information about user training from the ERP systems vendor</li> <li>• Ability to acquire quality information about ERP extended use from the ERP systems vendor</li> <li>• Ability to organize user training for ERP systems</li> <li>• Ability to locate consultants experienced in ERP implementation and use</li> <li>• Ability to provide documentation/manuals of ERP system for users</li> <li>• Ability to acquire latest information/technology about how ERP systems align with other applications, such as SOA or EAI</li> <li>• Ability to acquire information by attending seminars about ERP systems</li> </ul>	<ul style="list-style-type: none"> <li>• Ability to analyze information obtained from the ERP systems vendor</li> <li>• Ability to process information provided by the ERP systems vendor</li> <li>• Ability to interpret information provided by the ERP systems vendor</li> <li>• Ability to attending user training provided by the ERP systems vendor</li> <li>• Ability to assess users after training in ERP systems</li> <li>• Ability to provide a knowledge sharing platform for information about ERP systems</li> <li>• Ability to provide information on the communication systems of ERP systems for users</li> <li>• Ability to continuously upgrade employee skills through hire training and education, or outsourcing</li> <li>• Ability to understand information provided by consultants or the ERP systems vendor</li> </ul>
Knowledge Transformation	Knowledge Exploitation
<ul style="list-style-type: none"> <li>• Ability to develop processes in improving organizational efficiency based on information provided by ERP systems vendor</li> <li>• Ability to develop processes to improve productivity based on information provided by the ERP systems vendor</li> <li>• Ability to improve processes using the processes of the ERP system to support the needs of the business</li> <li>• Ability to refine the processes in facilitating organizational performance based on information provided by the ERP systems vendor</li> <li>• Ability to continuously examine and improve the flow fit of processes with the system</li> <li>• Ability to restructure the software/hardware in improving ERP use based on information provided by the ERP systems vendor</li> <li>• Ability to relocate human resources to improve ERP use based on information provided by the ERP systems vendor</li> <li>• Ability to restructure the organization to improve ERP use based on information provided by the ERP systems vendor</li> </ul>	<ul style="list-style-type: none"> <li>• Ability to integrate processes involving customers, suppliers and business partners</li> <li>• Ability to extend the ERP systems through integration with other systems, such as SCM, CRM, or B2B</li> <li>• Ability to leverage ERP related knowledge in facilitating performance of the organization</li> <li>• Ability to integrate ERP with existing legacy systems by using EAI tools or Web services</li> <li>• Ability to minimize the number of ERP instances through consolidation.-adopt shared services</li> <li>• Ability to gain high quality information from ERP systems</li> <li>• Ability to transform ERP data into context-rich information and apply it to support business analysis and decision making</li> <li>• Ability to improve the ability to inform by providing better data access.</li> <li>• Ability to enhance the usage of installed functionalities of ERP systems</li> <li>• Ability to upgrade the ERP systems or add additional software/hardware to extend ERP systems</li> </ul>

## 2.6 ACAP and benefits gained in post-ERP implementation

Zahra and George (2002) proposed that there is a relationship between knowledge absorptive capacity and the performance of the firm. This study offers the following propositions about the relationship between knowledge absorptive factors and benefits realized in post-ERP implementation.

***Proposition 1: The greater the absorptive capacity of the ERP system knowledge, the more the benefits realized in the post-ERP implementation period.***

The adoption of ERP systems after the implementation phase is a complex challenge in knowledge management. Prior studies (Davenport 1998; Lee and Lee 2000; Pan et al. 2001) suggest that if the ERP knowledge is completely absorbed and utilized properly, organizations can gain competitive advantage. The degree of knowledge assimilation and exploitation of the ERP systems is an important determinant of the benefits of ERP use. Thus, absorptive capacity is a critical factor in obtaining a return on investment in an ERP system.

Zahra and George (2002) observe that high potential ACAP provides firms with the strategic flexibility and freedom to adapt to the changing environment, but does not promise greater performance. By contrast, realized ACAP is a primary source of performance improvement. But it does not mean that the realized capacity can be fully leveraged without well-constructed potential capacity for making proper decisions and actions. Therefore, further examination of the combined situation of these two dimensions of ACAP are made in the following section and summarized in Table 2.6.

**Table 2.6 Potential and realized ACAP with benefits of post ERP**

<b>Proposition</b>	<b>Potential ACAP</b>	<b>Realized ACAP</b>	<b>Benefits of post ERP</b>
<b>1a</b>	High	High	High
<b>1b</b>	High	Low	Low
<b>1c</b>	Low	High	Low
<b>1d</b>	Low	Low	Low

***Proposition 1a : Higher potential ACAP with higher realized ACAP leads to higher benefits gained***

Given that profits are created primarily through realized ACAP (Grant 1996), firms that achieve or maintain a high efficiency factor are positioned to increase their performance (Zahra and George 2002). However, the full benefits of ERP cannot be realized until end users assimilate completely and use the new systems properly (Umble et al. 2003). Learning

can facilitate development of the firm's ability (core capacity) and the future ability to acquire new knowledge (Schilling 1998), and can provide firms with the strategic flexibility and the degree of freedom necessary to adapt and evolve in a high-velocity environment (Zahra and George 2002). Therefore, higher assimilation helps organizations upgrade the knowledge and capabilities of users in pursuit of full exploitation of the capabilities of the ERP systems.

**Proposition 1b : *Higher potential ACAP with lower realized ACAP leads to lower benefits gained***

Some firms possess to the ability to understand complex technical problems but were not as effective in translating such knowledge into product innovation strategies, and thus do not realize the benefits (Baker et al. in press). Although user training plays an important role in renewing a firm's knowledge base and the skills necessary to compete in changing markets (Zahra and George 2002) and develop or produce a technology to meet customer requirements (Schilling 1998), information systems researchers and practitioners often overlook the potential of user training (Jasperson et al. 2005). Thus, the acquisition and assimilation of knowledge in the absence of a capability to transform and exploit the knowledge will not lead to full realization of benefits for organizations (Zahra and George 2002).

**Proposition 1c : *Lower potential ACAP with higher realized ACAP leads to lower benefits gained***

Lower assimilation with higher exploitation may mean that exploitation is based on imperfectly/partially transformed knowledge (Zahra and George 2002). It may thus be carried out by imitating the practices of firms which have successfully obtained value from ERP systems, or perhaps by mere intuition. This implies that the exploitation is inaccurate and success may not be sustaining over the long haul. Different organizations probably have different ways of exploiting their ERP systems (Shang and Seddon 2002). Thus, prior to exploiting an ERP system, the enterprise might pause to examine its assimilation of the IT/knowledge instead of blindly integrating and extending it.

**Proposition 1d : *lower potential ACAP with lower realized ACAP leads to lower benefits gained***

Based on the foregoing, this study can infer that the condition in which knowledge absorption is low, coupled with lower capability to exploit knowledge, will lead to reduced organizational benefits.

**Proposition 2: *The higher the potential capacity of the ERP knowledge, the higher the realized capacity of the ERP knowledge***

Since potential ACAP and realized ACAP have separate but complementary roles (Zahra and

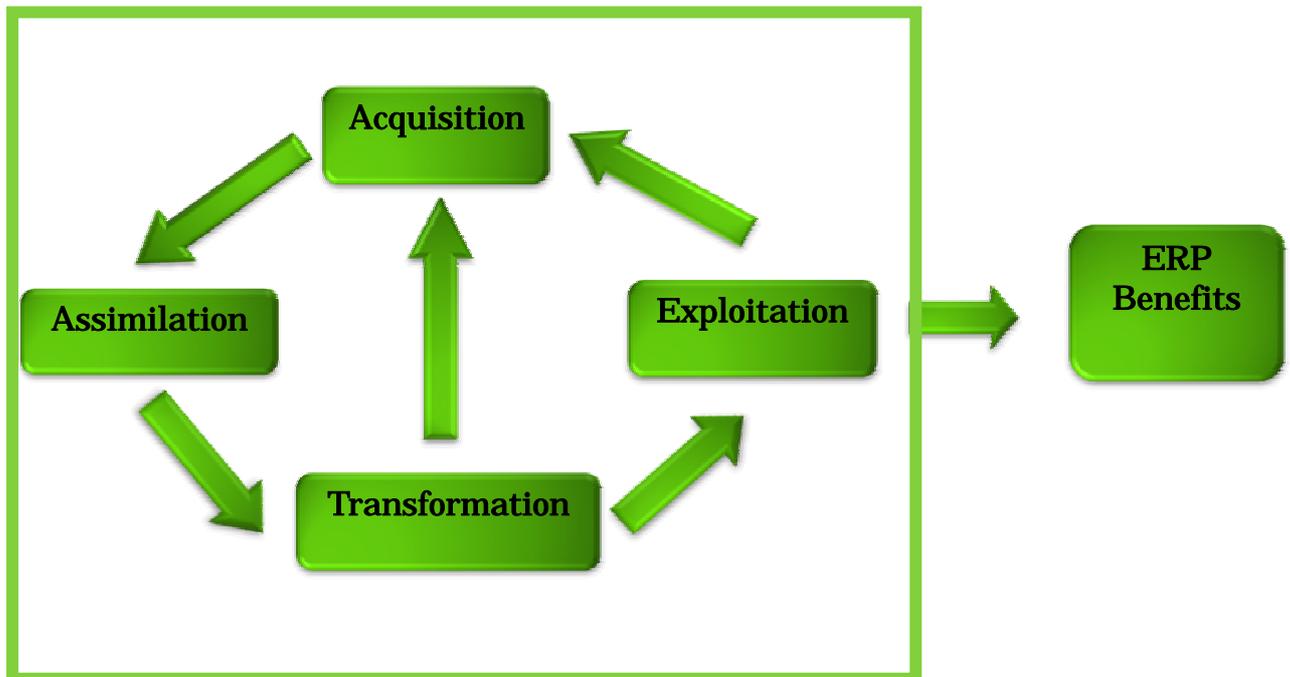
George 2002), they cannot bring their respective potential into full play without each other. Similarly, these factors play unique roles, yet complement each other, in the process of obtaining value from ERP systems.

Assimilating before exploiting the knowledge is important because knowledge assimilation can internalize knowledge and transform it into organizational knowledge, facilitating discovery of unique organizational approaches to maximizing the capacity to use the ERP.

**Proposition 3: *The process of absorptive capacity is a positive feedback loop, and the more cycles of the process of absorptive capacity the firm experiences, the more benefits gained***

The proposition can be supported by the theory of dynamic capability. Dynamic capabilities which underpin the long-term, continuous renewal of the firm rest on both the exploitation of existing knowledge-based competences and the exploration of new knowledge-based competences (Gibson and Birkinshaw, 2004). Verona and Ravasi (2003) and Dougherty et al. (2004) argue that dynamic capabilities are made up of knowledge creation and acquisition, knowledge integration and knowledge reconfiguration, and moreover, knowledge exploitation. If this study views the key element as knowledge, the processes of dynamic capability then become knowledge acquisition, knowledge assembly, knowledge sharing, knowledge integration and knowledge exploitation (Anders, 2006). In essence, these activities are dimensions of absorptive capacity. Thus, this study can infer that if the activities of absorptive capacity are circular, absorptive capacity of organizations can be viewed as dynamic capability. Organizations can sustain competitive advantage through cycling through the absorptive capacity cycle and gaining the benefits they anticipated.

Thus, this study proposes a cyclical relationship between these dimensions (Figure 2.2). This study argues that “exploitation” may continually go to “acquisition,” forming a positive feedback loop that cycles back to exploitation. After exploitation of ERP systems, users still need to acquire or update newly acquired knowledge about ERP systems to use the ERP systems properly. The next step may return to a “previous” step, such as transformation, then cycle back to assimilation and acquisition as users are aware that their knowledge or capabilities are insufficient to fully exploit the ERP system. Note, however, that this cycle of assimilation and exploitation leading to further assimilation and exploitation is not circular but a positive feedback loop, since at each iteration users have more knowledge of the system than they did in the previous iteration.



**Figure 2.2 Circular relationship of absorptive capacity**

**Proposition 3a : Realized without potential “cycle” leads to incomplete benefits gained**

Training is a key determinant of long-term viability of ERP in a given organization (Markus et al. 2000a; Yi and Davis 2003; Bajwa et al. 2004), and thus even after exploitation of ERP systems, it is not the terminus of investment in user training.

As observed before, realized ACAP is critical and has direct benefits for ERP use. The complexity and nature of the software limits the amount that users can absorb prior to actual use (Yi and Davis 2003) so it implied that after realized ACAP must come potential ACAP.

On a post-implementation basis, the *continuity* of the skills and knowledge acquired during the implementation process must be ensured in order for the system to be used effectively and provide the anticipated benefits (Nicolaou 2004). Firms that address the gap in employee abilities and performance after the ERP implementation, through an ongoing analysis, will have a greater likelihood of successfully implementing ERP than those that do not (Joseph et al. 2006). Absorbing knowledge before exploiting differs from merely exploiting it, because absorption can internalize knowledge and transform it into part of the organization’s knowledge, thus maximizing exploitation.

Continuous learning can facilitate development of the firm’s ability (core capacity) and the future ability to acquire new knowledge (Schilling 1998), and can provide firms with the strategic flexibility and the degree of freedom to adapt and evolve in a high-velocity environment (Zahra and George 2002). *Thus, if a realized cycle is not followed by a potential cycle, firms will not have sufficient flexibility to adapt to the environment, and may not improve their capabilities again, leaving them stuck at the same stage.* Organizations should not only consider whether training is sufficient, but also take into account the timing of training, thus enabling the ERP system to continue supporting the needs

of the organization (Nicolaou 2004).

**Proposition3b : *The more the cycling the four ACAP activities the more benefits gained***

Accumulating absorptive capacity in one period will permit more efficient accumulation in the next period (Cohen and Levinthal 1990). This implies that as dimensions of absorptive capacity are cycled through repeatedly, more benefits will be gained.

Successful organizations will learn how to effectively manage their ESs on an *ongoing* basis; they will continually integrate, optimize and informate to maximize the value of one of their most under-utilized yet powerful resources (Davenport et al. 2004). Thus, effective management of ERP systems requires ongoing training and exploitation.

In addition, Gattiker and Goodhue point out that the some benefits (ex: coordination-related) do not accrue automatically from successfully implementation of ERP systems, so ongoing investment after implementation is necessary (Davenport 2004; Muscatello 2006). When training is ongoing, if the organizations want to gain increased value they should exploit ERP systems continuously.

