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ERP SUCCESS: THE SEARCH FOR A COMPREHENSIVE FRAMEWORK

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Abstract

While there have been about a few dozen or so studies of ERP success measures, they have been centered on technical implementation success without taking into consideration that ERP implementation is only the first step towards its efficient and effective utilization. What's more, most of the studies have diverse opinions on the evaluation criteria for ERP systems. Through FG discussions that are supplemented with literature for I/S and ERP success, a model for evaluating ERP system success is developed to guide practitioners in planning, executing and optimizing ERP implementations. In addition, the ERP success model can be expanded and extended to direct the efforts for future academic research.

Keywords: Enterprise resource planning systems, integrator, facilitator

Introduction

Dynamic business environment has spurred an expansion of the market for Enterprise Resource Planning (ERP) systems to integrate the complete range of business processes in an enterprise so as to present a holistic view of the organization from a single Information Technology (IT) architecture (Davenport, 2000). With the promise of an inexpensive acquisition and maintenance cost, ERP systems are often the preferred replacement for obsolete legacy systems in organizations that have been custom-built over the years (Holland and Light, 1999a, 1999b). In addition, ERP systems embody emerging business paradigms that are designed to cope with the growing sophistication of business information requirements (Markus, 2000) and promises to deliver strategic competitive advantages for the organization (Glover et al., 1999).

However, despite the rapid diffusion of ERP systems across corporations, there are very few studies that focus on the success determinants for such a system. The majority of research studies in the field of ERP systems has revolved around the issues such as their implementation success or failures (for examples, see Adam and O'Doherty, 2000; Hirt and Swanson, 1999; Markus et al., 2000) and often fails to address the aftermath of their technical installation. In fact, there is a preconceived notion among most scholars that ERP implementation success can be directly translated into its successful adoption. Contenders have emphasized the importance of planning beyond technical implementations of ERP systems by considering additional issues of knowledge integration (Baskerville et al., 2000; Pan et al., 2001) or user empowerment (Ross, 1999). Hence, it is imperative to rethink the basic assumptions on ERP adoptions and derive a holistic framework from which to examine the success of ERP system implementations.

For the purpose of this paper, it is necessary to differentiate between implementation success and system success. Implementation success refers simply to the combination of factors necessary for the physical installation of a system within the organization and acts as the foremost condition for system success, which refers to not merely having the system in place but also its efficient and effective utilization. With an apparent lack of ERP systems success literature, this paper, through the use of focus groups supplemented with I/S and ERP literature, makes a preliminary attempt at the identification of the issues involved in evaluating the success of ERP systems. The findings from this study will serve to direct the efforts of further academic research and at the same time guide future developments of ERP systems. The next section presents some related works that have been conducted in similar fields and this will be followed by a brief account of the methodology for this study. Subsequently, the analysis and findings will be covered in a separate section. Finally, the report will conclude by the suggestion of some insights to be gained from this study.

Information and Enterprise Resource Planning System Success: A Review

The measurement of I/S success has been a popular topic of academic research and many authors have derived different scales on which I/S success can be quantified. These tools of measurement are often diverse in nature and at times, the results even contradict one another (Markus and Robey, 1988). One of the main reasons behind the equivocal outcomes is that different system implementations possess unique qualities, which alter the importance or effects of system success factors. It was not until 1992 when the first consolidation of I/S success literature was proposed by DeLone and McLean (1992). In their article, DeLone and McLean have surveyed 180 papers on both conceptual and empirical studies of I/S success factors, from which they have generalized the success evaluation tools into six broad categories, namely **System Quality**, **Information Quality**, **Use**, **User Satisfaction**, **Individual Impact** and **Organizational Impact**.

System quality refers to the desired characteristics of the system to meet the requirements of the organization such as reliability, response time and accuracy (Hamilton and Chervany, 1981). Information quality, on the other hand, represents a different approach by making use of the information output as the measure of success for I/S and this usually comes in the form of information attributes such as accuracy, timeliness and relevance (Ahituv, 1980; Bailey and Pearson, 1983). The next two valuation criteria for system success are proposed by academic writers who are preoccupied with the users' consumption of the information output produced by I/S. Even though these two measurements appear to be similar, there are distinctive differences between them. According to DeLone and McLean (1992), the measurement of system use is concerned with the practical use of I/S, such as the actual use figures (Kim and Lee, 1986). User satisfaction, in contrast, deals with the aftermath of system usage. Its emphasis is centered on the responses of users with regards to the I/S and measures the degree of user contentment with the output of the system. The last two categories of system success in their paper can be considered to be one coin, two sides. Basically, both of them emphasized the effects of information, the only difference lies in the angle from which these effects are perceived. Individual impact depicts the influence exerted by the resulting information from I/S on the behavior of recipients whereas organizational impact concentrates on the effectiveness of I/S in affecting organizational performance. Towards the end, DeLone and McLean have further elaborated on their idea by merging the six classification groups into a single framework for measuring I/S success (see Figure 1). They predicted that system and information quality affect both use and user satisfaction, which in turn impacted individual behavior and in the long run, influenced organizational performance. In addition, they believed that there is a bi-directional effect between use and user satisfaction.

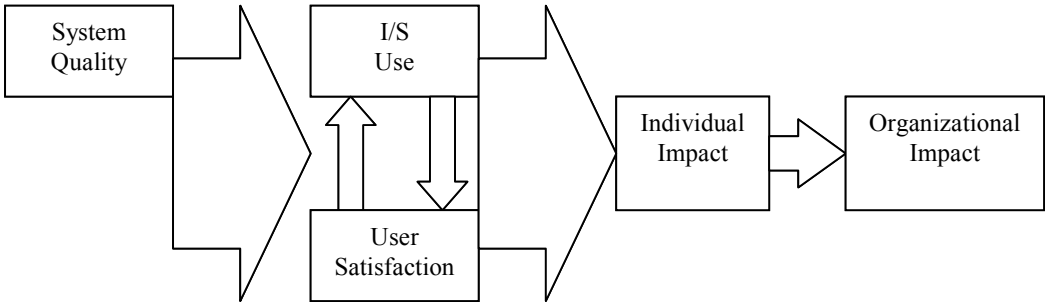

Figure 1. DeLone and McLean's Model of System Success

From this early study, the DeLone and McLean model of system success has been brought under criticisms for its combination of both temporal and casual explanations in deciding I/S success. Seddon (1997) contends for the need to rethink the DeLone and McLean's model because he believes that the model promotes diverse interpretations that erode its original value (Seddon, 1997). Moreover, Seddon considers the term **I/S Use** in DeLone and McLean's model to be ambiguous. To resolve these ambiguities, Seddon has introduced four new variables (**Expectations**, **Consequences**, **Perceived Usefulness** and **Net Benefits to Society**) and reconfigured the relationships between the various success measures to develop a respecified and slightly extended model of IS success as shown in Figure 2. The Seddon's model of I/S success bears important bearings for both academic research and practitioners. By downplaying the vague definition of I/S use and substituting it for factors governing the extent of its use, Seddon pointed out that it is not the use but rather the extent of use, which maximizes the potential of I/S. As repeatedly proven by Davis, perceived usefulness is a strong indicator of the extent of future I/S use (Davis, 1989, 1993). In other words, irregardless of the quality of a system, its functional capabilities will never be unleashed if it is never act upon by the intended user. Hence, by including perceived usefulness in his model, Seddon argues that the perception of the user is a strong motivator for continuous I/S utilization.

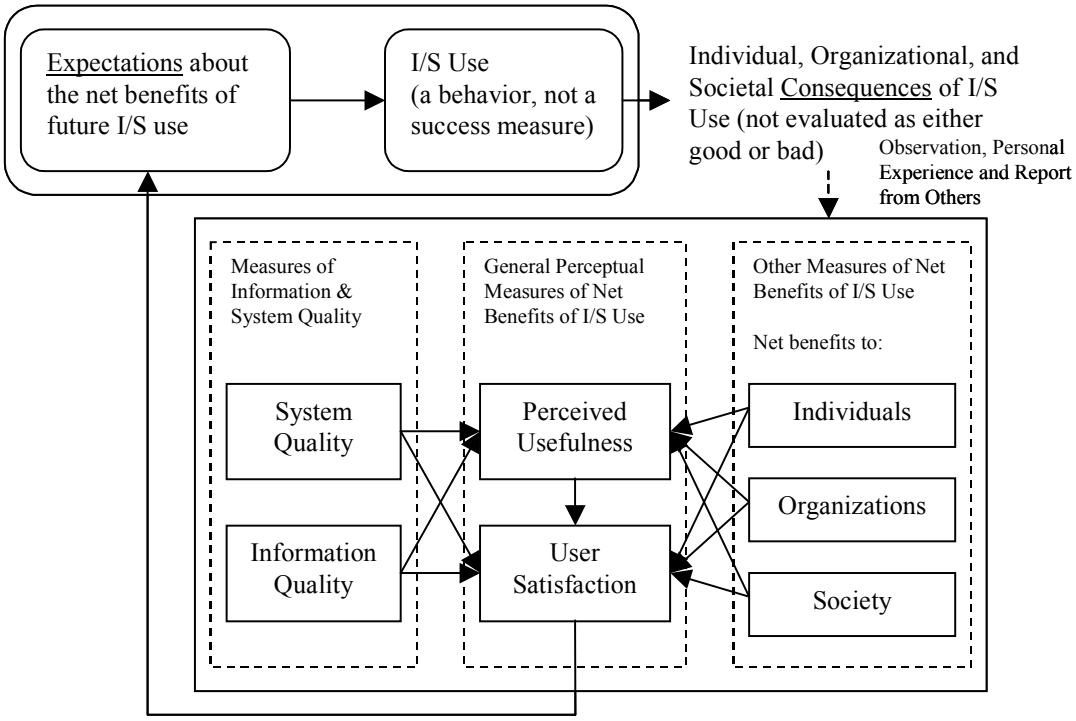

Figure 2. Seddon's I/S Success Model

Apart from extensive I/S success studies, there is also a minimal number of ERP studies on system success. The most noteworthy paper on ERP system success is presented by Markus et al. (2000), which examines the problems encountered and success achieved by analyzing adopters' experience with ERP systems. From the article, the ERP experience cycle is broken down into three distinct phases from which success can be probably assessed. The first phase is the **project phase** where success primarily appears in the form of the organization being able to complete the installation of the ERP system within its given resource constraints. Once the system is in place or what has been termed as the **shakedown phase** in the paper, the second success indicator sets in to measure the extent and duration of organizational impact caused by the ERP system. Finally, the **onward and upward phase** represents the period of stabilization after the initial period of organizational turmoil and success during this moment in time would be the capacity of the organization to derive the business benefits supposedly embedded within the ERP systems. The major contribution from this paper is in its revelation of the crucial implications for the adopting organization to position corresponding milestones at appropriate points of system integration so that problems can be resolved before their symptoms appear. In other words, the triumph of an organization over ERP systems is not a one-time affair, but rather an incremental process of control and progress. In spite of its contributions, most of the success measures proposed in the article have been cased into a narrow, technical perspective; the softer sides of ERP adoption such as the business knowledge transfer from ERP systems to organizations have not been covered.

Hence, the other topic that has shed a different light to the issue of system success measure is the business implications of ERP systems on the organization. Since best business practices are embedded within ERP systems (Soh et al., 2000), the adoption of an ERP system will undoubtedly result in the reengineering of organizational business processes (Markus, 2000) and as such, it is essential to probe into the organizational consequences caused by such a move. As studies have observed, ERP systems are not just software applications tailored to the requirements of an organization but rather, transforms the organizational infrastructure in the way it functions (Hanseth and Braa, 1998) and that it "imposes its own logic on a company's strategy, organization and culture" (Davenport, 1998). Lee and Lee, in their study of ERP implementations from a knowledge transfer perspective, examined the effects brought on by the migration of explicit and tacit knowledge from the ERP system to the organization (Lee and Lee, 2000). Their analysis exposed the conflicting knowledge-based nature of ERP processes with existing business values and rules. Hence, it is in their opinion that the implementation process should be understood by distinguishing the implementation from the integration so that the organization can adjust to each of the conflicts individually, which then provides a process-based competitive advantage. This theme of organizational knowledge management also appears in the exploratory paper by Baskerville et al. (2000). The study investigates the impact of ERP on organizational knowledge and its corresponding impacts on the

organization's strategic future. The findings conclude that the resultant organizational knowledge from the adoption of ERP systems is both converging and diverging. Knowledge convergence is apparent from the organization's point of view since the knowledge of IT and business professionals overlap much more substantially after ERP implementation. However, from the individual stakeholders' perspective, knowledge is becoming more divergent. Proficient operators can no longer seek comfort in their respective sectors and are increasingly expected to diversify into disparate areas of the organization. This convergence of knowledge domains in the organization points to the need for new knowledge management strategies that can facilitate information sharing across the organization and prevent users from "hogging" the information.

Methodology

This paper has adopted the Focus Group (FG) methodology for the collection of data. The FG is a collection of individuals handpicked by researchers to discuss and comment on a specific topic that is the subject of the study based on their personal experience (Powell and Single, 1996). As opposed to the use of interviews where interaction is bi-directional, the FG has a potential for multi-directional interactions that may be able to solicit insights, which would not have been easily accessible without group interactions (Morgan, 1988). Moreover, the FG is particularly useful for exploratory studies where there is very little known about the phenomenon of interest (Stewart and Shamdasani, 1990). The FG places a greater emphasis on the perspectives and practical experiences of the participants (Berg, 2001) as in the event of this study where there are differing views on how success in ERP systems can be measured. Hence, it is necessary to consolidate diverse opinions on how the success of ERP systems has been perceived across organizations and individual users in order to deliver on the promise of a holistic perspective from which to gauge the success of ERP system adoptions.

One of the crucial success elements for conducting FG workshops would be selecting participants who represent the population of interest and are willing to share the relevant information (Stewart and Shamdasani, 1990). As such, for this study, the FG participants have been selected from a class of students attending a postgraduate module on *Knowledge Systems and Management in Organization*, where ERP systems have been included as part of the learning curriculum. In addition, to ensure the relevance of participants' experiences with ERP systems in contributing to the discussion, individual profiles of the students were assessed. A total of 30 participants were then invited to contribute to the FG discussions; the majority of which were IT professionals whose organizations have the intention to adopt or have already adopted ERP systems. There were also 5 full-time postgraduate students with no prior working experience, but with research interests in similar or related fields so as to triangulate academic beliefs versus practical experience so as to increase the breadth and depth of discussions.

The FG was separated into 4 sessions, each lasting 2 hours and with an average of 8 participants. Each session was audio-taped and transcribed, before the application of thematic analysis to identify the main themes of the discussions (Boyatzis, 1998). Moreover, at the end of each session, a post-mortem was conducted to identify any improvements or additional topics to be brought up in subsequent discussions (Greenbaum, 2000).

Enterprise Resource Planning System Success Measures: A Research Framework

Although there are significant overlaps between the success measures for I/S and ERP systems as discussed in the above literature, there are a substantial number of success factors unique to ERP systems. Though most of the success measures for I/S are applicable to ERP systems, there are still aspects of ERP system sophistication, which cannot be addressed effectively by I/S success measures such as the tremendous difficulties in practical implementation and the transfer of embedded tacit business knowledge. Through a unification of the similarities and differences between I/S and ERP success measurements, it can be derived that the success of ERP systems can be assessed on three distinct and incremental layers.

Generally, initial victory for any ERP adoption stems from its technical installation while ensuring the smooth running of the system (Markus et al., 2000). Once seamless technical operations across the ERP system have been achieved, the organization is said to have attained the fundamental **Infrastructure Success**. This step is a pre-requisite of the next stage of ERP integration and facilitates the development of a singular information infrastructure within the enterprise (Davenport, 2000). Success at this phase refers to both the existence of standardized information channels across business processes and the cultivation of an environment conducive for information sharing among system stakeholders. It is only through the cultivation of such a prevalent information sharing atmosphere that the company can fulfill **Infostructure Success**. However, the ERP experience-cycle is never complete unless the underlying business benefits of the ERP system are realized by the adopting organization. Even then, it remains an unknown as to whether business knowledge from the ERP system can be well-integrated into the organization because

the transfer of business knowledge effectively destroys all the dominant business rules and values of the organization. Hence, there is a sense of urgency for organization to capitalize on individual's expertise in their respective work areas to create strategic business value for the firm (Lee and Lee, 2000). This sharing of knowledge across individuals and functions will eventually lead to the convergence of knowledge from the organization's perspective (Baskerville et al., 2000) and organizations can thus proclaim **Knowledge Success**. Since success of ERP systems is progressive and dependent on the prior success of the previous level of integration, it can be logically deduced that the three layers represent a hierarchy of success for the adoption of ERP systems.

From above literature discussions, a three-layer framework was developed to analyze the success factors for ERP systems that have been raised during the FG discussions (see Figure 3).

Figure 3. Framework for Analysis of ERP System Success

Based on the ERP system success framework, potentially differentiating themes that have emerged from the focus groups are categorized under the three broad areas and the number of participants who mention the themes are compared (see Table 1). From the classification of these themes, additional inferences could be made on a finer segmentation of the wider notions of infrastructure, infostructure and knowledge success, which take into consideration the proposed measurements that are brought up in the FG discussions.

Table 1. ERP System Success Model: Themes Comparison

Potentially Differentiating Themes			No. of Participants
Infrastructure Success	Project Success	Selection of ERP	6
		Technical Scope	11
		Resource Determination	6
		Implementation Approach	5
		User Acceptance Test	5
		Training	15
	System Quality	System Usability	6
		Software Upgrades	6
		Real-Time Transaction / Reporting	5
		Data Visibility	13
		Data Scalability	2
Infostructure Success	Information Quality	Real-Time Transaction / Reporting	5
		Data Visibility	13
	Perceived Usefulness	Information Sharing	8
		Efficiency	12
	User Satisfaction	Establish Better Working Relationships	1
Knowledge Success	Knowledge Transfer	Knowledge Conflicts	10
		Best Practices vs. Confidential Practices	6
		Change Management	11
Perceived Net Benefits		Competitive Advantage	7

The initial concerns of the FG participants with ERP adoptions are mainly towards its technical implementation, especially in defining the technical scope of implementation (Everdingen, 2000). As mentioned by one of the participants, "*selecting which processes to keep during ERP implementation is one of the most challenging and daunting tasks. Organizations should evaluate this carefully, as this decision will greatly impact the success of the implementation and the worth of their investment.*" In addition, the participants cited the level of organizational resource commitment as one of the restrictions on its successful technical installation. As observed by one of the other participant, "*many projects are not completed on time and they overshoot the budget. In fact, some organizations fail to see the benefits even after a couple of years past the implementation.*" This observation reinforces the study by Markus et al. (2000) that recognizes project schedule or project budget as one of the major threats to ERP system success. Another common theme is the general consensus that user training is an "*essential and crucial step in the whole implementation process.*" One of the participants has even proposed a cost-effective method of training end-users. He believes that "*the training process may take place in a hierarchical manner like a tree where training is carried out at different managerial levels with each level responsible for training the next subsequent level.*" This proposal for the need to assess user acceptance and formulate training sessions to familiarize users with the system will serve to alleviate users' resistance towards the ERP system (Hirt and Swanson, 1999). In short, **project success** can be deduced to be a collection of organizational factors crucial in supporting the implementation and efficient utilization of ERP systems.

Nonetheless, the success of the ERP project acts only as a precondition to assure the basic functionalities of the system. The operational performance of the ERP system is unquestionably another issue to be reckoned with in the determination of infrastructure success and some of the FG participants have mentioned system reliability as a possible measure. As pointed out by one of the participants, "*the ERP system is a good and efficient way of making sure your business is competitive in the tough business environment. But the efficiency will cost you when freak accidents happen.*" Also highlighted by one of the respondents, the advantage of ERP systems can be seen when "*a customer service representative can answer a potential client's queries promptly and accurately.*" Hence, the evaluation criteria for **system quality** as discussed in DeLone and McLean's (1992) model are appropriate measurements for such technical system characteristics since it include factors such as reliability, response time and data accuracy that reflect the desired attributes of a typical I/S.

With the elementary infrastructure in place, the organization is ready to advance into the next level of ERP integration. At the information layer, the top priority of the enterprise is the creation of a singular information infrastructure that spans across all business processes of the organization. As indicated by one of the participants, "*ERP systems improve the visibility of demand and supply in the company. Inventory, production, sales and procurement information are all available in the same integrated system. This facilitates real-time information to be propagated throughout the organization, thus enhancing visibility.*" These characteristics of information coincide with DeLone and McLean's (2000) quest for **information quality**. However, information quality is very much dependent on the quality and extent of use of the ERP system. From the discussions, it is generally agreed by the participants that the success of ERP systems lies in catering to the specific informational needs for different users such as in the example where "*the finance department can accurately pinpoint profit and loss instantly whereas mangers can get a more reliable overview about the state of the organization units within the organization.*" As such, **perceived usefulness** has been suggested by Seddon as the primary indication for extent of I/S use and it will be incorporated into the research model as a measurement for user consumption (Seddon, 1997). From above, it is clear that perceived usefulness and information quality has interdependent effects on each other. The quality of information will determine the degree of usefulness perceived by users whereas the user's perception of the system will affect the extent of use and ultimately decides the quality of information. Hence, the eventual goal of the organization would then be to promote a culture of information and data sharing that makes use of the standardized information channels running across business functions. The evaluation of organizational culture is a seemingly impossible task, and for that reason, a suitable substitution for assessing the presence of information and data sharing behavior would be **user satisfaction**. User satisfaction is a necessary condition for repeated use and a higher level of user satisfaction towards ERP systems would implicitly imply that stakeholders are more willing to participate in information and data sharing activities prevalent throughout the system. In fact, most of the participants perceived ERP systems to have "*the ability to satisfy customers delivering a consistent product lead time and information in a moment's notice.*"

Knowledge transfer would be the final obstacle before total system success is attained and can only be tackled in an environment with productive information and data sharing activities. Success at this stage would mean that the business paradigms embedded within ERP systems have been successfully migrated into the organization. Lee and Lee, in their paper, have made extensive efforts to explain the integration of business knowledge from the ERP system to the organization (Lee and Lee, 2000). This issue of knowledge transfer was also raised during FG discussions and some of the practitioners have revealed the need for the identification of knowledge conflicts, which could arise between the current business processes and the embedded organizational models due to misalignments of the best practices with existing organizational-specific or "*confidential*" processes. As pointed out by one of the respondents, "*each functional unit should be prepared to align the existing business processes with the*

recommended best practices of ERP systems because the automation of existing processes would not bring out the benefits of ERP systems. But this approach becomes questionable if the existing processes withhold the actual competitive advantage of the enterprise. Under such situations, it's better to concentrate more on the integration of processes rather than an extensive re-engineering effort." In other words, knowledge integration between ERP systems and existing business processes can be achieved through a strategic convergence of knowledge within the organization.

Before the above evaluation measures are combined to form the success framework for ERP systems, there is the additional measure of perceived net benefits, which is relevant to the definition of system success but should not be associated with any of the three layers of organizational system success. The rationale behind this arrangement branches out from the fact that the three layers of success refer to **Internal Organizational Success Measures**, which do not take into consideration the benefits or competitive edge that is introduced by the ERP system. "**Perceived net benefits**" is a broad term that encompasses both internal and external advantages, which can be solicited from the ERP system, as covered in the FG discussions. This point of an internal and external value consideration is brought yp by one of the participants when it was mentioned that "*due to a paradigm shift in conducting business, organizations are moving to a customer and demand driven business system. These systems emphasize the integration of their internal departments (inward) and integration to their suppliers, customers and partners (outward). Thus the role of ERP systems can be viewed from within an organization and outside of an organization.*"

Two main points must be highlighted pertaining to the perceived net benefits of ERP systems in conjunction with the hierarchy of success. First, as the adopting organization moves upwards in the hierarchy of success, the perceived net benefits change from an internal to a more external orientation. For example if only infrastructure success has been achieved by the organization, then the benefits will most probably take the form of greater efficiency and higher productivity. On the other hand, if the company is able to attain knowledge success, then the business knowledge of ERP systems will aid the organization in the creation of external value, which enhances the responsiveness of the organization to a dynamic environment. The second point to be highlighted would be the strategic impact of benefits derived from ERP systems as the adopting organization climbs the hierarchy ladder. As insightfully summarized by Hayman, internal value creation is necessary but insufficient in the new economy (Hayman, 2000) and companies should boost their competitive status by exploiting opportunities for external value creation. From the above statement, it is obvious that as ERP benefits change from an internal edge to an external advantage, the competitiveness or the strategic position of the organization is further consolidated. The exact classification of the different themes in accordance to its specific success component is illustrated in the table 1 below:

The preceding success measures can be brought together to construct a framework for the measurement of system success in ERP adoptions. The proposed ERP system success model is illustrated below:

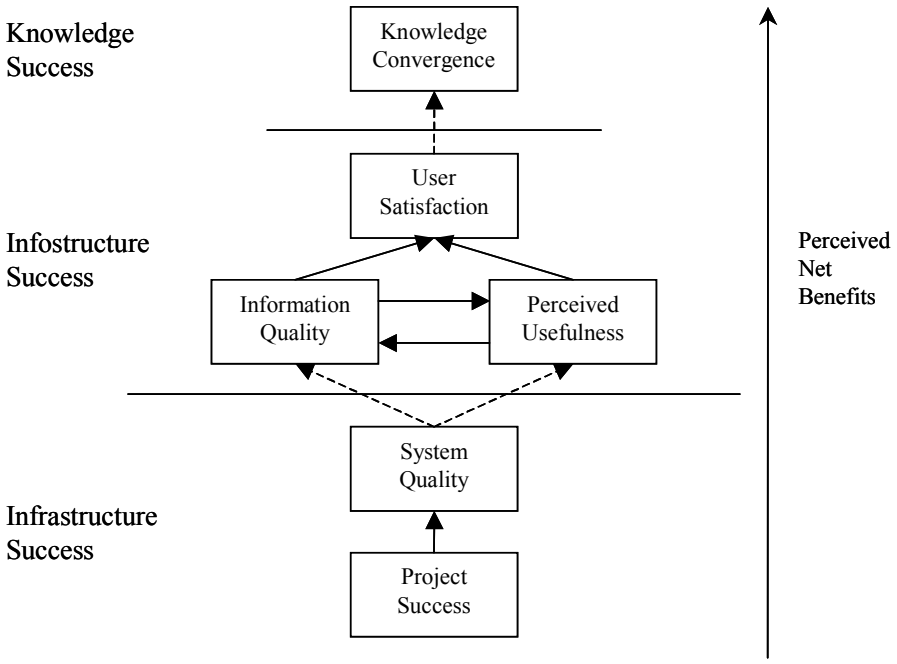

Figure 3. Proposed ERP System Success Model

To summarize the above model, the success of any ERP system adoption begins with a successful technical implementation or project success, which in turn affects the quality of the ERP system and it is only with the assurance of system quality that organizations can achieve the basic infrastructure success. Building above the stable infrastructure would be the integration of information necessary for a single information architecture. In any integration of system information, the information quality plays a pivotal role in affecting the perceived usefulness of the system. Since perceived usefulness is an indication of system use, a drop in information quality can be translated to a proportional decline in users' utilization of the system. However, the reverse is true as well. If users refuse to make use of a system which is in place, then no matter how good is the infrastructure, the information output produced by system will never be able to meet the minimum requirement of accuracy, timeliness and relevance. The user experience will not be enhanced unless both information quality and perceived usefulness can supplement each other effectively. The enhanced user experience or in more operationalize terms, the user satisfaction, is a key component of repeated system use, which in turn contributes to an information and data sharing culture essential for the company to attain infostructure success. With the success of infostructure, the organization is in a better position to embrace the business knowledge embedded within the ERP systems. This takes place in the form of knowledge integration with the eventual result being a converging organizational knowledge database that will serve to enhance the responsiveness of the organization and allow the fulfillment of business knowledge success.

Implications for Future Research

By drawing upon the literature available on success measures for I/S and ERP systems and complemented substantially with FG discussions, a research framework has been proposed that unites the success requirements for any typical I/S with the unique specifications demanded by ERP systems. This study considers both technical and strategic valuation of ERP system success. Within the research model, there are strong implications for future research direction. First of all, despite the fact that most of the success measures and relationships have been derived from prior I/S literature, it would be interesting to test it more rigorously to verify that these interdependencies still hold true in other implementations. Secondly, the link from user satisfaction to knowledge convergence has yet to be proven even though studies have demonstrated the possibility of the existence of such an association. It would therefore be fascinating to conduct empirical studies to prove or disprove the presence of an intimate connection between user satisfaction and knowledge convergence. Finally, since ERP systems share almost identical characteristics with other enterprise systems such as Supply Chain Management (SCM) and Customer Relationship Management systems, a possible future research direction would be to assess if the research model can be extended to all enterprise systems. This could be done with practical studies or a comprehensive review of existing literature of all enterprise systems. In sum, the research model exists only as a preliminary framework and fine-tunings are expected before it can fully convey the meaning of success for any ERP system adoption to the organization.

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