

System versus Process Perspectives of Enterprise Resource Planning Implementations

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Abstract - This paper reviews literature concerning implementation of Enterprise Resource Planning (ERP), its successful and unsuccessful cases, and the critical success factors of its implementation, in order to identify gaps in academic thinking and propose future research opportunities. ERP implementation research often takes only a systems-oriented view of the implementation process and not a process-oriented view. This narrow technological perspective of the implementation process feeds into limiting the measuring of the success of ERP implementation to standard project-based assessment performance measures. Since the process of ERP implementation consists of many phases, only one of which is the actual ERP system installation, and since each phase can have quantifiable success measures feeding the subsequent stage, it is feasible to take a broader approach to ERP implementation process and its success measurement. This paper categorizes and maps the extant research to this proposed ideology.

1. INTRODUCTION

Most organizations, irrespective of the nature of their business, are today involved in some kind of enterprise level Information Technology (IT) initiative. These initiatives, credited with improving operating efficiencies include Enterprise Resource Planning systems (ERP). While some organizations are evaluating purchase/upgrade of such systems, others are in various phases of the implementation process. Irrespective of the nature of the ERP initiative and the stage of adoption it is in, a perpetual issue faced by IT managers is the ability to measure the impact of such systems on the improvement in performance, and therefore validating the need for more of these costly initiatives.

Traditionally, the success of ERP implementation projects has been measured by checking its compliance against targeted time, optimal resource utilization and the budgeted cost. While this is desirable from a tactical perspective, it nonetheless is a restrictive performance criterion. Successful implementations are those where one can map the usefulness of the implemented IT system against verifiable and quantifiable enhancements in working performance. While a direct cause-effect relationship is generally challenging to establish, it is usually possible to keep track of the key indicators, which have the greatest potential to influence improvements in performance. The timely reporting of such indicators by IT project managers solidifies a company's commitment to continued IT initiatives, lays down benchmarked data for future implementations, and makes buy-in easier from work force.

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2. ERP: SYSTEM vs. PROCESS VIEWS

ERP as a concept may be defined as "seamless integration of processes across functional areas with improved workflow, standardization of various business practices, improved order management, accurate accounting of inventory and better supply chain management" (Mabert et al. 2000); whereas ERP Systems are merely the vehicles through which this is accomplished (Jacobs 2003). The concept of ERP is fundamentally tied to the integration, standardization, extension and assurance of future flexibility for corporate processes, whereas the system represents the technical manifestation of these goals and the changes required to attain and maintain them (Jacobs 2003, Ng et al. 1999).

Research dealing with ERP as a concept deals with issues like success factors, measures of success, ERP systems' integration into the business strategy, and impacts of ERP implementation on overall business objectives. Research in ERP systems deals with system intricacies and process design to meet the conceptual objectives of the ERP. As is evident from the definitions above, ERP as a concept goes above and beyond ERP Systems. ERP Systems are a means to an end; the end being a seamless information flow across functional areas. Permlle Kræmmegaard et al. (2000) define ERP implementation as "an ongoing process of integration and transformation of business using an ERP System." According to Jacobs (2003) and our survey of ERP implementation literature, academic research deals predominantly with the ERP systems. Consequently, the boundary demarcating a successful ERP deployment and a successful ERP Implementation is very blurred, and ERP System Implementation success measures are used as a substitute for measuring the ERP success.

Davenport (1998) indicates that there is an important difference between enterprise and enterprise systems. Many companies fail in their implementation efforts because of failure to "reconcile the technological imperatives of the enterprise system with the business needs of the enterprise itself."

Several authors have made the point that ERP deployments are in-fact sequential phase-by-phase activities. Markus and Tanis (2000) develop a framework for ERP Implementation and measuring its success using the Emergent Process Theory of Soh and Markus (Soh et al. 1995). This model describes IT Implementation as a series of three phases – system development, implementation and on-going operations. The outcomes of one phase become starting conditions for the next. Therefore, decisions and actions made in a phase may increase or decrease the potential for success subsequently. We thus feel that it is critical that ERP Implementation studies necessarily evaluate the performance based on comprehensive success measures and not on standalone success measures. Also, since a typical ERP project extends over several years and has profit and operational ramifications extending over several years (Mabert et. al, 2001), static and one-time success measures are

of little value and only capture one small aspect of the big picture.

Mabert et al. (2002) state that “many different factors ranging from pre-implementation planning to system configuration influence performance, which managers should be sensitive about when implementing major systems like ERP”. There is an extensive body of knowledge concerning IT System Implementations and their successes, and in some aspects ERP System Implementations can be thought of as extension of IT Systems. ERP research relating to purely system or package implementation can ideally make use of the fundamentals already developed in IT research (Jacobs et al. 2003).

Markus and Tanis (2000) indicate that “there is a fundamental gap in both practical and academic thinking about information systems and a lack of consensus and clarity about the meaning of success”. Upon review of literature concerning ERP implementation, ERP success and failure cases, ERP implementation critical success factors, etc. we noticed that the same problem applies to ERP: success is rarely explicitly defined, and if it is defined, the explanations often differ.

We feel that the academic community should take a holistic view of the ERP Implementation process and its success measurement. This would mean measuring the success or failure of an ERP Implementation not just from a technological perspective but from a multi-dimensional business perspective. With this in mind, we surveyed the most cited research done in ERP Implementation and tried to categorize where that research lies within our proposed ideology. In this paper, we make an attempt to collect most popular definitions of success, to cite some common performance measures used in the industries and in academic research, and to see how these measures can be used efficiently in correspondence with the phase-by-phase ERP implementation approach.

3. SURVEY OF LITERATURE

Understanding success of an ERP implementation project and being able to appropriately measure success is very important for numerous reasons. First of all, ERP implementation efforts are very expensive and usually cost companies several million dollars. Therefore, managers would be interested in evaluating the result of the implementation project, in understanding benefits that the company received from the project. Secondly, having a common understanding of ERP implementation success would make it easier for academics to conduct empirical studies and to compare and differentiate ERP implementations across industries and across different organizations. Lastly, Umble et al. (2003) list existence of focused performance measures as one of the very important factors that lead to successful implementation. Often in business, you get what you measure. So, existence of good success metrics creates a strong motivation for employees involved in the implementation project and the company may achieve desired outcomes. If we measure only the ERP Systems Implementation success then we may get a good system that may not necessarily benefit the business. If we measure positive business outcomes after the implementation,

then we may get a system that actually benefits the business in the long run.

In this section we review the most cited ERP research against our proposed ideology - that ERP Implementation is a phase-by-phase process where each phase should have its own success measures (Figure 1); and, for a meaningful evaluation of an ERP Implementation (not just an ERP System Implementation) comprehensive success measures would be more appropriate than stand-alone metrics. With this in mind we searched for published research, using the keywords “ERP”, “ERP Implementation” and “ERP success”, in our university’s academic databases. Some areas of research like - research concerning human-behavior/ change management during ERP Implementations were avoided. Our focus was on ERP Implementation research within the gambit of Operations Management.

“A model of ERP project implementation” by Parr et al. 2000, proposes a Project Phased Model (PPM) of ERP implementation which consists of three phases: planning, project, and enhancement. The main focus is on the project (system implementation) phase. In this paper the authors link the critical success factors (and not success measures) with implementation stages. The paper cites three other process models of ERP Implementations:

1. The five phase model of Bancroft et. al (1998) – the focus phase, as is phase, to be phase, construction and testing phase and the actual implementation phase
2. The five phase model of Ross (1998) – design, implementation, stabilization, continuous improvement and transformation
3. The four phase model of Markus and Tanis (1999) – chartering, project, shake-down and onwards and upwards.

Except for Markus and Tanis, none of the models relates success measures to the phases of implementation.

“Enterprise Resource Planning: Managing the implementation process” by Mabert et. al (2002) empirically investigates and identifies key differences in the approaches used by companies that managed their implementation on-time and/or on-budget versus the ones that did not, using data collected through a survey of US manufacturing companies that have implemented ERP systems. The paper implicitly uses the systems perspective for the ERP Implementation process and uses ‘on-time and on-budget’ as the performance measures for measuring success. Though they do report in their findings that pre-implementation issues play a major role in the overall system performance.

“A research framework for studying the implementation of Enterprise Resource Planning Systems”, by Kaemmergaard et. al, 2000, presents three different perspectives of ERP implementation – the organizational, business and technological. Their definition of implementation includes – IT/IS strategy formulation, decision process, development of implementation plans, the technical set-up, the use and profitability of the systems and the further development of the systems and the organization. The paper mentions the need to have performance measures which more accurately reflect the

true performance and capture all perspectives, but does not state any such measures.

“Towards the unification of critical success factors for ERP implementations”, by Sousa et.al (2000), implicitly refers to ERP System Implementation when in fact it is describing a full ERP Implementation. The paper develops a unified framework for analyzing critical success factors – strategic, tactical, organizational and technological. The critical success factors that they mention capture many business aspects and not just the technological implementation side of the project: business process reengineering, sustained management support, organizational change etc.

“Enterprise Resource Planning: Common Myths Versus Evolving Reality” Mabert et al. (2001) provides state of the art overview of the market for ERP Systems and alludes to the implementation of ERP as an IT/software implementation. The paper also hints at using ROI (return on investment as a measure of success for ERP Implementation).

“Enterprise Resource Planning: Measuring Value” by Mabert et al. (2001) – presents an attempt to capture, through a user survey, respondent’s and firm’s characteristics, the pre-implementation planning process and management, the implementation process, subjective measures of ERP success, and objective measure of ERP success. The authors point out that the environment in which businesses operate is continuously changing, a company which set out today to implement an ERP will be faced with a very different competitive environment by the time the implementation is over, which may be several years. Hence it may not always be possible (and perhaps advisable) to compare operational measures of success across different time-periods.

“ERP Implementation: Chief Information Officers’ perceptions of Critical Success factors” by Fiona Fui-Hoon Nah, Kathryn M.Zuckweiler, Janet Lee-Shang Lau (2003) reports the results of a survey of chief information officers’ perceptions of critical success factors in ERP Implementation. The questionnaire, (provided at the end of the paper) asks the respondents to rate factors which are critical for an ERP Package Implementation. However, the paper does not define what success measures the respondents should consider while answering questions on critical success factors. Moreover, the questions vacillate between ERP System related questions to ERP Concept related questions and hence the validity of what is being measured becomes a little fuzzy.

“Enterprise resource planning: Implementation procedures and critical success factors”, by Elisabeth J. Umble, Ronald R.Haft, M.Michael Umble (2003) state that “successful ERP implementations require that organizations engage in excellent project management. This includes a clear definition of objectives, developments of both work plan and resource plan, and careful tracking of project progress.” This definition is probably more apt for defining an ERP System implementation as its focus is on the “project” aspect of the Implementation. The paper does point out that managers need to understand that ERP is more of a business issue than just a technological challenge.

“Enterprise resource planning: a taxonomy of critical factors” by Majed Al-Mashari, Abdullah Al-Mudimigh, Mohamed Zairi (2003) provide a framework for analyzing critical success factors. They segregate the ERP Implementation process into – setting up stage, implementation stage and evaluation stage. They also provide general parameters for classifying ERP benefits. The authors cite various studies to make the point that the logic of an ERP System may conflict with the logic of the business, and this may result in an implementation failure. The authors also state that “well-defined strategic targets help to keep the project team on track throughout the entire implementation process”. This reasoning (which may be attributed to Davenport, 1998) is being used by more and more researchers. Our basic proposition is that researchers should view an ERP Implementation in its entirety with measurable successes along the way (Figure 1).

“Vicious and virtuous cycle in ERP Implementation: a case study of interrelations between critical success factors”, H. Akkermans and K van Helden (2002) is based on a case study used to analyze and explain poor project performance in one ERP implementation in the aviation industry. The paper depicts a timeline of the ERP Package Implementation which is inadvertently referred to as a timeline for the ERP Implementation. A look at the critical success factors proposed in the paper makes it apparently clear that what they are capturing clearly goes beyond just a software implementation. For example, some of the success factors identified include architecture choices, management support, business process re-engineering and user training. Each of these factors will be relevant in a different phase of the implementation of the ERP Concept and referring to them as factors of success for implementation of the ERP Package is taking a myopic view of the situation. Moreover, the paper does not define the measures of success used to rank and classify the success factors.

The most common way for looking at ERP success is to treat it as a regular IT implementation and to apply the most popular performance metrics used in IT to ERP implementation. According to Mabert et al. (2003), various companies commonly cite the following measures of ERP success: the project was completed on time and within budget. Although these metrics have been among the most popular success measure in IT implementation area, lately the IT success was redefined by various researchers.

M. Al-Mashari et al. extend the definition of IT success based on the Lytinen and Hirschheim’s definition of IT project failure. In addition to existing dimension of completing the project on time and within budget that they call “process success”, they define three new dimensions: correspondence success (does the system meet the specific objectives?), interaction success (do the users have positive attitudes towards the system?), and expectation success (does the system match the expectations?) (Al-Mashari 2003). We feel that adopting this success measurement framework to the definition of ERP success would lead to better understanding of the actual performance of the ERP system.

Moreover, ERP implementation is not only about installing a new IT system; it also has significant strategic, organizational, and even cultural implications (Davenport). Therefore, its success should not be measured solely on the same metrics as the success of any IT implementation. For this reason, Markus and Tanis suggest two major approaches for defining success of enterprise systems: from the implementation project perspective and from the business results perspective. The first approach may utilize IT implementation metrics, but the second approach should take into account whether the company has achieved its strategic goals and whether the business performance has improved in any way as a result of the implementation.

Sedera et al. outlay a research proposal that aims to develop a system for measuring performance of enterprise systems based on the Balance Scorecard framework created by Norton and Kaplan (1992). The Balance Scorecard helps organizations to convert their corporate mission and strategy into a set of performance metrics. This framework emphasizes use of financial performance indicators but also includes various operational drivers of financial objectives, in other words, this approach includes both quantitative and qualitative factors. The authors argue that ERP implementation projects may benefit from adoption of this measurement framework, because the ERP systems bring in many intangible benefits that cannot be measured quantitatively (Sedera 2003). Bartholomew (1999) argues that actually 80% of the ERP benefits in a typical business organization are intangible. The Balance Scorecard framework was created to measure performance of the whole organization, and, certainly, it will need some alterations to be applicable to the ERP implementation projects. For example, instead of translating corporate mission, companies would have to translate their implementation objectives into performance metrics.

A very rich stream of literature in ERP implementation concerns ranking and classification of critical success factors. Umble et al. (2003) list existence of focused performance measures as one of the very important factors. Some business performance measures proposed in the paper are as following: on time deliveries, gross profit margin, customer order-to-ship time, inventory turns, vendor performance. They suggest considering ERP implementation successful if “it achieves a substantial proportion of potential benefits,” where potential benefits of ERP implementation include personnel reductions, decrease in operating and IT costs, improved demand forecasts, increased speed of production cycle, improved customer service, reduction of inventory and better inventory control.

Another success measurement is proposed by Ptak and Schragenheim and cited by Umble (2003) in one of the critical success factors studies. They define success as achievement of the desired level of ROI, as it was identified during the planning phase. Hitt, Wu and Zhou use the following performance metrics in their empirical study of relationship between companies' success and ERP adoption: labor productivity, return on assets, inventory turnover, return on equity, profit margin, asset turnover, account receivable

turnover, debt to equity ratio, and Tobin's q (market value over book value).

We believe that in some cases measuring achievement solely based on the above stated indicators may lead to fallacious conclusions about the success or failure of ERP. Mabert et al. (2001) raise an important issue of business dynamics as it is related to the measurement of success. Since most implementation projects take a few years to complete, a lot can happen in business during these years and the business performance indicators may change significantly due to various intervening factors that are absolutely not related to the ERP implementation. We feel this is a very valid and important point and fits nicely with our thinking that ERP Implementations should be considered as a phased activity with each phase feeding into the other, hence the implementation should be studied as a whole and its success measured in terms of improvements in the operational parameters on a longitudinal time-phased basis over each phase of the implementation life-cycle.

4. CONCLUSIONS AND FUTURE RESEARCH SUGGESTIONS

A review of ERP Implementation literature reveals misalignment in understanding between academics on what aspect of the implementation and success of the implementation is actually being measured. This gap also highlights the potential opportunity for future research (Figure 2).

Throughout the years of research in ERP field, academic researchers have suggested numerous definitions of ERP implementation and practitioners have approached it in different ways. Based on our literature review and common understanding of business, we believe that the most comprehensive approach to defining ERP implementation is in terms of phases. Defining ERP implementation in terms of phases captures different stages of ERP implementation starting from planning period and ending with the long term business outcomes achieved as a result of the implementation. We identified four major phases models proposed in the academic literature:

1. The Project Phased Model (PPM) of Parr et al. (2000) The limitation of this model is that it focuses mainly on the project phase, therefore it deals mostly with the ERP Systems implementation;
2. The five phase model of Bancroft et al. (1998). In our opinion, a limitation of this model is that it ends with the implementation phase and does not consider the business performance after the ERP implementation;
3. The five phase model of Ross (1998) – This model starts with the design phase, which refers to the determination of critical guidelines and decision making for the implementation. In our view, this is a limitation of this model: it does not consider the very early phase where the business determines the need for the ERP implementation. We feel that the seeds of success or failure of an ERP Implementation are planted in this very first stage.

4. The four phase model of Markus and Tanis (1999) – This model is the most comprehensive in our view. It starts with the creation of the ERP business case and ends with the long term outcomes of the ERP implementation.

If the company adopts a phased framework for the ERP implementation (Figure 1), the success should also be measured by stages. Companies have a choice of numerous operational and business metrics proposed by different researchers and practitioners. IT success metrics are applicable only during the actual system implementation stage. The metrics to be used at each stage will vary according to the nature of the business and specific business objectives. In any case, these metrics should be defined during the planning stage of the implementation, so that the implementers know what to strive for in the implementation process. Developing such phase-wise success measures can be a very fruitful area of research. Such research, in our opinion, could have a profound impact on ERP Implementations.

This analyses and conclusions are based solely on our literature review and personal judgment. We believe that another opportunity for further research in this area is to conduct a survey of companies that have implemented ERP and of ERP implementation consultants to test our proposition that approaching implementation in terms of phases, where each phase has its own set of success metrics, leads to a better and smoother implementation process; and using the same survey to see whether the outcome of one phase affects the success or failure of the subsequent phase.

Research and Development in the field of ERP implementation is an evolving and developing area. Conducting analytically studies that address and quantify the ERP Implementation success and factors will greatly benefit the entire Information Technology industry.

Another research opportunity in this field is creating a pool of success metrics and identifying what circumstances should make businesses choose certain metrics and not use the others. A research tool that may be applicable to such analysis is an empirical based longitudinal study of companies that have implemented ERP couple of years ago to see what changes did they notice in the long term business outcomes, what quantitative and qualitative benefits did they encompass, and also to collect information about their business characteristics, business objectives, and motivation for ERP implementation. Once this information is obtained, it would be interesting to match certain business benefits achieved with the business and ERP implementation objectives. Once there is a pool of such success metrics created, another interesting research study could be to go back to the famous ERP implementation cases that describe either success or failure of the implementation (von Helens et. al 2004) and check whether the use of proposed metrics would actually give a truer picture of the success of the case.

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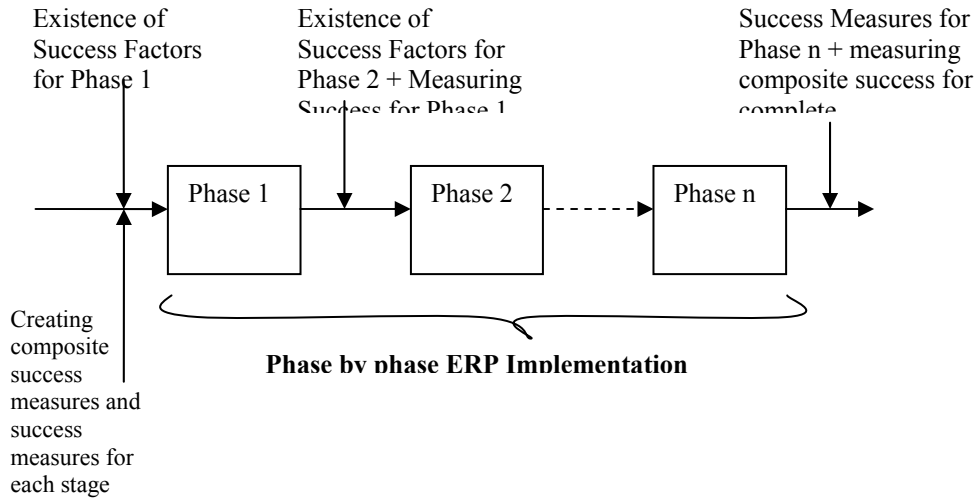


Figure 1: Proposed Framework for Measuring Composite Success of ERP Implementation

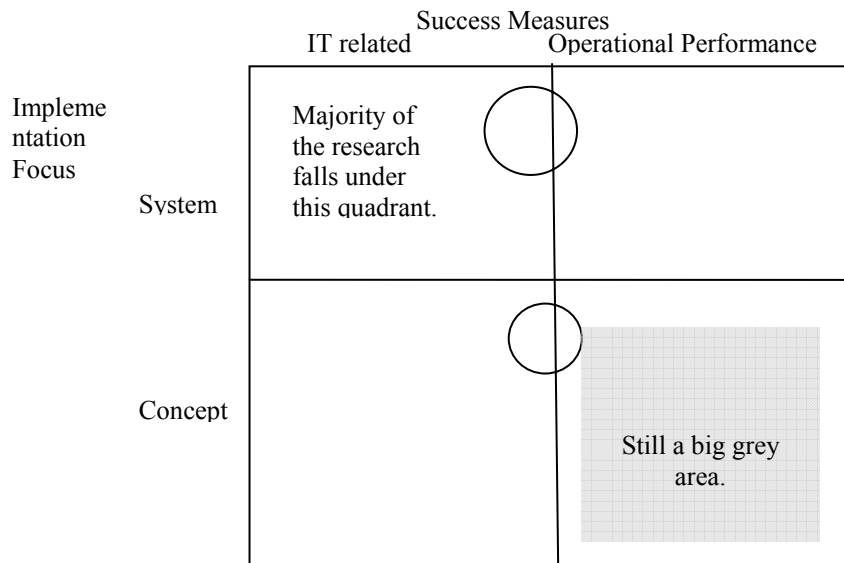


Figure 2: Identify Potential Research Areas in ERP Implementations and Success Measurement