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Abstract

Enterprise Resource Planning systems are complex systems that integrate data and business processes. ERP implementations have been plagued with failure but ERP continues to be adopted and is expanding into new areas. This paper identifies frequently cited factors of success, describes them within the context of supporting evidence and compares identified factors with actual practice using two case studies. Successful ERP implementations begin with education that requires organizations to develop an understanding of their business processes and to map those processes to a fully integrated ERP system. The focus should be on improving the way an organization conducts business by exploiting the capabilities of ERP and recognizing the dynamism of an enterprise initiative that represents change.

Keywords: Enterprise resource planning

Introduction

In the past, information systems were developed based on independent requirements from individual functional areas to automate manual systems. As one requirement was satisfied, others were identified and were either added to existing applications in a piecemeal fashion or new standalone applications were developed. Applications in one organization did not share data and processing with other organizations. The outcome was duplicated data represented in multiple formats across multiple applications in multiple locations. As a result, an authoritative source for data elements was not easily discerned and reports, more often than not, reflected inconsistent data and resulting information. These systems have become monolithic 'stove pipes' that lack the flexibility to satisfy an enterprise's requirements for integrated, consistent, and near real-time information. Furthermore, these monolithic systems have become so complex they require extensive resources to maintain and to incorporate new requirements. In the late 1990's, industry was focused on Best Practices, ISO 9000 certification, and the need to respond quickly to the year 2000 dilemma. As a result, many companies found it prudent to replace these old monolithic systems.

Today, information systems are being built based on fully integrated data and process models that are focused on the enterprise. These systems are no longer monolithic 'stove pipes.' Rather, they are highly flexible distributed tools that ensure data integrity and reliability. Furthermore, current information systems have the ability to adapt quickly to changes in business rules and processes without having to make complex changes to coding structures. Once an integrated system is in place, the accessibility of reliable information can be instantaneous. Recognizing a crucial need for an integrated information system within a corporate enterprise makes the selection and implementation of an Enterprise Resource Planning (ERP) system essential to operational effectiveness. ERP is now considered the price of entry into running a business (Kumar and Van Hillegersberg, 2000).

ERP systems are information systems that "integrate information and information-based processes within and across functional areas in an organization" (Kumar and Van Hillegersberg, 2000, p.23). The goal behind an ERP system is to integrate data and business processes from all departments and functions into a single computer system. An ERP system consolidates these processes into one software application utilizing one centralized database. ERP permeates throughout an enterprise impacting employees in all areas of the firm from manufacturing to finance to purchasing to human resources.

Future of ERP

From the beginning, ERP implementations have been plagued by failure. Many of these failures have been featured in trade journals. Most organizations experience challenges in their ERP implementations but too much money has been spent and too much time invested for organizations to abandon their ERP strategy. Even companies who failed in their initial attempts to bring such systems into production, such as Dow Chemical who halted their first ERP project after seven years and $500 million, are trying again. A recently completed survey of US manufacturing firms cited that 75% of the respondents were pursuing an ERP approach and 44% had already implemented this type of software (Mabert et al. 2000). The authors suggest that ERP is pervasive in manufacturing and it is likely to increase in importance. They conclude that extremes are reported in the popular press while common outcomes are ignored.

Reports about the demise of ERP are premature. ERP software solutions extend beyond their traditional manufacturing and logistics base to other industries such as banking, finance, insurance and retail operations (Kumar and Van Hillegersberg, 2000). These systems are incorporating applications that support marketing, sales, and customer relationship management and the next generation of ERP systems will incorporate Internet technologies. The focus is moving beyond internal business processes to external connectivity between ERP systems of suppliers and customers (Mullin, 2001). The untapped market of midsize companies is being embraced and ERP adoption is expanding geographically into such countries as the United Kingdom, India, Japan, China and Brazil (Kumar and Van Hillegersberg, 2000). ERP vendors are changing their business model as they move towards a component strategy that separates ERP systems into modules that can be adopted individually. As ERP systems continue to infiltrate the enterprise, models for successful implementation become paramount.

ERP Implementation Factors of Success

Implementing an ERP system is a major undertaking. An often-referenced META Group study cited that the average ERP implementation takes 23 months at a cost of $15 million (META Group, 1999). Considerable media attention has been given to high profile ERP failures and factors attributed to these failures have been cited in the literature. Correspondingly, best practices for successful implementation have also been identified. This paper identifies frequently cited factors of success described within the context of supporting evidence and compares the identified factors with actual practice using two case studies.

Factor 1: Executive Support Is Pervasive and Accountability Measures for Success Are Applied

Executive support is a key success factor for any initiative an organization undertakes. Executive support is paramount for ERP systems because they imply fundamental organizational change (Prasad et al. 1999). Implementing an ERP system is not just installing another software package; ERP transforms the way an organization does business. In fact, change management is often used in conjunction with ERP implementations.

Successful implementations have shown that effective change management driven from the top is a key factor. Management must be involved from the beginning and remain involved by monitoring progress and providing direction. Responsibility for implementation cannot simply be handed over the to IT department (Prasad et al. 1999). ERP implementations test accountability, responsibility and communication (Koch et al. 1999). Measures of accountability must be formalized and tied directly to management performance plans.

Factor 2: Business Processes/rules Are Well Understood and Functional Requirements Built from These Processes Are Clearly Defined Before Selecting an ERP Product

The most cited reason for abandonment of an ERP project is the discovery that the system does not correlate with the organization's current business practices (Koch et al. 1999). ERPs have been designed around the idealistic view that there is one 'universal' set of best practices. ERPs employ the traditional hierarchical, functional view of organizations (Kumar and Van Hillegersberg, 2000) so a mismatch between company specific business practices and the ERP model may exist.

According to Baker (2000), most problems in ERP implementations are related to defining what the ERP system should do. This is difficult because employees cannot always articulate exactly what they do, why they do it or why they do it in a particular manner. Functional requirements should describe data relationships, process relationships and work flows. Jenson and Johnson (1999) recommend blueprinting the 'current state' of organizational processes. They suggest using business modeling techniques,

documenting business events, identifying tasks and who performs them and diagramming the flow of information. They also suggest conducting a gap analysis comparing current practices with those provided by the ERP system.

Factor 3: Minimal Customization Is Utilized

ERP systems were designed to be generic representations of business procedures. Often implementing an ERP system means that business processes must be changed to accommodate the software or the software must be changed to accommodate business practices (Holland and Light, 1999). Harris (2000) advises that changes to the software be avoided. Organizational defined business requirements often result in complex customizations. Further, many firms make needless changes because the people making the changes do not understand the firm's business practices or the interrelatedness of one business practice to another. Each required modification should be identified prior to implementation and its impact on cost, maintenance and affect on other parts of the system evaluated (Harris, 2000). Designing the system to handle exceptions is not what ERP systems are about (Schultz, 2000).

The main considerations related to customization center around the need to have technical expertise in-house to manage the customized code and implications of what happens to the customization when new releases are announced. The choice between organizational practice and following the methods inherent within the ERP system often means hard choices and difficult trade-offs must be made.

Factor 4: ERP Is Treated as a Program Not a Project

The Project Management Body of Knowledge (2000) defines projects and programs. "Projects are temporary endeavors undertaken to create a unique product or service" (p. 204). Projects have a beginning and end. Programs are more comprehensive usually including a group of related projects. Programs are ongoing. While the various phases of an ERP implementation should be treated as discrete yet integrated projects, ERP as a whole must be viewed as a program. However, most companies treat their ERP implementations as they would any other software project (Koch et al. 1999). Once the installation is complete, they view the project as over. Organizations must not be too ambitious too soon. One in four companies report a drop in productivity after their systems went live (Koch et al. 1999). This is attributed to the fact that things look differently and comfortable practices have been altered. Firms often mistakenly implement ERP applications believing that standardized software will standardized business processes (Harris. 2000). The software might complement standardized practices but change takes time. ERP should be considered an ongoing activity (Krumwiede, 2000).

Factor 5: Organization Wide Education and Adequate Training Are Provided

Training is always cited as a necessity but is often reduced when budget overruns are encountered. According to the trade press, without proper training, 30-40% of front-line workers will not be able to handle the new system. These people, however, are now making decisions that impact other departments (Prasad et al. 1999). ERP training is complex as it extends beyond learning a new software interface to learning a new set of processes. Technical training is not enough; education of the broad user community including senior management is necessary (Wheatley, 2000). This education must begin pre-ERP selection and include "figuring out the underlying flow of information through the business itself" (p. 86).

ERP demands rigorous and continuous training (Prasad et al. 1999). The necessary transfer of knowledge cannot be achieved in a short manner of time. According to Wheatly (2000) what is needed is, "broad-based holistic education in the company's ERP-mediated business processes" (p. 86). The focus of education is 'what' and 'why' while the focus of training is 'how.' Both are important to successful ERP implementations.

Factor 6: Realistic Expectations in Regards to ROI and Reduced IT/IS Costs Exist

Chief Information Officers reported frustrations with ERP include justifying a Return on Investment (ROI) before initial purchase and finding the ROI after implementation (Vickers, 2000). One misleading legacy of traditional software projects is that results are seen immediately after implementation (Koch et al. 1999). This is not the case with ERP. In fact, initially, lost productivity and increased IT support costs may result as employees learn to adapt old habits to new ways of performing their work (Schultz, 2000). ROIs are only seen after the system has been running long enough for the organization to concentrate on making improvements in the business processes affected by the system.

Many of the benefits offered by ERP systems, such as support functions like finance and human resources, are not direct contributors to the bottom line. Other efficiencies such as user-satisfaction, improved functionality, improved workflow, better access to accurate data and better analytical and reporting tools are not easy to measure in quantified dollars. It may take 2-3 years before an ERP system impacts the bottom line (Vickers, 2000). Organizations that focus on intangible benefits or recognize that the integration provided by ERP systems is now a necessary cost of business, do not ascribe to unrealistic expectations. ROI should be used as means to an end, not as the end itself.

Factor 7: Realistic Deadlines for Implementation Are Set

Estimates of the time it takes to install an ERP solution range from 14 months to 4 years with most implementations extending well beyond initial deadlines. Factors that affect implementation time include the number of modules being implemented, scope of the implementation, the extent of customization and the number of interfaces with other applications (Prasad et al. 1999).

Organizations must be prepared to make hard decisions in relation to deadlines. "It is an almost universal fault of human nature to promise too much, too soon, with too few resources" (Rooney and Bangert, 2000, p. 64). Unrealistic deadlines result in compression of necessary components such as testing and training. Go-live should be postponed if tests are not successful or training has not been completed.

Case Studies

Two case studies were conducted to compare identified factors of success with practice. In order to maintain the confidentiality of the clients, identities are not presented. Case A is a subsidiary of a Fortune 500 company that began their ERP strategy in 1996 but discontinued it in 2000. Case B is a government organization that began their implementation in 1997 and it is still ongoing.

Both organizations used a phased approach to implementation. The strategy used by Case A defined their phases based on individual ERP modules (human resources, finance and procurement). Modules were brought into production separately in a successive fashion. The initial focus for Case B was limited to human resource and payroll functions. Their approach was to phase-in the ERP system by individually replacing 13 legacy systems.

Subsidiary of a Fortune 500 Company – 1996 – 2000

Executive involvement was evidence early on and executive support continued throughout the project. Case A began their ERP implementation strategy following best practices. Prior to initiating the ERP selection process, they achieved ISO 9000 certification. This required them to document and streamline their business processes. The requirements document, however, was based on the process flows supported by legacy systems and did not address organizational data requirements or workflows.

In order to meet specified functional requirements, many modifications to the generic ERP software were required. When a new version of the software was released, an upgrade path was abandoned. Management and the user-community cited that the processes and customizations previously mandated were not necessary. Also, the IS implementation team presented a strong case that upgrading would be more costly and time consuming than re-implementing a new 'vanilla' version. When the subsidiary was acquired, the new executive management discontinued the project based on the assessment that re-implementation would take three years.

Case A followed a basic project management process to understanding change, implementing new systems and selecting appropriate solutions. After the selection of a vendor, ERP was designated an IS department implementation project and while executive support for the project remained positive, executive involvement diminished.

Case A provided extensive education that spanned the organization. Seminars were brought onsite to educate executives and senior management on the principles of ERP. In addition, each department received generic overviews and tailored workshops related to their specific operational functions. The members of the ERP project team participated in all of the educational offerings. The objectives were to develop an understanding of ERP, how it would change jobs and the benefits it would provide. According to project management, not only did the education program provide an excellent means to communicate with and educate staff, it facilitated change management and fostered 'buy-in.' One aspect that was not included in the education program was training on specific customizations made to the software.

The initial justification for ERP was reduced IS/IT costs. This did not materialize. Savings were offset by implementation costs that included the need for additional staff to support modules put into production. A gain in efficiency in purchase order processing and data integration throughout the supply chain was reported. The project was discontinued before any monetary ROI was realized.

After initial education sessions and product selection, the implementation was turned over to the IS department with a deadline to be fully operational within a year. This included making all specified customizations. In order to meet deadlines, numerous short cuts were taken. Configuration management controls were by-passed, testing time and methods were reduced and regression testing became superficial. Each module put into production required additional technical intervention to support users and resolve problems. The project fell more than a year behind schedule.

The project was successfully launched and modules were put into production but the ERP system never achieved its expected potential. ERP was not perceived to be an ongoing activity but as another IS project. When the subsidiary was acquired and the assessment given that re-implementation was necessary in order to upgrade to the next version of the software, a decision by the new executive team was made to discontinue the project.

Government Organization – 1997 – 2001

The initial focus of this organization's ERP strategy was on human resources and payroll. The objective was to replace the 13 existing legacy systems that performed these functions. Executive participation beyond two project managers was not evidenced.

Those charged with responsibility for ERP had a limited understanding of the organization's business practices. The policies and procedures that existed did not fully describe or adequately define business processes. ERP team members with functional backgrounds were focused on a specific functionality as provided within one of the 13 legacy systems. Their experience and business knowledge was limited to their interaction with one of these systems.

Requirements for an ERP system were written at a high level and did not address business processes, data relationships or workflows. For example, the functional requirements document specified that the ERP implementation must be transparent to the users, could not impact personnel activities, must only replace field entry systems, must support existing business processes and interfaces to the 13 legacy systems must not impact existing systems or require changes to those systems. The functional requirements also included a specification that the system must distribute data across approximately 300 locations.

Prior to procuring the ERP package, a fit analysis was conducted indicating no better than a 30% fit with the software from a leading ERP vendor. In spite of this finding, the ERP software was procured from this vendor. To address the gap between what the software provided and the requirements identified by the organization, significant customizations were required. Additional customization was undertaken to insure that processes that currently existed within the legacy systems were maintained. No investigation was conducted to determine if those processes could be improved, modified or even adapted to the new product. Customizations were also required for interfaces to the new system and to give the new product the same look and feel as the legacy systems. The first phase was deployed with 95% customized software.

ERP was not viewed as a long-term process or as a long-standing program. It was identified as an IS department project with an expected duration of 18 months. Two project teams were setup to implement the selected product – a functional project team responsible for functional requirements and a technical project team responsible for customizations. This separation of responsibilities complicated project coordination. The project managers did not view their involvement as long-term and saw their role as limited to their area of responsibility. Functional baselines, allocated baselines and product baselines were not defined and release planning was non-existent.

No education was provided to the users or project team members prior to the selection of the ERP product solution. Product training was provided to key personnel. These key personnel received training from the vendor and also worked directly with the implementation contractor to produce customized training for the organization. Training was provided 3 months prior to the initial expected go-live date for the first phase of the project. This occurred 21 months later. During this time span, software was not available for practicing skills taught during training nor was additional training provided.

The business case presented to justify an ERP system was heavily weighted with estimates of cost savings in the area of IS support. Excluding implementation costs, savings that might result from the replacement of two legacy systems were offset by the support costs incurred for the new system. These costs are estimated to be four times greater than that expended for the systems being replaced.

The project was initially expected to take eighteen months. The first implementation phase took 3 and ½ years and provided less than 50% of the functionality specified in the requirements document. Eighteen months later, the development of the remaining functionality was still ongoing.

A cross case comparison summarizing the case study findings in relation to each identified factor of success is presented in Table 1.

Table 1. Cross Case Comparison

Factor	Case A	Case B
Executive support is pervasive and accountability measures for success are applied.	Executive support was provided; involvement was strong up to the selection of a vendor.	Two project managers were assigned sole responsibility.
Business processes/rules are well understood and functional requirements built from these processes are clearly defined before selecting an ERP product.	Business processes were evaluated pre-ERP. Functional requirements reflected legacy system processes.	Business processes were not evaluated. High level functional requirements provided. Functional specifications reflected legacy system processes.
Minimal customization is utilized.	Extensive customizations made.	95% of the software was customized.
ERP is treated as a program not a project.	ERP designated an IS Department project.	ERP identified as an IS Department project.
Organization wide education and adequate training are provided.	Education and training were provided; training on customized processes not included.	Training was provided but occurred almost 21 months before go-live.
Realistic expectations in regards to ROI and reduced IT/IS costs exist.	Estimated cost savings not realized.	Estimated cost savings not realized. Support costs increase significantly.
Realistic deadlines for implementation are set.	Initial deadline exceeded by more than one year.	Initial deadline exceeded by more than 18 months with only 50% functionality.

Conclusions

The case studies revealed similarities and differences between the two organizations. Case A had executive support for pursing ERP. They began their venture by identifying, streamlining and even documenting their business practices. They even provided extensive education that spanned the organization. Requirements for the ERP system however, were drawn directly from the way the monolithic systems currently in place worked and ERP became an IS project. The system put into production was extensively customized which attributed to higher support costs and missed deadlines. Although the organization remained committed to ERP, they were unable to justify to new management the benefits of starting over.

Even from the beginning, Case B viewed their ERP initiative as a project with the primary goal to replace legacy systems. They did not conduct any reviews of business processes nor engage in any education related to ERP. The objective was simply to replicate existing processes on a new technology platform. The software put into production was 95% customized. They failed to realize what ERP is designed to bring about: organizational change, streamlining of business processes and standardization to facilitate the integration of data and commonality of processes.

In order for an organization to compete in today's rapidly expanding and integrated marketplace, new generation information systems such as ERP must be employed to ensure access to an efficient, effective, and highly reliable information infrastructure. Moreover, these technologies must be deployed in an integrated manner utilizing information engineering methodologies to ensure accurate information processing, data integrity and consistency, reliability, and usability for the enterprise. Understanding ERP begins with education; comprehensive education that that begins pre-ERP, starts with the 'why' behind business processes and addresses change management. ERP must be recognized as an evolutionary process and it through an education plan that the dynamism of the changing environment promoted by ERP can be addressed. The details of business processes, their relationship to data elements, and how these relationships interrelate within the enterprise must be understood and mapped to a

fully integrated ERP system. System requirements should focus on data relationships, dependencies, business rules, process flows and workflows. Major disconnects with the product and existing business processes should be documented and evaluated so work arounds are provided with a minimum of customization. Rather than focusing on reduced operations costs and ROI, the focus should be improving the way the organization conducts business by exploiting the capabilities of ERP technology. Only then will financial benefits be realized. ERP should not be viewed simply as another IS department project. ERP implementation is complex, impacts many facets of the organization and is as dynamic as any enterprise program initiative that fosters change.

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