The Identification and Control of Failure Preferences in ERP Implementation Using FMEA

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ABSTRACT

An enterprise resource planning system (ERP) is the information backbone of a company that integrates and automates all business operations. It is a critical issue to implement the suitable ERP system which meets all the business strategies and the goals of the company. ERP systems have received more attention in the recent years. However, ERP projects have often been found complex to implement in business enterprise. There are several factors which influence the successful implementation of ERP. The main reasons of failures in ERP process have been proposed in the literatures but there is not any comprehensive framework which prevent the problems occur and to provide system's requirements before ERP implementation. The organizations can reduce the effect of failure through the identifying the strength and weaknesses of ERP system. One of the main significant methods which identify the failure causes is failure mode and effect analysis (FMEA). In this paper the FMEA is used as a preventive technique to decrease the failure rate in ERP implementation. The proposed FMEA also identifies the major failure causes and effect of potential defects in ERP implementation. The methodology of this research is useful for those organizations which try to implement ERP successfully.

Keywords: Failure Mode and Effect Analysis, FMEA, Enterprise Resource Planning, ERP Implementation, RPN

1. INTRODUCTION

Enterprise resource planning (ERP) began in the 1960s as a Material Requirements Planning (MRP), and an outgrowth of early efforts in bill of material processing. The ERP system is a generic term for a broad set of activities supported by multi-module application software that helps organizations to manage their own resources [1]. The ERP system has been proved to be able to provide significant improvements in efficiency, productivity and service quality, and to lead to a reduction in service costs as well as to more effective decision-making. [2]

ERP systems assure to provide an integrated, packaged software solution to the information requirements of organizations for substitution of legacy information systems (IS). These systems are usually aging solutions created by IS departments or older accessible packages that have become difficult to maintain and meet the organizations' business needs. Despite the guarantee of ERP systems, these software solutions have proven "expensive and difficult to implement, often imposing their own logic on a company's strategy and exiting culture".[7] Numerous examples of failed implementation projects are cited in literatures, such as Fox–Meyer Drug, Mobile Europe, Dell and Applied Materials.

Muscatello and Parente [8] mentioned ERP failure rates to be as high as 50%. Although these findings differ in percentage, it is clear that information technology projects, including ERP, are very risky. Although many large organizations have completed their initial ERP implementations, demand for enterprise systems from small and mid-sized organizations is increasing. With limited resources, experience and staffing skills [9], these organizations may face problems in implementing ERP. As ERP vendors add functionality to their software, large organizations that did not participate in the first phase of implementations are now purchasing the systems. Global businesses seek to improve or maintain their competitiveness in the increasingly challenging

global market place. IS are often used as an instrument to improve customer service, shorten cycle times and reduce cost. Hitt et al. [10] demonstrate that firms which invest in ERP have "higher performance across a wide variety of financial metrics." ERP provides a powerful business system infrastructure for organizations "a depth of information by function and also a breadth of information horizontally across the value chain". [11]

Through the increasing global competition, the success of projects becomes more critical to an organization's business performance. However, many projects still present delays, changes in their scope and failures. These problems might occur due to inefficient management of project risk. However, techniques and tools for risk management that have been developed and used to increase the chances of project success are not yet extensive or generally applied. [12]

There have been many studies that have investigated the factors that lead to ERP implementation success. But most of these studies simply list factors and do not follow the systematic efforts in critically evaluating factors. [3] Nah et al. [13] reported the results of a survey of Chief Information Officers from Fortune 1000 companies on their perceptions of the critical success factors in ERP implementation. 11 critical success factors and some sub factors were identified. The identified factors are top management support, project champion, ERP teamwork and composition, project management, and change management program and culture. The importance of each of these factors has been discussed. Aloini et al. [14] collected and analyzed a number of the key risk factors and their impact on ERP project success. They classified each risk factor and its relevance during the stages of the ERP project life cycle. Huang et al. [15] reported unusually high failure in ERP projects. They used a Delphi method to identify potential ERP projects risk factors, and constructed an AHP-based framework to analyze and also prioritize the ERP projects risk factors.

Risk analysis is a suitable approach for identifying and evaluating the critical failure factors (CFF). Risk identification produces lists of project-specific and risk item that are likely compromise a project's failure. Risk analysis assesses the loss in probability and magnitude for each identified risk item. Risk prioritization produces a ranked ordering of risk items that are identified and analysed. One of the methods which can identify and prioritize the CFF is failure mode and effect analysis (FMEA).

FMEA is a design technique to systematically identify and investigate potential system (product or process) weaknesses. It consists of a methodology for examining all the ways in which a system failure can occur, potential effect(s) of failures on system performance and safety, and the seriousness of these effects. [16]

As the last considered point in failure investigation, the FMEA is devoted to determine design reliability by considering potential causes of failure and their effects on the system under study. [11] The goal of FMEA is to prevent unacceptable failures from reaching the customer and to assist management in a more efficient allocation of resources. FMEA is used within a company' risk management program to prevent customers from being subject to unacceptable faults and to avoid customer dissatisfaction. [17]

There are many reasons for companies to invest in the development of the FMEA report. A good use of the FMEA report can provide companies with several advantages such as higher product reliability, less design modification, better quality planning, continuous improvement in product and process design, and lower manufacturing cost, in addition to meet customer requirements.

FMEA is usually carried out by a team of people with direct knowledge of the procedures or processes concerned. The elements of FMEA are: the identification and listing of modes of failure and the consequent faults; assessing the chances that these faults occur; assessing the chances that the faults are then detected; assessing the severity of the consequences of the faults; calculating a measure of the risk; the ranking of the faults on the basis of the risk; taking action on the high-risk problems; checking the effectiveness of the action, and using a revised measure of risk. The goal of FMEA is to prevent unacceptable failures to assist management in a more efficient allocation of resources. [18]

Over the last decades many organisations have made significant investments in Enterprise-wide Systems, particularly Enterprise Resource Planning (ERP). Whilst in most cases implementation is pretty successful, but the considerable numbers of them have failed to achieve the expected objectives. Research studies have identified factors effect on the success of ERP implementations

In this paper a FMEA approach is proposed to identify the major failure causes and effect of potential defects in ERP implementation. Thus the failure preferences are characterized through the

severity, occurrence values and using the related area chart. The severity, occurrence values and results can be different in the organizations.

2. RISK FACTORS IN ERP IMPLEMENTATION

A lot of CFF have stated in the literatures but there is not any framework or outline to prevent the problems occurred in the organization and also to provide system's requirements before ERP implementation. The organizations can reduce or obviate the effect of failure by the identifying their strength and weaknesses. The FMEA as one of the most significant methods for defect prevention can analyse the defects of failure and their risk through the implementation.

The CFFs are categorized by literature. In this paper the authors attempt to gather the most important factors in order to prioritize the CFFs through the FMEA approach. Table 1 presents these critical factors in two levels. The first level is referred to the requirements which should be prepared in ERP implementation projects, while the second level is related to the reasons which may cause to failure mode in details.

Table 1- Critical failure factors in ERP implementation

Factors Affect the Implementation of ERP	Organization Fit	• Insufficient resources • Extent of change • Failure to redesign business process • Fail to support cross-organization design
	ERP Teamwork & Skill Mix	• Fail to recruit & retain ERP professional • Lack of appropriate experience of the user representatives • The ability & experience of inner expertise • Inappropriate Staffing • Lack of analyst with business and technology knowledge • Failure to mix internal and external expertise effectively
	Project Management & Control	• Lack of agreement on project goals and scope • Lack of senior management commitment to project • The composition of project team members • Lack of effective project management methodology
	Software System Design	• Unclear/Misunderstand changing requirements • Lack of effective software management methodology • Unable to comply with the standard which ERP software supports • Lack of integration between enterprise-wide systems • Developing the wrong functions and wrong user interface
	User Involvement and Training	• Conflicts between user departments • Fail to get user support • Low key user involvement • Inadequate training & instruction
	Technology Planning	• Capability of current enterprise technical infrastructure • Technology newness • Stability of current technology • Attempting to link legacy systems
	Communication	• Inefficient communication • Expectations communicated at all levels
	Information Technology & Legacy System	• Inadequate IT system issue • Inadequate IT system maintainability • Inadequate IT supplier stability and performances • Inappropriate legacy system and business setting
	Change Management	• Inadequate change management
	BPR	• Inadequate BPR
	Top Management Support	• Bad management contact • Low top management involvement • Poor leadership • Ineffective strategic thinking & planning
	Financial Support	• Inadequate financial management

3. FMEA MODEL FOR ERP IMPLEMENTATION

The classical FMEA model is modified in order to prioritize the CFF in ERP implementation. The five steps are as follows:

Step1- Potential Failure Modes Specification

Failure mode is the inability of a component, subsystem, system or process. In other hand, it may potentially fail to perform its functions. The potential failure modes in ERP implementation can be factors which obstruct the EPR implementation project to finish on time or continued as explained in project scheduled. The potential failure mode is depicted in the part one of table 2.

Step2- Potential Failure Effects Specification

A potential effect of the failure is the consequence of a system failure mode. The question usually asked is: "what happened or what is (are) the ramification(s) of this problem or failure?" Often the failure effect is evaluated by severity from zero to ten. [19] In this step the effects of the failure mode are specified. Column two and three in table 2 explain the potential failure effects in ERP implementation. The numbers one to ten should be selected by FMEA team in order to determine the severity of failure effects. The one number is referred to the low severity while the 10 number is related to the high severity of failure effect.

Step3- Potential Failure Causes Specification

The causes of a system failure mode are the system design deficiencies that result in the failure mode. This step is the most significant step in ERP implementation analysing because if these causes can release correctly organisation meet lower same defects through the implementation and the essential prevention can be planned. Occurrence is the rating value corresponding to the estimate number of frequencies and/or cumulative number of failures that could occur for a given cause. Numbers one to ten are allocated for significance value of the causes as cause's occurrence. Column four and five as presented in table 2 is completed for this step.

Step4- Control of Failure Modes

This step includes the method that can be used for identifying and preventing the failure occurs in ERP implementation process. The one number is referred to the high probability of identification while the 10 number is related to the low probability of identifying the failure in ERP implementation. Column six and seven in table 2 explain the control and detection of failure in ERP implementation.

Step5- Failure Mode Risk Prioritizing

No FMEA should be done without a risk prioritizing of failures. The FMEA team must prioritize the failure modes by ranking them. In this paper the RPN number is used for prioritizing the failure mode. This number is calculated through the multiplying severity, detection and occurrence numbers. The higher RPN number has higher prioritization in ERP implementation process. Column eight as presented in table 2 is completed for this step.

The proposed method suggests how to identify the main factors before implementing ERP. The questionare and statistical techniques can be used to determine the severity, occurrence and detection values. Risk priority number (RPN) is also calculated for identifying the important factor which cause to failure in ERP implementation process.
As it is stated in the table 2, the lack of organization fit in ERP system with the 8 severity value is on of the potential failure effect of unsuccessful ERP system. This potential failure effect can cause to some problems such as Time exceed, Customer and Employee Dissatisfaction and Cost increasing. The occurrence number of these potential failure causes are 7, 4 and 5 respectively. Organizations should use some ways to control these potential causes. The proper ERP selection and organizing are the two methods which companies can overcome the potential causes. The detection number of these two ways are shown in table 2. The RPN number in column 8 is calculated through the multiplyning the severity, occurrence and detection number.

4. DISCUSSION AND CONCLUSIONS

During the past decade, the huge investment in ERP system packages and the significant different adoption results prompt many researchers to search for critical success factors. The implementation of ERP must be viewed as a transformation in the way the company does business. The implementation of ERP contains various changes, which may cause conflicts of different departments. Without the intervention of senior management, no one will compromise the rearrangement of ERP. some of the biggest ERP system implementation failures occur because the new software's capabilities and needs are mismatched with the organization's business process and procedures. The mismatch between ERP

Table 2 – An example sample for the application of FMEA in ERP implementation

(1) Potential Failure Mode	(2) Potential Failure Effect	(3) Severity	(4) Potential Failure Causes	(5) Occurrence	(6) Control	(7) Detection	(8) RPN
Unsuccessful Implementation of ERP	Inadequate Organization Fit	8	Time exceed	7	Proper ERP selection	2	112
					Organizing	4	224
			Customer and Employee Dissatisfaction	4	Proper ERP selection	2	64
					Organizing	4	128
			Cost increasing	5	Proper ERP selection	2	80
					Organizing	4	160
	...						
	Lack of Project Management & Control	3	Time exceed	7	Scheduling	3	63
					Planning	4	84
					Budgeting	2	42
			Customer and Employee Dissatisfaction	4	Scheduling	3	36
					Planning	4	48
					Budgeting	2	24
			Cost increasing	5	Scheduling	3	45
					Planning	4	60
					Budgeting	2	30

systems, existing structure, and business process of organization will generate widespread chaos.

In recent years, there has been an abundance of research on ERP. Many studies in the ERP literature have examined the issue of the adoption of ERP at a higher level. Some authors believe in-depth studies into the experience of the success (failure) of ERP for both advanced and developing regions/countries will be of great benefit to organizations. For instance, the literature has alluded to the proper management of consultants, and training as critical to the success of ERP projects. There have been many recent reports in the industrial literature about the managing of consultants and training as causes of ERP failures. Conversely, training is regarded as one of the critical resources of an organization that must be managed on an on-going basis. An in-depth study of existing cases would uncover the details of the 'what' and 'how' of ERP implementation. This detailed knowledge and practical experience is what is still lacking in the literature, and would benefit business managers and MIS practitioners the most, especially those based in the developing world. [2]

This research presented a new methodology for identifying the main reason of failure in ERP implementation. Based on the review of relevant literatures and the result of this study, this research demonstrated the most critical elements affecting the implementation of ERP successfully. This methodology provides the suitable structure for determining the main causes of ERP projects failures. Therefore the FMEA methodology for preventing failure in ERP implementation projects can be used to prioritize and identify the significant factors of ERP failure. The proposed methodology is unique because it considers the intangible aspects of organizations which influence the ERP implementation successfully. This approach consider all the management parts of a firm because these factors are available in all the organizations however the importance of which may differ. This study recommend that organizations consider the intangible aspects of organization as an integrated management approach and also recognise the most important factors which may cause to failure in ERP implementation through FMEA technique. Thus, a

good implementation of ERP requires to consider the management aspects of organisation. Based on the extensive survey and ERP literature, this study introduced 12 factors and 40 sub-factors which influence the implementation of ERP projects. The sub factors explain the details of each factors and help the organization determine how an organization can improve the critical factors in order to implement ERP successfully. The proposed method help organization to identify the main factors in ERP implementing.

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