

RISK MANAGEMENT IN ENTERPRISE RESOURCE PLANNING IMPLEMENTATION USING A FUZZY APPROACH

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Abstract: Without powerful risk management, it is very difficult to imagine a successful implementation of enterprise resource planning (ERP) system. In order to analyze risk management we need an overall view to project's Critical Success Factors (CSFs). Having an accurate assessment of CSFs is a key point to challenges ahead in ERP projects. Some weighted list of CSFs has been created up to now. In this article, a new classification over CSFs by Balance Scorecard (BSC) will be presented. Our fuzzy approach causes some changes over CSF importance.

1 INTRODUCTION

ERP systems are software applications that use single information architecture to integrate a range of business functions in order to acquire an overview of the business (Gable et al., 1998). They automate core enterprise activities such as manufacturing and the management of finances, human resources, and the supply chain. This has eliminated complex, expensive links between systems and business functions that had been previously performed across legacy systems (Bingi et al., 1999; Kumark and Hillegersberger, 2000; Mabert et al., 2000; Hong and Kim, 2002; Tarn et al., 2002; Aloini et al., 2007; Jones et al., 2006; Markus et al., 2000).

The implementation and utilization of ERP systems represent a radical change from the legacy systems of the past. Implementation is defined as the

process that begins with the initial analysis of organizational processes and data (often referred to as the "as is" stage), includes the planning of organizational process and data changes the ERP is used to bring about ("to be"), extends through training users and installing the completed package for use (Ross, 1999), and continues through a period of adjustment or stabilization that can take several months or years (Rockart 1979; Holland et al., 1999). So that ERP implementation is one of the most important challenges in information system deployment in an organization. It is a little bit hard to imagine a successful ERP implementation without considering and planning on CSF.

The Critical Success Factors are defined as "the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization (Somers and Nelson, 2001). In the ERP context, (Kaplan and

Norton, 1996) define them as "the factors needed to ensure a successful ERP project".

The Balance Scorecard (BSC) evaluates the management process from four different perspectives: financial, customer, internal processes and learning and growth. For a better description learning and growth has been replaced by human resource (HR). In this paper a new arrangement of CSFs on BSC with a small change in its concept will be presented. To have an analytical view on ERP implementation, Somers & Nelson 2001 (Capaldo et al., 2008) CSF List will be re-ranked by a fuzzy approach.

2 LITERATURE REVIEW

The BSC evaluates the management process from four different perspectives: financial, customer, internal processes and learning and growth (Centeno, 2002). Kaplan and Norton comment that a properly constructed balanced scorecard should tell the story of a company's strategy. But in our model we are going to use this tool to give a better view to project stockholders like project managers, top management, Vendor Company and etc (Centeno, 2002). We described these aspects as follow:

A. Financial:

Although in original BSC the Financial Perspective covers the financial objectives of an organization and allows managers to track financial success and shareholder value, but in our new definition we look at the financial situation of organization to carry out such an expensive project (TCO of software, expensive consultant, valuable personnel salary such as project champions and key users ...) on start and during implementation of ERP.

B. Customer:

In BSC classic definition the Customer Perspective covers the customer objectives such as customer satisfaction, market share as well as product and service attributes. For us, the ERP vendor is the most important customer you may insert external implementation team to the customers list, So that any CSF related to solution vendor may returned to this aspect.

C. Internal Process:

In classic definition the Internal Process Perspective covers internal operational goals and outlines the key processes necessary to deliver the customer objectives. And in our view it is refer to those

activity which affect the business process in organization like project management, Interdepartmental communication and so on. It seems to be the most important aspect.

D. Learning and Growth:

With a small change in the learning and growth Perspective that covers the intangible drivers of future success such as human capital, organizational capital and information capital including skills, training, organizational culture, leadership, systems and databases. We emphasize on Human resource (HR) issues that more affect the project related CSF and the other sides of it will be mentioned during the work.

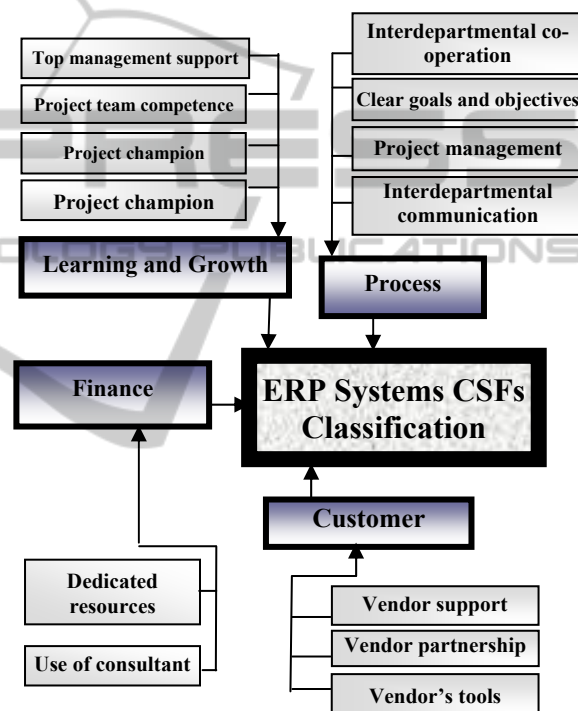


Figure 1: The structure of ERP model.

3 OBTAINING THE CSFS PRIORITY BY AHP METHOD

In this paper Somers & Nelson 2001 CSF ranked list categorize upon BSC aspects as Table 1.

The AHP enables decision-makers to structures a complex problem to a simple hierarchy form in order to evaluate large number of quantitative and qualitative factors in a systematic way under conflicting multiple criteria. It first structures the problem in the form of a hierarchy to capture the basic elements of a problem and then derives ratio

Table 1: Somer & Nelson CSF list categorized by BSC.

ROW	CSF Name	Rank	Category
1	Top management support	4.29	Learning and Growth
2	Project team competence	4.2	Learning and Growth
3	Interdepartmental co-operation	4.19	Process
4	Clear goals and objectives	4.15	Process
5	Project management	4.13	Process
6	Interdepartmental communication	4.09	Process
7	Management of expectations	4.06	Process
8	Project champion	4.03	Learning and Growth
9	Vendor support	4.03	Customer
10	Careful package selection	3.89	Process
11	Data analysis and conversion	3.83	Process
12	Dedicated resources	3.81	Finance

scales to integrate the perceptions and purposes into a synthesis (Dasarathy, B. V., 1976).

Most of the CSFs would hold for IT implementation projects in general, but some are more important for ERP projects in particular. AHP ranked factors have been selected to the rest of study. Table 2 displays the priority of the CSF.

Table 2: Classification CSFs in BSC aspects (process, customer, finance, learning and growth) by AHP method.

Row	customer	process	learning and growth	finical
1	Vendor support	Interdepartmental co-operation	Top management support	Dedicated resources
2	Vendor partnership	Clear goals and objectives	Project team competence	
3	Vendor's tools	Project management	Project champion	
4		Interdepartmental communication	Project champion	

4 RULES INDICATING ERP IMPLEMENTATION SUCESS LEVELS

Clustering is one of the refining techniques to find the rules in fuzzy models. In this paper, k-means clustering has been chosen.

$$J = \sum_{j=1}^k \sum_{i=1}^n \|x_j^{(i)} - c_j\|^2 \tag{1}$$

A major function in clustering k-means is equation 1.

All clustering activities were done by SPSS software and the fuzzy rules have been refined from clusters.

Where $\| \cdot \|$ is the criteria of distance between points and C_j is the center of j^{th} cluster.

The rules describing the ERP implementation success level are based on the degree of learning and growth, process, customer and finical that these degrees have been formulated like linguistic variable .similarly, the degree for ERP level has been graded from very low to very high in 5 distinctive fuzzy, collections .these rules have been reached from the users ' answers after ordering, analyzing, and clustering.

One of the collection rules for ERP implementation success level can be like following:

If (HR = high and Process = high and customer = high and finical=high) then (ERP =high).

5 ERP IN THE DEVELOPED FUZZY SYSTEM

After discovering the rules related to ERP level, relevant inputs and outputs for earning ERP implementation success level in fuzzy tool box to Be organized and were created relevant membership for input and output. Figure 2 shows the fuzzy system that can be used to derive the ERP implementation success level. Figure 3 shows the fuzzy membership functions of ERP Implementation level too.

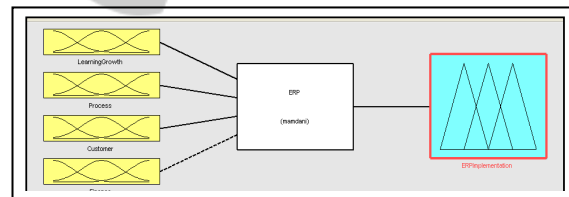


Figure 2: Fuzzy system to obtain ERP implementation success level based on learning and growth , PROCESS , CUSTOMERS and FININCE inputs.

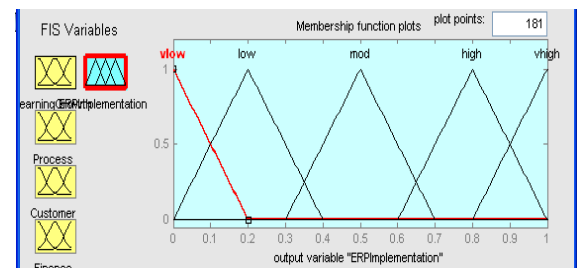


Figure 3: Fuzzy membership functions of ERP Implementation level.

6 ANALYSIS OF ERP IMPLEMENTATION VERSUS LEARNING AND GROWTH

To complete understanding participation need in ERP Implementation success level, it is necessary to test the participation of each factor separately.

Figure 4 shows contribution ERP Implementation success level originating from the learning and growth. Therefore, the contribution from three factors has been kept fixed. Figure 3 shows ERP Implementation success level is monotonically increasing by increasing perceived learning and growth for any given level of three other factors.

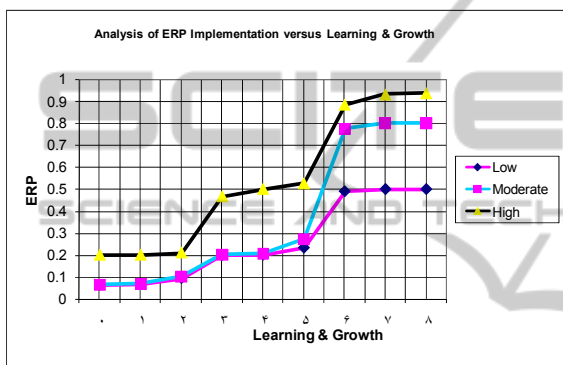


Figure 4: ERP Implementation success level versus learning and growth factor.

7 VISUALIZATION OF ERP IMPLEMENTATION SUCCESS LEVEL AS FUNCTION OF PROCESS AND LEARNING AND GROWTH

We now attempt to visualize the ERP Implementation success level as a continuous function of its input parameters. Figure 5 Attempts to portray variation of ERP Implementation as encapsulated in the rules for ERP Implementation success level. The highest gradient for ERP Implementation is when process is 'moderate' and learning and growth is 'moderate' to 'high'. Look at figure 4, diagonally from (low, low) to (high, high) levels of learning and growth and process.

As observes three plateaus where the last one is around 0.911, and remains at that level even when the input factors are increased further. This result is somehow unexpected and may be due to the fuzzy

nature of the expert system where a 'ERP Implementation success' level of 100% is unrealistic.

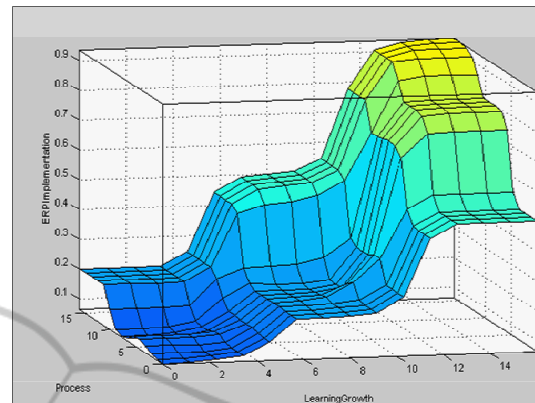


Figure 5: ERP Implementation is positively related to levels of learning and growth and process.

8 CONCLUSIONS

This study shows the learning and growth plays a very important role in ERP implementation success. Although the direct sum of these factors ranks give us a different conclusion. As you can see in figures 3 there is a very low chance of successful ERP implementation for low amount of learning and growth, so it is strongly recommended to empower this aspect of organization before attempting any large IT project like ERP. Process is another important aspect of each project, by a linear sum, you can easily understand that it should be important aspect; this study shows that with a strong backbone of process and learning and growth you can increase the chance of successful ERP implementation up to 90%. However a successful ERP implementation by empowering process aspect lonely could not be guaranteed.

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