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Abstract: In the risk management of Information Technology (IT) projects, you should be very careful about the Critical Success Factors (CSFs). This will be more important when you are going to implement a full blown IT project like Enterprise Resource Planning (ERP) or Customer Relationship Management (CRM) or etc. Having an accurate evaluation of these factors will guide us to make a better decision on implementation such projects. From previous researches we know about the weight of each CSF. In this study we categorize these factors on a Balanced Scorecard (BSC) structure and then use fuzzy logic to translate risk management definition in ERP implementation. Finally a new approach to this structure will be presented.

Key words: Risk Management, Customer Relationship Management (CRM), Enterprise Resource Planning (ERP); Critical Success Factor (CSF); fuzzy logic; Balance Scorecard (BSC).

INTRODUCTION

Companies have begun to organize themselves based on their processes, abandoning functional management or by departments. However, information systems are far from achieving this, due to the fact that software companies that develop management software make products based on a function or department within a company. This situation exists because, historically, the application of information technologies within a company has been carried out in an independent way for each one of the islands of information that makes up the company. So, for example, information systems have been developed for the commercial function, for the production or for the logistic function. The lack of information integration within companies is the main consequence of the functional specialization used in current information systems. This unconnected information usually hinders decision making because in most cases it affects more than one task within the company. On the other hand, the independent growth of each information system has given rise. Moreover the new key points in business management are incompatible with non-integrated information systems. Little by little systems improve toward integrity to overcome this problem and the result was ERP systems.

The functions of an ERP include integrating the internal or external resources of an enterprise, allowing managers to control the efficiency and operational situation of the entire enterprise, and improving the enterprise’s overall competitive capability. These systems are software applications use single information architecture to integrate a range of business functions in order to acquire an overview of the business (Gable, G.G., 1998). The American Product Inventory Control Society (APICS) defines ERP as “a system (with) a financial accounting oriented information system. Its primary functions include effectively integrating and planning resources required for satisfying customers’ orders (such as resources required for procurement, production, and distribution logistics), increasing overall operational performance and reducing cost.” Consequently, an ERP system integrates all information within an enterprise, consolidates cross-department functions and regional business activities, realizes information sharing via the Internet, and supports the applications of other related modules. The operational flows of an enterprise are therefore integrated, and optimal benefits are achieved. Davenport (1998, 2000) believed that an ERP system facilitates linking to enterprise internal information systems and integrates operational information from all departments and 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 (Gable, G.G., 1998; Bingi, P., 1999; Kumark, K., 2000; Mabert, V.,
Such centralized databases and applications are then used for the enterprise’s decision-making support. Several potential tangible and intangible benefits of applying the ERP technology to various businesses include the following:

1. Improving organizational performance
2. Understanding a range of functionalities not catered to in the existing system
3. Increasing returns from the implemented ERP systems
4. Streamlining the organization’s internal processes
5. Lowering costs for developing an ERP that more accurately reflects business needs
6. Improving capability to react to a changing environment
7. Improving customer satisfaction related to services rendered or products manufactured (Davenport, T.H., 1998; Davenport, T.H., 2000; Chang, She-I., 2002; Ranganathan, C., 2006).

Implementation is one of the most important challenges in information system deployment in an organization. However, 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, J., 1999), and continues through a period of adjustment or stabilization that can take several months or years (Rockart, J., 1979; Holland, C.P., 1999). So implementation and utilization of ERP systems represent a radical change from the legacy systems of the past. In spite of the many failures that have been reported about the implementation of these systems (Davenport, T.H., 1998), management in enterprises or organizations do not have a set of clear and convenient guidelines to successfully implement an ERP system. For many of them, this process is still uncertain and risky. A “successful implementation” of an ERP system means that the system is implemented in a correct and complete form at minimum cost, time, and human resources. Human resources can be internal or external personnel. It is implementation process is complex and risky and engages a considerable amount of enterprise resources, which are put at risk during implementation. So it is a little bit hard to imagine a successful ERP implementation without considering and planning on project risks. In this paper we are going to study on Critical Success Factors (CSFs) of an ERP implementation project, by grouping them on a certain platform which is known as Balance Scorecard (BSC).

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

Literature Review:
The implementations of ERPs are renowned for their cost, scale and propensity to fail to deliver expected results. It is unsurprising therefore that the vast bulk of the literature on the ERP phenomenon focuses on the critical success factors thought to be associated with a successful implementation (Esteves, J., 2001). In response to these problems, there has been a developing body of academic literature (Ross, J.W., 1998; Bancroft, N., 1998; Holland, C.P., 1996; Markus, M.L., 1999; Parr, A., 1999) which addresses the difficulties of ERP implementation by proposing CSFs and process models of the implementation.

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, T.M., 2001). In the ERP context, (Kaplan, R.S., 1996) define them as "the factors needed to ensure a successful ERP project".

The Balanced Scorecard method of Kaplan and Norton (1996) is a strategic approach and performance management system that allows the implementation of vision and strategy, working from four perspectives:

- Financial perspective
- Customer perspective
- Internal business processes perspective and
- Learning and growth perspective.

Also BSC can evaluate the management process from four mentioned perspectives. Kaplan and Norton comment that a properly constructed balanced scorecard should tell the story of a company’s strategy. But we believe that this model has a higher potential of description for our purpose. So we are going to use it for a better view to project stockholders like project managers, top management, Vendor Company and etc. In order to cover our purpose CSFs are categorized in this framework by their subject and semantics means. So we redefine 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 return 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. Also, we emphasize on Human Resource (HR) issues that more affect the project related CSF, however, the other sides of it will be mentioned during the work.

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

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

Fig. 1: A Sample of ERP implementation CSFs classification over BSC framework.
Obtaing The CSFS Priority By AHP Method:
In this paper Somers & Nelson 2001 CSF ranked list categorize upon BSC aspects as Table I.

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 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 II displays the priority of the CSF. Table III shows more detail of priority of the CSF that was generated with expert choice software. Financial aspect has only one factor and there is no other factor to compare with. also we know most of Somers & Nelson 2001 list has financial aspect but not pure one -which is a good idea for future studies-, as matter a fact other aspects of these factors are more important and effective than the financial one. So that in table III in financial aspect there is no factors to be compared with dedicated resources.

### Table 1: Classification CSFs in BSC aspects (Process, customer, Finance, Learning and Growth) by AHP method.

<table>
<thead>
<tr>
<th>Row</th>
<th>Process</th>
<th>Learning and growth</th>
<th>Financial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vendor support</td>
<td>Interdepartmental co-operation</td>
<td>Top management support</td>
</tr>
<tr>
<td>2</td>
<td>Vendor partnership</td>
<td>Clear goals and objectives</td>
<td>Project team competence</td>
</tr>
<tr>
<td>3</td>
<td>Vendor’s tools</td>
<td>Project management</td>
<td>Project champion</td>
</tr>
<tr>
<td>4</td>
<td>Interdepartmental</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Rules Indicating ERP Implementation Success levels:**
Clustering is one of the refining techniques to find the rules in fuzzy models. In this paper, k-means clustering has been chosen.

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

\[
J = \sum_{j=1}^{k} \sum_{i=1}^{n} \| x_{ij} - C_j \|^2
\]

All clustering activities were done by SPSS software and the fuzzy rules have been refined from clusters. Where \( \| \) 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).

**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.

**Fig. 2:** Fuzzy system to obtain ERP implementation success level based on Learning and Growth, PROCESS, CUSTOMERS and FININCE inputs.
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.

Visualization of ERP Implementation Success Level As Function of Factors:
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 5, 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 6 shows visualization of ERP Implementation success level as a continuous function of customer and process.

Conclusion:
Actually drawing a solid line between these aspects and encapsulating them without considering the interaction and collaboration of these aspects is not completely possible but as this study shows the learning and growth plays a very important role in ERP implementation success. Although we expect from direct sum of these factors ranks, the process aspects plays the most important role in BSC platform, but this study gives us a
different conclusion. As you can see in figures 5 there is a very low chance of successful ERP implementation for low amount of learning and growth. Process and customer compares chart in figure 6 says that these factors has same priority in successful ERP implementation, so it is strongly recommended to empower learning and growth aspect of organization before attempting any large IT project like ERP. Process is another important aspect of each project, by a linear sum over the ranks of these factors, 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.

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

| Table 3: Assessment and prioritization effective indicators of customer, process, Learning AND Growth, finical. |
|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|
| Relative weights of attributes By Expert Choice Software | Indicators and priority |
| 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Average | LR | |
| 0.399 | 0.39 | 0.392 | 0.39 | 0.338 | 0.384 | 0.397 | 0.39 | 0.306 | 0.39 | 0.38 | Vendor support |
| 0.379 | 0.326 | 0.327 | 0.306 | 0.227 | 0.366 | 0.263 | 0.329 | 0.343 | 0.372 | 0.32 | Vendor partnership |
| 0.377 | 0.326 | 0.326 | 0.366 | 0.245 | 0.366 | 0.298 | 0.201 | 0.264 | 0.284 | 0.3 | Vendor’s tools |
| 0.289 | 0.292 | 0.294 | 0.29 | 0.384 | 0.299 | 0.229 | 0.299 | 0.296 | 0.299 | 0.3 | Interdepartmental co-operation |
| 0.288 | 0.215 | 0.213 | 0.241 | 0.299 | 0.297 | 0.3 | 0.19 | 0.152 | 0.23 | 0.24 | Clear goals and objectives |
| 0.148 | 0.155 | 0.191 | 0.261 | 0.132 | 0.149 | 0.12 | 0.136 | 0.179 | 0.254 | 0.17 | Project management |
| 0.17 | 0.142 | 0.166 | 0.119 | 0.169 | 0.114 | 0.126 | 0.15 | 0.164 | 0.103 | 0.14 | Interdepartmental communication |
| 0.106 | 0.088 | 0.066 | 0.075 | 0.101 | 0.086 | 0.094 | 0.071 | 0.077 | 0.077 | 0.08 | Careful package selection |
| 0.067 | 0.069 | 0.086 | 0.055 | 0.063 | 0.064 | 0.085 | 0.115 | 0.1 | 0.055 | 0.07 | Data analysis and conversion |
| 0.39 | 0.44 | 0.46 | 0.48 | 0.39 | 0.43 | 0.45 | 0.49 | 0.48 | 0.43 | 0.44 | Top management support |
| 0.37 | 0.38 | 0.28 | 0.38 | 0.28 | 0.38 | 0.28 | 0.28 | 0.28 | 0.32 | Project team competence |
| 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | Project champion |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Dedicated resources |
| 3097 | 3097 | 3097 | 3097 | 3097 | 3097 | 3097 | 3097 | 3097 | 3097 | 3097 | Financial |
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