IDENTIFICATION OF CRITICAL SUCCESS FACTORS TO ERP PROJECT MANAGEMENT

An Application of Grey Relational Analysis and Analytic Hierarchy Process

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Abstract: ERP system implementations are complex undertakings and many of them are unsuccessful. It is therefore important to find out what the critical success factors, or CSFs, are, that drive ERP project success. In the present article we identified 17 CSFs from the literature survey and the responses of questionnaire from various targeted respondents which include some of the International Inc.'s of ERP Vendors, ERP Customers and ERP implementing companies. Based on the ground theory of analysis these 17 CSFs are grouped with regard to Project Management (PM) knowledge areas of time, quality, cost, scope and expectation. And finally analyzed the questionnaire responses using Grey Relational Analysis and Analytic Hierarchy Process (AHP) for finding the CSFs contribution to the success of ERP project management. We further analyzed the set of questionnaire responses for a group that is unable to reach a compromise to make a decision.

1 INTRODUCTION

ERP (Enterprise Resource Planning) systems may well count as 'the most important development in the corporate use of information technology in the 1990s'. ERP implementations are usually large, complex projects, involving large groups of people and other resources, working together under consider able time pressure and facing many unforeseen developments. Not surprisingly, many of these implementations turn out to be less successful than originally intended.

Over the past few years, a considerable amount of research has been conducted into critical success factors, or CSFs, for ERP implementations and IT implementations in general. Such factors typically include top management support, sound planning, end user training, vendor relations, project champions, interdepartmental collaboration and communication and the like. Now we even have available a ranked version of such a list, based upon a survey among managers of organizations that have recently gone through an ERP implementation process (Somers and Nelson 2001). However, at present it is not yet clear how these CSFs interrelate.

In the present article we identified 17 CSFs from the literature survey and the responses of questionnaire from various targeted respondents which include ERP Vendor: SAP, ORACLE; ERP Customers HEINKEN, British Waterways, Coca-Cola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat and ERP implementing companies: Accenture, IBM, LogicaCMG, Cap Gemini. Based on the ground theory of analysis these 17 CSFs are grouped with regard to Project Management (PM) knowledge areas of time, quality, cost, scope and expectation and analyzed the questionnaire responses using Grey Relational Analysis and Analytic Hierarchy Process (AHP) for finding the CSFs contribution to the success of ERP project management. We further analyzed the set of questionnaire responses for a group that is unable to reach a compromise to make

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a decision.

2 LITERATURE SURVEY

A considerable amount of research has been conducted into critical success factors, or CSFs, for ERP implementations (eg Holland & Light, 1999; Sumner, 1999; Willcocks & Sykes, 2000) and IT implementations in general (Reel, 1999; Marble, 2000). Such factors typically include top management support, sound planning, end user training, vendor relations, project champions, interdepartmental collaboration and communication and the like. In a paper by Toni Somers and Klara Nelson 2001, a very useful and well-grounded ranked list of CSFs for ERP implementation is presented. The 21 CSFs in this list were first compiled from a meta-study of over 110 ERP implementation cases described as well as on the general literature on IT implementation, BPR (Business Process Reengineering) and project management.

PMBOK (Project Management Institute 2000) identifies nine knowledge areas upon which project management is based. These nine areas, although presented as distinct features are usually totally integrated, as are their component processes. Some of the key areas used in our research are: 1. ERP Project Scope Management: Wood and Caldas (2000), Shanks *et al*. (2000), Davenport (1998), Scott *et al.* (2000). 2. ERP Project Time Management: McKie (1999), Bingi *et al.,* (1999). 3. ERP Project Cost Management: Berger (1998), Stedman (1998). 4. ERP Project Quality Management: Shanks *et al.* (2000). 5. ERP Project Expectation Management: Stefanou (2000).

3 IDENTIFICATION OF CSFS FOR MANAGING ERP PROJECT MANAGEMENT

We have given the detailed explanation of each and every CSF (numbering is done in such a way to interpret say 1, 2,..., 17 as CSF 1, CSF 2,..., CSF 17) and the source from where it is derived as described below:

1. Top management commitment: Sustained management commitment at top during the implementation, in terms of their involvement and the willingness to allocate valuable organizational resources (Holland et al. 1999). Management support is important for accomplishing project goals and objectives and aligning these with strategic business goals (Sumner 1999).
Source: Charles 2003, Janet Lee, Marc 2003, Brian 2003, Buckhout 2001, Peter (pemeco), Buckhout, 1999; Sumner, 1999; Wee, 2000; Holland et al., 1999; Jinghua Kuang 2002, HEINKEN , British Waterways, Coca-Cola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

2. Employee support and involvement: User participation refers to the behaviors and activities that employees perform in the system implementation process. Employee involvement refers to a psychological state of the individual, and is defined as the importance and personal relevance of a system to a user (Hartwick and Barki 1994). Employee involvement and participation will result in a better fit of user requirements achieving better system quality, use and acceptance.
Source: James 2004, Brian 2003, HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

3. Clearly defined goals, objectives and scope of implementation: This factor is related with concerns of project goals clarification and their congruence with the organizational mission and strategic goals. This includes both scope definition and subsequent scope control. Some components of this factor are: scope of business processes and business units involved, ERP functionality implemented, technology to be replaced/upgraded/integrated, and exchange of data.
Source: James 2004, Charles 2003, Best Foods, Phillips, BPCL Buckhout et al., 1999, J .S. Reel,IEEE; Wee, 2000; Falkowski et al., 1998; Rosario, 2000, HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

4. Proper balance of IT and Business Emphasis: ERP implementation is not just any technical implementation, it is software which affects the business processes of a organizations. So while deciding on the scope of implementation both the technical side and business side should be taken into consideration.
Source: James 2004, Campbell 2000, HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

5. Adequate Project Planning: This means to have a well-defined plan/schedule for all the activities

involved in the ERP implementation, with an appropriate allocation of budget and resources for these activities. Evidence shows that the majority of projects fail to finish the activities on time and within budget.
Source: James 2004, Brian 2003, Janet Lee, Peter (pemeco), Rosario, 2000; Holland et al., 1999, Sumner, 1999; Wee, 2000, HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

6. Project monitoring at every stage: To ensure the project completion according with the plan/schedule, close monitoring and controlling of time and costs is necessary.
Source: James 2004, Brian 2003, Holland et al., 1999, Rosario, 2000, HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

7. Competent project leader: The main reason why this person is considered to be central to successful implementations is that s/he has both the position and the skills that are critical for handle organizational change (Parr et al. 1999). The role of the project champion is very important for marketing the project throughout the organization (Sumner, 1999).
Source: Janet Lee, HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

8. Change management: The change management approach will try to ensure the acceptance and readiness of the new system, allowing the organization to get the benefits of its use. A successful organizational change approach relies in a proper integration of people, process and technology.
Source: Psulcas 2003, Brian 2003, Janet Lee, HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

9. Capable and committed implementation team members from tech and business knowledge: ERP projects typically require some combination of business, information technology, vendor, and consulting support. The structure of the project team has a strong impact in the implementation process. Thus team members should be chosen from both the technical area and functional areas of the business so that all the requirements are adequately specified.
Source: Charles 2003, Marc 2003, Janet Lee, Buckhout et al., 1999; Bingi et al., 1999; Rosario, 2000; holley,2002; collett,2000, Nelson and Somers 2001

10. Proper training and education: The training plan should take into consideration both technical staff and end-user. This will ensure ready acceptance by the employees and will help maintain the quality of ERP implementation. It can be done an in-house training approach or by using training consultants.
Source: Charles 2003, R. R. Nelson, and P. H. Cheney,2002; C. P. Holland, and B. Light,1999, HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

11. Selection of best suited ERP package and good consultants: Selecting appropriate ERP package and consultants with right skills to implement the same.
Source: Marc 2003, Peter (pemeco), HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

12. Business process re-engineering: This is related with the alignment between business processes and the ERP business model and related best practices. This process will allow the improvement of the software functionality according to the organization needs. Managers have to decide if they do business process reengineering before, during or after ERP implementation.
Source: Charles 2003, Brian 2003, Falkowski et al., 1998, Roberts and Barrar, 1992, Bingi et al., 1999, Rosario, 2000; Holland et al., 1999, HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

13. Knowledge transfer between consultants and implementing team: knowledge transfer is important because when the consultants leave the company after implementation the team members must be able to handle ERP, its working and any problems that may arise during its use. This is a very important factor for making ERP implementation successful.
Source: Marc 2003, Brian 2003, HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

14. Interdepartmental communication and cooperation: Communication should be of two kinds: 'inwards' the project team and 'outwards' to the whole organization. This means not only sharing

information between the project team but also communicating to the whole organization the results and the goals in each implementation stage. Also interdepartmental cooperation is very necessary as implementation of ERP means integrating all the departments and thus requires all the departments to communicate and cooperate.
Source: Charles 2003, Peter (pemeco), HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

15. Setting realistic expectations from the software: ERP is generic software and may not provide all the functionalities of the organizational business processes. Also the benefits from ERP implementation are not realized immediately so realistic expectation should be set, this will help in acceptance and success of the software.
Source: Peter (pemeco), HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

16. Employing Best practices: Best practices within that sector of the industry when used helps in a better business process reengineering and makes working of the organizational much more efficient.
Source: Brian 2003, HEINKEN , British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

17. Clearly defining roles and responsibilities: Every employee in the organization must be clearly told his responsibilities and role in ERP implementation. This will help in eliminating chaos and reduction in wastage of time, effort and money.
Source: James 2004, Psulcas 2003, HEINKEN, British Waterways, CocaCola, Philips, Alstom, ABN-AMRO, Nestle, BMW, McDonals's, Nike, British Gas, Shell, Sony, Fiat

CSFs are then grouped according to the Project Management areas taken by survey and literature which is shown in Table 1.

Table 1: CSFs categorized into PM area groups.

PM Areas	CSF'S Affecting PM Areas
Scope	1,3,4,5,15,16
Cost	6,7,9, 10,11
Time	2,3,6,7,9,14,17
Quality	1,2,3,4,5,6,8,9,11,12,13
Expectation	1,3,5,15

4 CONTRIBUTION OF EACH CSF FOR A SUCCESSFUL ERP IMPLEMENTATION

We have analyzed the questionnaire which is framed by incorporating Likert scale R. Likert (1932). Using Analytic Hierarchial Process (AHP) Saaty (1980, 1986, 1994) we develop a AHP model described in the Figure 1.

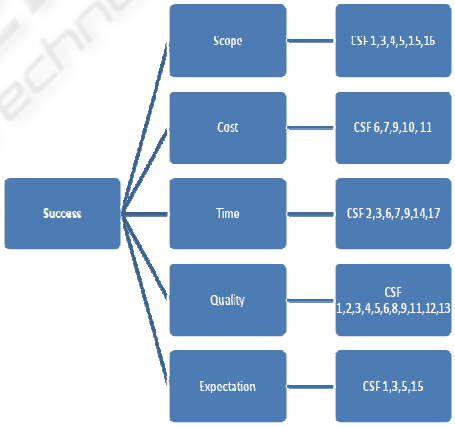

Figure1: AHP Model for finding CSFs contribution.

From the survey it has been observed that the responses are conflicting in which responses among the group members are unable to reach a consensus. This research applies grey relational analysis J. Deng (1982) Chien-Ho Wu (2007) to approach group decision that determine the optimal grey relational grade of various weights for some level in the duplicate hierarchal structure, when some weights belong to the grey number in AHP Chin-Tsai L *et al.*,(2004).

Finally, after resolving conflicts in responses we get the contribution of each CSF and their Project Management area contribution for successful ERP implementation in Table 2 & 3.

Table 2: Individual CSFs Contribution in the Successful Implementation of ERP Project.

S. No	Critical Success Factors	Contribution (%)
1.	Top management commitment.	9.865
2.	Employee support and involvement.	2.877
3.	Clearly defined goals, objectives and scope of implementation.	8.236
4.	Proper balance of IT and Business Emphasis	4.761
5.	Adequate Project Planning	3.221
6.	Project monitoring at every stage.	21.78
7.	Competent project leader.	13.31
8.	Change management.	0.731
9.	Capable and committed implementation team members from tech and business knowledge.	7.974
10	Proper training and education.	4.34
11	Selection of best suited ERP package and good consultants.	4.11
12	Business process re-engineering.	2.016
13	Knowledge transfer between consultants and implementing team.	2.142
14	Interdepartmental communication and cooperation.	2.761
15	Setting realistic expectations from the software.	5.686
16	Employing Best practices.	1.007
17	Clearly defining roles and responsibilities.	5.127
	Sum	**100**

Table 3: Contribution of each project management area in the success of ERP project

scope	14.60%
cost	21.56%
time	38.47%
quality	16.37%
expectation	8.99%

5 CONCLUSIONS

ERP implementations are usually large, complex projects, involving large groups of people and other resources, working together under consider able time pressure and facing many unforeseen developments. Not surprisingly, many of these implementations turn out to be less successful than originally intended. So, this paper gives out the 17 critical success factors and the project management area it relates for a successful ERP implementation from survey and literature. Using appropriate quantitative techniques the responses has been evaluated and finally gets the contribution of each CSF in an ERP project.

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