



CSFS OF ERP IMPLEMENTATIONS IN LARGE SCALE INDIAN ORGANIZATIONS: A MULTIPLE CASE STUDY

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ABSTRACT

The study performs a literature search for critical success factors in ERP implementations. The study classifies the success factors in five groups (Vision, scope and goals; Culture, communication and support; Infrastructure; Approach and Project management). The researcher then study successful ERP implementations in four Indian large scale organizations. Through a detailed survey, we determine which factors in these companies contributed to the success of the implementation. The study then compares these factors to the literature to determine which of the critical success factors in the literature are relevant to the selected organizations. The results show that most of the success factors, found in the literature apply to Indian sectors, although some factors, such as a clear scope definition, management reporting, standardized infrastructure are clearly not important success factors in Indian large scale industries.

Keywords: Critical Success Factors, Large Scale Enterprises, ERP implementation

I. INTRODUCTION

ERP systems are extensive, integrated software systems, supporting the internal operations of an enterprise. They bring about enormous investments in software and in package customization. Many cases are known of ERP implementations, failing to

deliver the promised functionality and even endangering the future of the implementing company.

In view of these alarming figures, researchers and companies have looked for ways of improving the chances of success of ERP implementations. Research into ERP implementations around the globe has revealed some of the ERP critical success factors (Mabert et al. 2000, Olhager & Selldin 2003, Parr & Shanks, 2000, Bingi et al 1999, AlMashari et al. 2003).

In this paper, the researcher develops a view on critical success factors of ERP implementations on large scale Indian sectors. In Section 2, the literature for critical success factors of ERP implementations. This leads to a general classification framework for ERP success factors. In Section 3 the methodology, used to study the successful ERP implementation in four Indian companies, each company belonging to a different sector of the Belgian industry. The results of this study are presented in Section 4, where we discuss the critical success factors, found in each of the four companies, in detail. In Section 5, the study compares the critical success factors, found in de multiple case studies, to the ERP critical success factors, discovered in the literature. Finally, the study presents conclusions in Section 6.

II. CRITICAL SUCCESS FACTORS FOR ERP IMPLEMENTATION

A critical success factor (CSF) is a factor which, if addressed, significantly improves the changes of a successful project implementation (Pinto & Slevin 1987). There is no general consensus on the critical success factors of an ERP implementation. In the literature, the number of CSFs varies from nine to sixteen (Ernst & Young 2006, Holland & Light 1999, Nah et al. 2001, Parr & Shanks 2000, Shanks et al. 2000, Sumner 2005, Umble et al. 2003). The merging of these lists of CSFs leads to a list of over forty candidate CSFs. In order to structure these candidate CSFs, the study divide them into five groups according to the theme:

1. Vision, scope, and goals;
2. Culture, communication, and support;
3. Infrastructure;
4. Approach
5. Project management.

The study has grouped the CSFs, discussed in the literature into these four groups. Below, we review these CSFs and their meaning.

2.1 Vision, Scope, and Goals

This group contains CSFs relating to the vision of the enterprise, the scope of the ERP project and the goals of the implementation. The critical success factors of this group are:

- **Vision, Strategic goals and Business plan.**

- A clear and motivating overall business vision (Holland and Light 1999, Nah et al. 2001, Umble et al. 2003).
- A clear project mission, related to the business needs (Nah et al. 2001).
- A clear business plan, describing strategic and tangible benefits, the project resources and timing, the costs and the risks (Nah et al. 2001).
- A clear model of the target business after the implementation of the project (Holland and Light 1999, Nah et al. 2001).
- **Scope.**
 - A clear definition of the ERP project scope (Parr and Shanks, 2000, Shanks et al. 2000).
 - The limitation of the scope to essential business functions (Parr and Shanks 2000, Ernst & Young, 2006).
- **Efficient management reporting.**

2.2 Culture, Communication, and Support

- Senior management support.
- Project approval,
- Identifying the project as top priority,
- Senior management participation,
- Defending and supporting the project,
- Mediate between parties in times of conflict,
- Involvement with corporate strategy,
- Understanding of ERP technology and issues,
- Proper assignment of resources to the project

Effective change management (Nah et al. 2001, Shanks et al. 2000, Sumner 2005, Umble et al. 2003). Some company properties may ease the implementation of changes:

- A corporate culture with shared values and common goals (Nah et al. 2001);
- A culture that encourages open communication (Sumner 2005);
- A strong corporate identity (Nah et al. 2001);
- A flexible organization, open to change (Nah et al. 2001, Umble et al. 2003);
- Emphasis on quality (Nah et al. 2001);
- Strong information technology capabilities (Nah et al. 2001);
- Determination to accept and use new technologies (Nah et al. 2001);
- Determination to overcome implementation problems (Parr & Shanks 2000).

Internal communication (Holland & Light 1999, Nah et al. 2001)

- Communication of expectations at all company levels.
- User participation by taking into account user requirements, remarks, reactions and by seeking user approval.
- Formal presentations by the project teams and announcement of the project results within the company.

- Announcement of the project scope, objectives and activities before the project onset.

2.3 Infrastructure

This group contains critical success factors, related to the IT infrastructure. It contains two critical success factors:

- A standardized IT infrastructure (Ernst & Young 2006, Ross et al. 2006).
- Suitable business and IT legacy systems (Holland & Light 1999, Nah et al. 2001).

2.4 Approach

This group contains critical success factors related to the overall approach to the ERP implementation. The critical success factors of this group are:

- Focus on user requirements. This critical success factor is mentioned by Sumner (2005).
- Use of external consultants (Shanks et al. 2000, Sumner 2005).
- User training (Shanks et al. 2000, Sumner 2005,. Umble et al. 2003).
- Data accuracy (Shanks et al. 2000, Umble et al. 2003). Two factors of importance are:
 - The data quality of the data, input from legacy systems into the ERP system, should be guaranteed.
 - The absolute need to input correct data into the ERP system.

2.5 Project Management

Many authors consider project management related factors to be critical for a successful ERP implementation. The main critical success factors from this group are:

- Proper project management (Ernst & Young 2006, Sumner 2005, Nah et al. 2001, Parr & Shanks 2000, Shanks et al. 2000, Sumner 2005).
- Good project teams (Nah et al. 2001, Parr & Shanks 2000, Shanks et al. 2000,.Umble et al. 2003) Some important factors are:
 - Collaboration on a single physical location;
 - Incentives for teams delivering within time and budget;
 - Regular meetings managing partnerships;

3. METHODOLOGY

In order to find out whether the critical success factors apply to Indian companies, the study selected four sectors with known successful ERP implementations. In this selection, the selected companies with a number of employees from 10 up to 250 and with a yearly revenue of less than 50 million or a balance total of less than 43 million to be considered as large scale enterprises. The number of employees, the revenue and

balance total were verified in the company's website, from websites of ERP vendors and partners and via personal contacts with ERP consulting firms.

Table 1: Properties of the four companies, considered in the multiple case-study on critical success factors of ERP implementations

Company Name	Activity	Employees	Revenue (In Millions)	Balance Total (In Millions)	Profit (Loss) (In Millions)
C- I	Glass manufacturer	113	14.1	24.5	1.9
C – II	Pharmaceuticals	57	14.5	8.2	(0.2)
C – III	Tractors	87	84.0	43.3	0.3
C - IV	Petrochemicals	51	40.5	79.2	4.6

Note: The names of companies are changed because of confidentiality

All the selected companies were sent an email containing a Microsoft Word document with a list of 30 questions on their ERP implementation. The questions were adapted, restructured and expanded in order to reflect the classification of critical success factors, discussed in Section 2. For all questions, predefined answers were provided. Open answers were only solicited in order to indicate exceptions to the standard answers. The list of questions was accompanied by a letter, addressed to the person who assumed the final responsibility for the ERP implementation in the company.

The questions explicitly solicited for critical success factors: respondents were instructed to indicate factors only if these contributed to the success of the ERP project in the opinion of the respondent. In this way, we ensured that factors identified were indeed critical to the success.

From the responses, four Indian representative companies were selected for a detailed study. A polar sampling technique was used: each of the companies belongs to a different industry sector. General information on the four studied companies is given in Table 1. It was then also verified that the company's successfully implemented ERP and that the person answering the questions was indeed the final responsible for the ERP project. In order to determine the success of the ERP implementation, a scorecard was set up for each of the four studied companies, evaluating success criteria like time, budget, quality, user satisfaction and realized benefits All four selected ERP implementations were successful according to this evaluation.

4. CASE STUDY IN FOUR INDIAN COMPANIES

4.1 C - I

C- I located in 64 countries with nearly 190,000 employees, the world leader in the habitat and construction markets, designs, manufactures and distributes building materials, providing innovative solutions to meet growing demand for energy efficiency

and for environmental protection. The firm consistently demonstrated its ability to invent products that improve quality of life. As one of the top 100 industrial groups in the world, the firm continues to deploy its technological know-how, often in partnership with the most prestigious universities and laboratories.

C – I have implemented the SAP ERP system, including the modules supporting purchasing, order entry, materials management, production planning, financial accounting, distribution and logistics and asset management. According to C-I 10% of each of the implemented modules needed to be modified to suit the needs of the company. In addition, C-I has implemented a data warehouse/business intelligence system, an advanced planning system and the company is considering the integration of its customer information system with its ERP system.

C-I spent ample effort to manage the ERP implementation project and to keep it under control. The duration of the project was initially estimated at six months, but the project took between 7 and 12 months to complete. The total cost was within the planned budget of 1 to 1.5 million. The company aims at a lifetime of 10 years for the ERP system.

The users were heavily involved in the implementation of the ERP system. They were informed, could participate in the project by offering suggestions and advice, were given ample training and were also involved in the identification of the requirements. Although the users did not formally accept the final project results, acceptance is high and the attitude of users towards the new system was largely positive.

Senior management at C-I had a pivotal role in the ERP implementation. Senior management approved the project. They also assumed the final responsibility of the project and gave it top priority, defending the project whenever necessary. This proved to be of the utmost importance, as the ERP project lead to major reorganizations

C-I appointed a project champion. This person, from the middle management, became the promoter and facilitator of the ERP project, defending the project at all occasions and resolving internal and external project conflicts.

One quarter of the ERP implementation project team was composed of external consultants (**see Appendix**). The project manager was chosen, based on the person's competences and experience, reputation and flexibility being the secondary factors. Team members were selected among the top performing staff of the company. Some team members, being involved in several projects, were only involved part-time in the ERP project. The project team did not have the authorization to take critical decisions independently, as critical decisions were taken by the company management, in close consultation with the project team. The project team was motivated by extra compensation for delivery of the project within time and within budget.

4.2 C – II

C- II Is a leading manufacturer of Pharmaceutical formulations in India. Established in the year 1978 by a budding team of first generation entrepreneurs, the company has pioneered the use of elemental zinc in their formulations. Leading Manufacturer &

Exporter of Allopathic - Multivitamins - Zincovit Tablets, Zincovit Syrup, Zincovit Drops. The firm has also created state of art testing facilities conforming to cGLP standards to maintain end to end quality standards. The firm has planned to launch these products in the Indian market in the ensuing year.

The implemented ERP suite covered about 80% of the business processes of C-II. To close the gap, both the business processes and the ERP software were modified. To modify the business processes, C-II used business process reengineering and process modeling tools. Most of the modifications were in the distribution and logistics module, where 30% of the module needed modification. About 20% of the financial module needed modification and about 5% of the purchasing module. The order entry and materials management modules were not modified.

The ERP project received a higher priority on time, budget and staffing than other projects in C-II. The project overran slightly in budget and staff and had a major overrun in time, taking between 7 and 12 months to complete. The total project cost was between 1 and 1.5 million euro. The progress and performance of the project was only measured by project management related criteria. Operational criteria were not considered although user feedback was taken into account.

The participation of C-II top management was crucial for the success of the ERP project. Top management approved the project and assumed responsibility. They publicly characterized the project as top priority and supported it at all instances. The top management also selected a project champion from the middle management, although it remained unclear how this person effectively contributed to the success of the ERP implementation at C-II. The project champion, a different person from the project manager, has the role of principal promoter and facilitator of the ERP project, defending the project at all occasions and resolving internal and external project conflicts.

4.3 C- III

C – III is a renowned manufacturer of tractors and a variety of farm equipment. The firm product tractors can be used in a variety of soil and weather conditions and are exported to over 47 countries across the globe where they have earned a reputation for reliability, ruggedness, minimal maintenance and low fuel consumption. The firm also has the unique distinction of developing application specific tractors such as specialized tractors for vine yards, compressor applications and for deep puddling in paddy cultivation to name a few. The firm has major presence in a number of Indian states like Rajasthan, Gujarat, Andhra Pradesh, Karnataka, Madhya Pradesh and Uttar Pradesh.

C-III has implemented the SAP ERP system to support purchasing, order entry, materials management, production planning, financial accounting, distribution and logistics and financial management. Other business functions are implemented with specific software, interfaced with the SAP system. In addition, the ERP system contains a data warehouse module, management query and reporting tools and advanced planning facilities. C-III is considering to open up the system to its customers.

About 70% of the existing business processes were directly supported by the ERP software. The implementation thus required significant modifications to the ERP package. To close the gap, business processes were modified and modifications to the ERP software were implemented. Special attention was paid to keeping modifications to business processes and the software to a strict minimum. Before migration from the existing systems to ERP, the existing data was extensively monitored for errors. In addition, users were made aware of the importance of entering correct data into the ERP system.

However, the firm top management did not assume the final responsibility of the project, this responsibility being carried by a member of the operational management team. The adoption of the ERP system was further enabled by the corporate culture of open communication, openness for change, a commitment to new technology and the strong will to overcome operational problems.

The firm also appointed a project champion, selected from the middle management. The tasks of this person included: presenting the advantages of the system, defending the project against critics, resolve conflicts, keeping contact with users and detecting problems with the new system. The remainder of the project team largely consisted of external consultants, with limited participation of internal business analysts. The most important factors in the selection of the project manager were the capabilities, experience, reputation and flexibility. All critical decisions in the project were taken by the corporate management.

4.4 C – IV

C – IV is a leader in the production and marketing of Propylene Oxide, Propylene Glycols and Polyols in India. The Company operates two grassroots production facilities to manufacture Propylene oxide (PO), Propylene Glycol (PG) and Polyols. It markets its Polyols with isocyanates sourced indigenously as well as imported from Japan and China and the pre-polymers produced at MPL in meeting the demand of polyurethane industry in India.

The supported functions of ERP to C – IV are purchasing, order entry, materials management, production planning, financial accounting, distribution and logistics and financial management. The ERP system also contains e-business functions and management query and reporting tools. It also interfaces with a data warehouse.

The ERP system was implemented to simplify and standardize the ICT systems and to improve interaction and communication with suppliers and customers. The ERP software to the firm was selected, based on the functions offered, the vendor support and the references.

The ERP software covered 95% of the existing business processes. The remaining gap was closed by modifying the ERP software. Business processes remained unchanged or

were at most marginally modified. The production planning and distribution and logistics modules required 5% modifications. The order entry module required 10% modification. The ERP system was rolled out in a single operation.

The ERP project was only loosely planned: there were no critical paths defined and there was no room for contingency. However, the project was split into subprojects and a complete model of the future business was elaborated. The project completed within time and budget and with the allocated staff. There was a small budget overrun. The project took between 7 and 12 months to complete. The cost of the ERP implementation was between 1 and 1.5 million.

The project was evaluated using project management criteria only. The return on investment of the project was estimated at 5%, the useful lifetime being estimated at three to five years. No specific extra compensation was provided for project completion within budget or within time.

Several changes in the structure and culture of the organization were necessary at C-IV. Top management was instrumental in this, clarifying the role of the ERP system and the required changes in corporate culture. Top management had a very large participation in this project: approving the project, alignment with corporate strategy, public identification as top priority and conflict mediation. In addition, top management provided a project champion and took the final responsibility over the project.

The project members were selected among the best available staff. Not all project team members were fulltime assigned to the project. The principal criteria for the selection of the project manager were the person's reputation and flexibility. The project team was authorized to take urgent critical decisions autonomously, although proper communication with the management was considered important.

FINDINGS FROM THE STUDY

- Efficient management reporting. All four studied companies have implemented query and reporting tools for management reporting. However, it is not possible to determine to what extent these reporting tools contributed to the success of the ERP implementation.
- The study of the four cases shows that in all four cases senior management support was an important factor for the success of the ERP implementation, confirming the importance of this CSF.
- Three of the four implementations actively involved the users. At firm C-III users even had a primordial role in the implementation. User approval of the final system was less pronounced, but was also present in three cases.
- C - I and C – IV had rather standardized IT infrastructures while the two other companies did not. Our results show that a standardized IT infrastructure is not an important CSF for ERP implementation in the firms
- All studied companies have used external consultants. Three companies stated that this was done to tap into expertise of business processes, systems configuration and module customization. Although none of the four companies

outsourced its project completely to external consultants, the use of external staff is considered an important CSF.

- Although all four studied cases took measures to ensure data accuracy, both during conversion and during the use of ERP, it is not clear that this is actually a critical success factor for a successful ERP implementation

CONCLUSIONS

The study concludes that the largest fraction of the critical success factors, found in the literature, apply to the four studied implementations. The most important critical success factors we have identified in ERP implementations in Indian firms are:

- A clear vision on the strategic goals of the ERP implementation.
- Senior management support.
- Active user involvement.
- A suitable corporate culture, open to change.
- Internal communication on the ERP project, both before and during the project.
- The proper management of the ERP supplier.
- A formalized project approach and methodology.

REFERENCES

1. AlMashari M., AlMudimigh A., Zairi M., 2003, Enterprise resource planning: A taxonomy of critical factors. *European Journal of Operational Research*, 146:352–364
2. Atkinson, R., 1999, Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria, *International Journal of Project Management*, Vol. 17, N° 6, p337342.
3. Bingi, P., M.K. Sharma, and J.K. Godla. 1999. Critical issues affecting an ERP implementation. *Information Systems Management*; 16(3):714
4. Ernst & Young, 2006, Een ERP in een KMO: een utopia of realiteit? Ernst & Young studie over ERP oplossingen voor KMO's, Retrieved from http://www.ey.com/global/download.nsf/Belgium_D
5. Holland C. P., and Light B., 1999, A Critical Success Factors Model for ERP Implementation, *IEEE Software*, Vol.16, N° 3 (May/June), pp 3036.
6. Kremers and van Dissel, 2000, ERP system migrations, *Communications of the ACM*; Apr 2000; 43, 4;
7. Mabert V. M., Soni A., and Venkataramanan M. A., 2000, Enterprise Resource Planning Survey of US Manufacturing Firms, *Production and Inventory Management Journal*, Vol. 41, N° 2, pp 5288.
8. Nah, G. F.H., Lau, J. L.S, and Kuang, 2001, Critical factors for successful integration of enterprise systems, *Business Process Management Journal*, Vol. 7, N° 3, pp285296.

9. Olhager J., and Selldin E., 2003, Enterprise Resource Planning Survey of Swedish Manufacturing Firms, *European Journal of Operational Research*, Vol. 146, N° 2, pp 365373.
10. Parr, A., and Shanks, G., 2000, A model of ERP project implementation, *Journal of Information Technology*, Vol. 15, N° 4 (December 1), pp 289303.
11. Pinto J. K., and Slevin, D. P., 1987, Critical factors in successful project implementation, *IEEE Transactions of Engineering Management*, Vol. 34, N° 1, pp 2227.
12. Ross, J. W., Weill, P. and Robertson, D. C. 2006, *Enterprise Architecture as Strategy*, Boston: Harvard Business School Press
13. Scott, J.E. (1999), The FoxMeyer Drugs bankruptcy: was it a failure of ERP?, *proceedings of the 5th Americas Conference on Information Systems (AMCIS)*, Milwaukee, WI,
14. Shanks G. et al., 2000, Differences in Critical Success Factors in ERP Systems Implementation in Australia and China: A Cultural Analysis, *Proceedings of the European Conference on Information Systems*, <http://is2.Ise.ac.uk/asp/aspecis/20000073.pdf>, retrieved on March 23, 2007
15. Umble, E. J., Haft, R. R., and Umble, M. M., 2003, Enterprise Resource Planning: Implementation procedures and critical success factors, *European Journal of Operational Research*, Vol. 146, N° 2, pp241257.
16. Zhang, L., Lee, M., Zhang, Z., and Cheung, C., 2004, ERP systems implementation determinants and success measures in China: a case study approach, in Camp, O, Filipe, J. B. L., Hammoudi, S., Piattini, M., (eds.) *Enterprise Information Systems V*, Kluwer Academic Publishers, p 109116.

APPENDIX

COMPOSITION OF TOTAL COST & IMPLEMENTATION TEAM OF ALL FOUR FIRMS

Factors		C – I	C – II	C- III	C - IV
DIVISION OF TOTAL COST OF ERP IMPLEMENTATION					
Hardware	Fraction of Total Cost	10%	30%	10%	5%
Software		60%	35%	10%	15%
Consulting		5%	10%	50%	50%
Implementation Team		5%	10%	20%	10%
Training		20%	15%	10%	20%
COMPOSITION OF ERP IMPLEMENTATION TEAM					
Users	Fraction of Project Staff	50%	40%	50%	10%
Business Analysts		15%	20%	10%	50%
Technical Experts		10%	20%	0%	20%
External consultants		25%	20%	40%	20%