

# CRITICAL SUCCESS FACTORS IN ERP PROJECTS

## *Case studies in two industrial organizations in the Netherlands*

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Abstract: Over the past decade many organizations are increasingly concerned with the implementation of Enterprise Resource Planning (ERP) systems. Implementation can be considered to be a process of organizational change influenced by different factors of type organizational, technological and human. This paper reports on critical success factors (CSFs) in two actual ERP implementation projects in industry. Critical success factors are being recognized and used in these projects and serve as a reference base for monitoring and controlling the implementation projects. The paper identifies both (dis)advantages of CSFs and shortcomings of ERP implementation project management.

## 1 INTRODUCTION

Over the past decade a new class of software applications has emerged: ERP systems. These software packages seek to integrate the complete range of a business's processes and data communication patterns on the basis of one single information and IT architecture (Klaus et al, 2000).

Quality control and assurance during the implementation of ERP packaged software has been under-researched, in particular regarding the identification, definition and validation of critical success factors (Krumbholz et al, 2001), (Marble, 2003). These factors can be of different types, such as organizational (e.g. top management support), human (e.g. communication attitude, user resistance), technical (e.g. business process modeling methods and tools), (Stelzer et al, 1998), (Trienekens et al, 2001). Although some articles look at factors that drive success in ERP implementation, they look at them from different perspectives and also with different definitions of "success factors" in mind (Aladwani, 2001), (Amoako-Gyampa et al, 2003). Over the past years several research papers have emerged that strive at

the identification and classification of CSFs (Hoon Nah et al, 2001). More recently research papers have emerged that focus on the evaluation and validation of the CSFs relevance in practice, e.g. the CSFs relevance along the different ERP implementation project phases (Esteves et al, 2004). This paper takes the latter research direction and reports on two ERP implementation case studies in that CSFs are being recognized and used.

In section 2 a set of 11 success factors for ERP implementation is introduced. This set of success factors is presented in (Hoon Nah et al, 2001) and has been derived from 10 relevant articles, on the basis of a well-structured computer search of databases of published works and conference proceedings in the information systems area. Each of the 11 success factors is described in terms of sub-CSFs and their aspects. In section 3 the results of the discussion sessions with the project management of the two distinct ERP projects are presented and discussed. Section 4 finalises the paper with conclusions and recommendations, and points to further work to be done.

## 2 RESEARCH FRAMEWORK AND APPROACH

A total of 11 critical success factors for ERP implementation have been identified, based on a review of the ERP literature (Hoon Nah et al, 2001). These 11 factors were obtained after careful analysis and grouping of related sub-factors. To classify the CSFs identified a process theory approach was used that focuses on the sequence of events leading up to implementation completion (Markus et al, 2000). This sequence consists of our phases in an ERP life cycle, respectively chartering (decisions defining the business case), project (getting system and end users up and running), shakedown (stabilizing, eliminating 'bugs', getting to normal operations), onward and upward (maintaining systems, supporting users, getting results, upgrading, system extensions). These phases are in line with the stages of the traditional systems development life cycle. The eleven CSFs are respectively:

1. ERP teamwork and composition
2. Top management support
3. Business plan and vision
4. Effective communication
5. Project management
6. Project champion
7. Appropriate business and legacy systems
8. Change management program and culture
9. Business process reengineering (BPR) and minimum customization
10. Software development, testing and troubleshooting
11. Monitoring and evaluation of performance

In section 3 each of the CSFs will be highlighted on the basis of their so-called key aspects, as identified in literature (Hoon Nah, 2001). Consequently the way they are recognized in two case studies in practice will be reported as well as their shortcomings and advantages.

The approach that has been followed in our research consists of four main steps (Hendriks et al, 2004):

- Selecting two appropriate ERP implementation projects in industrial domains.
- Collecting relevant project documentation on these selected projects (in particular the project plans).
- Discussing and analysing the relevant project documentation and the project experiences with the ERP project management, on the basis of structured questionnaires that are derived from the unified CSF models from literature.

- Summarizing lessons learned from practitioners regarding the usage of success factors in ERP implementation projects.

The two main research questions that formed a basis for a structured questionnaire, to be used in the discussion sessions with ERP implementation project managers, are respectively:

1. Can CSFs be recognized in ERP implementation projects in practice? What are shortcomings and what are opportunities?
2. Can CSFs really be used as management instrument to support project managers with monitoring and controlling the ERP project? What are shortcomings and what are opportunities?

A structured questionnaire starting from these two research questions and making use of the literature on the identification and classification of CSFs has been applied in structured in-depth discussion sessions with the project management of the two selected ERP implementation projects.

## 3 DISCUSSING CSF: CASE STUDY RESULTS

In this section the results of the two case studies on ERP implementation are presented. In the following we will first introduce in section 3.1 briefly the two case study environments. Subsequently we will present in section 3.2 the results of the discussion sessions regarding each of the CSFs.

### 3.1 Case study characteristics

#### *Case study 1: ERP implementation at OCE The Netherlands*

Océ is a global market leader in systems for the production and management of technical documentation packages. This includes hardware, software and services that help customers move from analogue to digital and subsequently to colour and web-based document operations. The ERP project will have a major impact on the sales and service processes in the sales units of OCE. Functional business areas that are currently involved are respectively Finance & Accounting and Sales. The project is currently in its 'project' phase (see section 2). More than 250 employees will make use of the ERP implementation. The project budget exceeds E500.000,-. Main objectives are the streamlining of the heterogenic sales and service processes and the reduction of IT costs.

### Case study 2: ERP implementation at Bosch VDT.

Van Doorne's Transmissie (VDT) in The Netherlands is part of the Robert Bosch GmbH concern. VDT in Tilburg The Netherlands produces the so-called 'steel push', an important component of the Continuously Variable Transmission (CVT), which is increasingly being used in a variety of CVT applications in the automotive industry. Also in this organization more than 250 employees will make use of the ERP implementation.

At VDT an ERP package is currently being implemented in the functional areas Finance & Accounting, Warehouse, Technical support. Project documents covering the implementation have been evaluated on the basis of identified success factors from literature. The project is partly in its 'project phase' and partly in its 'shakedown phase' (see section 2). The project budget exceeds E500.000,-. Main objective of the project is a replacement of the outdated and cost-ineffective current system.

## 3.2 Results of the discussion sessions on CSFs

In this section the main results will be presented of the discussion sessions on the CSFs with the project managers (Hoon Nah et al, 2001).

### CSF-1: ERP Teamwork and Composition

The CSF teamwork and composition is described in terms of respectively:

- Best people in the organization, which is reflected by experience, educational level and performance track record.
- Cross-functional composition of the team; team members should come from distinct functional areas of the organization so that implementation problems can be discussed from different angles.
- The mix of consultants and internal staff so that the internal staff can develop the necessary technical skills for design and implementation.
- The priority of the ERP implementation project for a project manager should preferably be the top and only priority and team members need to be assigned fully to the implementation.
- The team should be co-located together at an assigned location to facilitate collaboration.
- Incentives should be given for successfully implementing the system on time and within the assigned budget.

- Sharing of information within company is vital.

Table 1: Results regarding ERP Teamwork and Composition

CSF: ERP teamwork and composition	OCE	VDT
best people in the organization	team members have both process and system knowledge	team members have both system and process knowledge
cross-functional team	coming from different functional areas	coming from different functional areas
mix of consultants and internal staff	both external consultants and internal staff	both external consultants and internal staff
information sharing	formally organized	not formally organized
top and only priority of ERP implementation	high priority, full-time work	average priority, no full-time work
incentives for successful implementation	no incentives for team members	no incentives for team members
location for working together	more than one dedicated location for team work	one dedicated location for team-work

Table 1 shows that both projects have similar teamwork characteristics. The project leader at VDT has besides his tasks as project manager also tasks as a manager at the tactical level in one of the VDT business functions. Surprisingly both organizations don't make use of incentives for their employees, although this was stressed as a very important factor in previous research (Hoon Nah et al, 2001).

### CSF-2: Top Management Support

Sub-CSFs that are recognized in literature are respectively:

- Approval of project by top management; publicly and explicitly identifying the project as a top priority; tying management bonuses to project success.
- The implementation project is aligned with business goals.
- Conflict handling; management has a mediate function between the different parties.
- Allocation of valuable resources to the project.

Table 2: Results regarding Top Management Support

CSF: Top management support	OCE	VDT
Project approval by top management	top management personally involved in implementation project (BU managers are member of the steering group. CEO is chairman of the reference board). No management bonuses.	no personally involvement of top management. no management bonuses.
Alignment with business goals	shared vision of the organization and the role of the new system	no explicit shared vision,
Conflict handling	conflicts during implementation via formal escalation procedures	no explicit formal conflict handling procedures
Allocation of valuable resources	big project team with high experienced team members; enough time	experienced team members, however: not enough time

Quite opposite from the situation at OCE the implementation project at VDT clearly lacks top management support. All sub-CSFs scored negative in the latter ERP implementation project.

**CSF-3: Business Plan and Vision**

Regarding this CSF the following sub-characteristics are mentioned, respectively:

- Steering the direction of the project on the basis of a business plan.
- Project mission related to business goals.
- Justification for investment based on an explicitly defined business problem.
- Usage of a clear business model of how the organization should operate after behind the implementation effort.

Table 3: Results regarding Business Plan and Vision

CSF: Business plan and vision	OCE	VDT
Steering the direction of the project	steering is explicitly specified, controlled and monitored	steering is explicitly specified but not controlled and monitored
Project mission related to business goals; justification for investment	clear link	no link between project and business plan
Usage of a clear business model	specification of how business should operate after implementation	specification of how business should operate after implementation

The VDT project shows that it is not explicitly integrated in an overall business plan. There isn't an active control function at the higher management level.

**CSF-4: Effective Communication**

Effective communication is, according to previous research results, critical to ERP implementation. Important aspects of communication are respectively:

- Management of expectations, management of user input.
- Content of communication, e.g. towards user organizations: promotion of project teams, project progress; towards team members: importance, scope, objectives, activities of the project.

Table 4: Results regarding Effective Communication

CSF: Effective communication	OCE	VDT
Management of user input	none	none
Content of communication	one-way publication of project progress; intensive communication with team members	informal information on project progress; informal communication with team members

The table shows that both projects don't match the sub-CSFs regarding effective communication. VDT is clearly more informally organized from this perspective than OCE.

**CSF-5: Project Management**

Important aspects regarding Project Management which are mentioned in (Amoako-Gyampah, 2003) are respectively:

- Clearly defined and limited scope, e.g. amount of systems implemented, involvement of business units, and needed amount of business processes to be reengineered.
- Formally defined milestones in order to manage timely decisions and timeliness of the project.
- Coordinated training facilitated by an active human resource department; application of conflict escalation procedures.
- Measuring success early, a focus on results and constant tracking of schedules and budgets against targets are important.

Table 5: Results regarding Project Management

CSF: Project Management	OCE	VDT
Clearly defined and limited scope	defined, but not formally and measurable; dynamic management of changes	defined, but not formally; no management of changes
Formally defined milestones	formally specified	formally specified
Conflict escalation procedures	formally arranged	none
Early project success measurement	milestone measurement of progress and budget	none

Project management is elaborated at OCE much more than at VDT. Most of the sub-CSFs from literature were recognized, excluding the sub-CSF 'Coordinated training and active human resource department'. Surprisingly both projects don't have to maintain clear links with this type of department.

**CSF-6: Project Champion**

Important sub-CSFs are respectively 'High level executive sponsorship' and 'Continuous conflict management'. A business leader should be in charge in order to have a business perspective in the project.

Table 6: Results regarding Project Champion

CSF: Project Champion	OCE	VDT
Project champion control by executive sponsorship	project leader formally managed by steering group	no direct influence of higher management on project leader
Continuous conflict management	explicit task of project leader to manage conflicts	difficult position of project leader due to other operational tasks then ERP implementation

The table shows that the sub-CSFs are recognized in both organizations. At VDT the situation regarding conflict handling is difficult because the project manager represents different stake-holders: on the one hand the ERP implementation in the overall value chain of the business, and on the other hand the operational management of a particular business function.

**CSF-7: Appropriate Business and Legacy Systems**

A stable and successful business setting is necessary for successful ERP implementation. Business and IT systems involving existing business processes, organization structure, culture, and information technology affect success. It determines the IT and organizational change required for success (Hoon Nah et al, 2001).

Table 7: Results regarding Appropriate Business and Legacy Systems

CSF: Appropriate business and legacy systems	OCE	VDT
stable and successful business setting	intuitively yes; however could not be determined in a measurable way	intuitively yes; however could not be determined in a measurable way

In both organizations it appeared to be difficult to discuss and determine in an objective, measurable way whether the business setting is stable and successful enough for starting up an ERP implementation project. Although intuitive opinions of managers point in the direction of a stable and successful situation, too many subjective factors are

playing a role for explicit and formal statement to this CSF.

**CSF-8 Change Management and Culture**

The CSF Change Management and Culture covers a wide range of cultural and business change aspects. On the one hand subjective and qualitative subjects are addressed, such as shared values and common aims, corporate identity, strong willingness to accept new technology (Wohlin et al, 2001). On the other hand also quantitative tangible aspects are covered such as the existence of a change management program, team member training, user training and the involvement of users in the implementation project.

Table 8: Results regarding Change Management and Culture

CSF: Change Management and Culture	OCE	VDT
Change management program	yes	no
User training	formal training program for user groups	formal training program for user groups
Team member training	formal program	formal program
User involvement in project	none	none

The table shows that only the more tangible CSF-aspects could be addressed positively in the discussion sessions in both the organizations. However, it appeared to be impossible to get enough clarity regarding the usage of the qualitative intangible aspects of this CSF.

**CSF-9: BPR and Minimal Customization**

Previous research shows that business process should be molded, in advance of the actual implementation project, to fit the new system. Aligning the business process to the software implementation seems to be critical. The usage of process modeling tools is strongly advocated.

Table 9: Results regarding BPR and Minimal Customization

CSF: BPR and minimal customization	OCE	VDT
Business process redesign and customization	BPR before ERP implementation; customization: emphasis on business processes	BPR during ERP implementation; customization: emphasis on ERP system
Usage of business process modeling tools	formal modeling tools (ASAP)	no tools used

The table shows clear differences between the two organizations. OCE conforms completely to the described CSF while VDT takes a rather opposite standpoint.

**CSF-10: Software Development, Testing and Troubleshooting**

Key aspects in this CSF are: establishment of an overall ERP architecture before deployment to prevent reconfiguration at every stage of implementation. Troubleshooting errors is critical. The organization implementing ERP should work well with vendors and consultants to resolve software problems and also for planwise data migration. Proper tools and techniques, and skills to use them, will aid in ERP success.

Table 10: Results regarding Software Development, Testing and Troubleshooting

CSF: Software development, testing and troubleshooting	OCE	VDT
Software methods, architecture and tools	explicit ERP architecture as basis for ERP-architecture	explicit ERP architecture
Software testing, trouble shooting	advanced methods and tools, e.g. SAP Solution Manager	advanced methods and tools, e.g. ABAB workbench
Data migration	formal plan available	formal plan available

Regarding this CSF it became clear that both organizations covered completely and professionally the specified sub-CSFs.

**CSF-11: Monitoring and Evaluation of Performance**

Project management based criteria should be used to measure against completion dates, costs and quality. Operational criteria should be used to measure against the production system.

Table 11: Results regarding Monitoring and Evaluation of Performance

CSF: Monitoring and evaluation of performance	OCE	VDT
Measuring project performance, e.g. achievements against project goals	periodically measured	periodically measured
Measurement of operational criteria to measure against the production system	measurement of operational criteria based on explicit Critical Project Indicators (CPIs)	no measurement of operational criteria

At OCE measurement is elaborated on two levels, respectively project performance and against the production system. At VDT only the project level is covered.

**4 CONCLUSIONS**

The presentation of the research results in the tables in section 3 shows that CSFs can (partly) be recognized and discussed with the project management of ERP implementation projects. In discussion sessions with the management of two distinct ERP implementation projects, both (dis)advantages of CSF-usage, as well as shortcomings of project management, became clear. Based on the results some recommendations have been developed for on the one hand CSF elaboration and improvement, and on the other hand ERP implementation management improvement. Hereafter we briefly summarise the main results.

*1: CSFs being recognized and used.*

Most CSFs could be addressed with the project management of both the ERP implementation projects and lead to fruitful discussions, in particular CSFs such as CSF-5 Project Management, CSF-11 Monitoring and evaluation of Performance. However, only one CSF is treated in a more or less identical way in both projects, namely the ‘technology oriented’ CSF-10 Software Development, Testing and Troubleshooting. Based on the discussed sub-CSFs we concluded that both organizations have professional software development and testing departments that make use of ‘state-of-the-art’ methods and tools. CSFs that show big differences in the way they are used in both projects are some of the so-called ‘organization oriented’ CSFs, respectively CSF-2 Top Management Support, CSF-3 Business Plan and Vision, CSF-6 Project Champion and and CSF-9 BPR and Minimal Customization. The differences between the two projects seem to be consistent: the OCE project addresses each of the CSFs extensively and formally, while the VDT project doesn’t. The rationale for this could be that the ERP implementation at VDT is considered to be the responsibility of a particular project management who has to do the job with a particular (and dedicated) team. The VDT higher level management has little confidence, and doesn’t want to spend extra resources, in steering such a project from a higher level (CSF-2, CSF-6), and/or in embedding the project in an overall business plan and vision (CSF-3, CSF-9).

*Recommendation-1*

The two projects are currently in their second and third phase of ERP implementation (see section 2). Still, no serious problems have occurred, although rather big differences in ‘organization oriented’ CSF-usage could be identified. In on-going case study research we will continue to investigate these differences and we will strive at the determination of the real importance of particular ‘organization oriented’ CSFs for ERP implementation.

*2: CSFs being recognized, but not used*

Some sub-CSFs that seem to have a high importance in literature are not at all addressed in the two ERP implementation projects, respectively:

- the sub-CSF Incentives for both team members and management (of CSF-1 ERP Teamwork and Composition);
- the sub-CSF Management of user input (of CSF-4 Effective communication);

- the sub-CSF Coordinated training and active human resource department (of CSF-5 Project Management).

Regarding the first sub-CSF it appeared to be common (European?) business policy in the two organizations that no explicit connections are made between successful work and incentives, such as extra bonuses and/or other rewardings. Regarding the second and the third sub-CSF mentioned above: the project management of both projects considered the way they (had) treated this CSF as a shortcoming of their project management and defined some improvement activities.

#### *Recommendation-2*

Differences regarding the way CSFs are used in practice should be investigated on the level of sub-CSFs. Sub-CSFs offer the opportunity to define a particular CSF in a formal and measurable way. Based on sub-CSF research more precise explanations can be given for particular shortcomings of an ERP project and/or motives can be identified for not using a CSF as defined in literature.

#### *3: CSFs not being recognized and not being used.*

CSF-7 and CSF-8, respectively Appropriate Business and Legacy Systems and Change Management and Culture are hardly being recognized in each of the projects. The reason is that they cover a too broad range of intangible and subjective aspects, which makes it impossible to get clear consensus on their precise meaning and their impact on successful ERP implementation. Therefore they are not being used as management instrument for controlling and monitoring an ERP implementation project.

#### *Recommendation-3*

The discussion sessions with the project management made clear that further elaboration of particular CSFs is needed, e.g. regarding the subjective and intangible elements in the defined CSFs. In on-going case study research we will investigate the possibilities of elaborating these CSFs, e.g. in terms of practical guidelines for their usage as an instrument for monitoring and controlling ERP implementation projects.

Case study research on CSFs for ERP implementation shows that CSFs, as identified in literature, are not only abstract concepts and terms but that they can be applied fruitfully in industrial practice. The research results can be used both for the improvement of the conceptual background of the CSFs (e.g. the unified CSF models from literature) and for the improvement of the actual

controlling and monitoring of ERP implementation projects.

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