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# Applying Grounded Theory to Create a Unified Critical Success Factors Model for ERP Implementations

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**Abstract.**

Despite the benefits that can be achieved from a successful ERP system implementation, there is already evidence of high failure risks in ERP implementation projects. Too often, project managers focus mainly on the technical and financial aspects of the implementation project, while neglecting or putting less effort on the nontechnical issues. Therefore, one of the major research issues in ERP systems today is the study of ERP implementation success. Some authors have shown that ERP implementation success definition and measurement depends on the points of view of the involved stakeholders. A typical approach used to define and measure ERP implementation success has the been critical success factors approach.
Along this line, in this research we seek to contribute to our understanding of the critical success factors of ERP implementations and how these critical success factors can be put into practice to help the process of project management in ERP implementations. We attempt to build a consensus from previous research and to derive a unified model of critical success factors in ERP implementations.
For this purpose we apply grounded theory as our main research method. We have collected all the relevant research material and we have coded it. To increase the validity and reliability of the study, the several information sources have been triangulated and inconsistencies have been clarified with additional documentation. This study provides the results of the open coding process from our application of the grounded theory method. After the coding step, we obtain an initial unified model of the critical success factors in ERP implementations. We then map these critical success factors in a matrix with four perspectives: organisational, technological, strategic and tactical.

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# 1 Introduction

An Enterprise Resource Planning system (ERP) is an integrated software package composed by a set of standard functional modules (production, sales, human resources, finance, etc.) developed or integrated by the vendor, that can be adapted to the specific needs of each customer. The current generation of ERP systems also provides reference models or process templates that claim to embody the current best business practices by supporting organisational business processes.

Despite the benefits that can be achieved from a successful ERP system implementation, there is already evidence of failure in projects related with ERP implementations (Davenport, 1998). Too often, project managers focus on the technical and financial aspects of a project and neglect to take into account the nontechnical issues. To solve this problem, some researchers are using the critical success factors (CSFs) approach to study ERP implementations.

This technical research report summarises the principal findings of a research project that seeks to provide a comprehensive understanding of CSFs in ERP implementations. The first stage of the research is concerned with the unification of the CSFs previously proposed by other authors. Thus, the goal of this study is to unify previous research on the subject, to define and to unify concepts related with CSFs. We use the grounded theory method as the research method. We use the work of 10 research studies that identify lists of CSFs and that define them. Other works were analysed but they just present a list with lack of information on how they get the CSFs or their definition. Although these studies have separately developed lists of CSFs, we have determined similarities or patterns of communality between them.

The technical research report is organised as follows. Chapter 2 explains the research method used. Chapter 3 defines success and failure in ERP implementations. Chapter 4 describes the open coding procedure and the coding of the various primary documents. Chapter 5 presents the unified model proposed with the CSFs categorised in four perspectives. Finally, we give some conclusions and further work.

## 2 Research method

We follow a qualitative research approach. This kind of research provides the understanding of a problem through research instruments that are oriented towards searching /determining/finding/analysing the facts in a temporal and geographic mark, giving significance to the context and usage. The reason to choose qualitative research is due to the fact that the main concerns of this research are organisational.

The research method used is grounded theory, proposed by Glaser and Strauss (1967). For more information about grounded theory method see Estay and Pastor (2000). The choice of this methodology ties in with the commitment to the process of developing emergent theory. This inductive approach "*generates structural patterns and hypotheses from repeated synthesis of the qualitative findings themselves, within their full organisational context - in contrast with traditional hypothesis-testing methods which seek a more contextual-neutral, formal model*" (Evans, 1997 P5).

## 2.1 Grounded Theory Method

Grounded theory is a general methodology for developing theory that is grounded in data systematically gathered and analysed. The methodology was presented initially by Glaser and Strauss in The Discovery of Grounded Theory (1967). The rigour of the grounded theory method depends upon developing the range of relevant conceptual categories and saturating those categories, to explain the data.

The core of grounded theory relies on several components:

- An empirical, iterative approach to the collection and analysis of data. That is, data are collected, analyzed, and revised cyclically as checked against empirical findings;
- A constant comparative approach to the development of theory. Similarities across disparate domains are sought in order to illuminate the dimensions present in a situation.
- An approach to sampling which is theoretical, rather than site or population driven. That is, emphasis is put on making theories as richly complex as possible, rather than on proving instantiations of hypotheses or applications of previous theories.
- Theory development which works from substantive (close to descriptive) through to formal (abstract) levels as constant comparison proceeds over time.

The key process in grounded theory is coding. Next, we describe the way coding is conceived in grounded theory. This will take us through the mains paths of the methodology - through open, axial and selective coding.

## 2.2 Coding Process

Coding: "Coding represents the operations by which data are broken down, conceptualized, and put back together in new ways. It is the central process by which theories are built from data." (Strauss and Corbin 1990, p.57). The coding process in grounded theory has three important procedures:

1) Open Coding: Labelling concepts that represent discrete happenings and other instances of the phenomena under study.
Grouping and classifying concepts into categories
Properties: Attributes or characteristics pertaining to a category - must be defensible
Dimensions: Location of properties along a continuum - must be defensible

2) Axial Coding: Procedures by which data are put back together in new ways after open coding, by making connections between categories.
Causal conditions: Antecedent conditions leading to the occurrence or development of a phenomenon
Context: Specific set of properties that pertain to a phenomenon; that is, the location of events or incidents pertaining to a phenomenon along a dimensional range. Context represents the particular set of conditions within which the action/interaction strategies are taken.
Action/interaction: Strategies devised to manage, handle, carry out, respond to a phenomenon under a specific set of perceived conditions
Intervening conditions: Structural conditions being on action/interaction strategies that pertain to a phenomenon. They facilitate or constrain the strategies taken within a specific context.
Consequences: Outcomes or results of action and interaction

3) Selective coding: The process of selecting the core category, systematically relating it to other categories, validating those relationships, and filling in categories that need further refinement and development.
Story: A descriptive narrative about the central phenomenon of the study
Story Line: The researchers own conceptualization of the story. This is the core category.
Core category: The central phenomenon around which all the other categories are integrated.
STEPS: Explicating the story line; relating subsidiary categories around the core category/story line; relating categories at the dimensional level; validating those relationships against the data; filling in categories.

## 2.3 Research Procedure

Our use of the grounded theory method was composed of the following phases:

- The first phase (research design phase) had two steps. The first step was the definition of the research subject and scope. Through the analysis of articles related with ERP systems, we detected a shortage of knowledge about the implementation of ERPs in organisations. Therefore, the goal of this study was to analyse (identify and define) the CSFs of ERP implementations. The second step consisted in the collection and analysis of specialised literature.
- In phase two (data collection phase) we located 10 papers related with CSFs models that became our primary research documents: Bancroft et al. (1997), Brown and Vessey (1999), Clemons (1998), De Bruin (1997), Dolmetsch et al. (1998), Gibson and Mann (1997), Holland et al. (1999), Parr et al. (1999), Stefanou (1999) and Sumner (1999).

- Phase three (data analysis phase) represents the operations where data are divided, conceptualised, and organised in new ways. We only made the open coding process.

  To increase validity and reliability of the resulting unified model, the several sources of information where triangulated and inconsistencies where clarified with additional documentation (namely with documents published in the trade press).
- The last phase (comparison phase) was a comparative analysis of the resulting model with other studies related with the subject.

In this report we describe the open coding procedure. Next, we describe the concept of ERP success and failure and we present each of the concepts developed, their relationship with the data gathered, and the related categories.

# 3 ERP Implementations Success

## 3.1 Success and Failure Definition

Nowadays, in the emerging ERP research area, the definition and measurement of ERP implementation success is a thorny issue. Markus and Tanis (2000) state that success means different things depending of who defines it. Thus, for instance, project managers and implementation consultants, "*often define success in terms of completing the project on time and within budget. But people whose job is to adopt ERP systems and use them to achieve business results tend to emphasise having a smooth transition to stable operations with the new system, achieving intended business improvements like inventory reductions, and gaining improved decision support capabilities*" (Markus and Tanis 2000, P2). This relative point of view for success can also be applied to failure, and people will also qualify an implementation as a failure according to their goals.

According to Markus and Tanis (2000), optimal success refers "to the best outcomes the organisation could possibly achieve with enterprise systems, given its business situation, measured against a portfolio of project, early operational, and longer term business results metrics." In this research we adopt Markus and Tanis point of view.

Pinto and Slevin (1987) defined a model of a project implementation success as $S = f\left(x_1, x_2, \ldots\ldots, x_n\right)$ where S is project success and $x_i$ the critical success factor i. In this work we attempt to define a model of this nature for an ERP implementation project. Thus, our first task is to define each $x_i$.

## 3.2 CSFs in ERP implementations

Faced with an increasingly complex ERP implementation, managers today are deciding that they need access to the information which is pertinent to their particular roles and responsibilities. One method of determining precisely what information is most needed is the "critical success factors" (CSFs) method. Next, we will briefly describe the CSFs definition and its usage, first in the information systems area and then in ERP systems.

### 3.2.1 CSFs Overview

Rockart (1979) was the first that applied the CSFs approach in the information systems area. He proposed the CSFs method to help CEOs specify their own information needs about issues that were critical to their organizations, so that information systems could be developed to meet those needs. According to his account, CSFs are *"…the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization*". By concentrating on the factors that were vital if an organization was to meet its objectives, Rockart (1979) demonstrated that a CSFs approach could be used to identify the information needs of managers and thereby give some direction to the development of any computer-based information system.

Accordingly to Rockart (1979), the CSFs planning process offers the following benefits:

- The management team gains a unified direction and consensus on how to better orchestrate the organization's resources.

- The organization's operational activities are unmistakably associated with the enterprise's ability to succeed.
- The CSFs provide a business-to-technology link. This link highlights the role of information technology as an enabling tool.

Identification of critical information needs, high pay back areas, and project prioritisation is facilitated.

### 3.2.2 Literature Review

We can evidence a lack of research studies in the area of ERP implementation success and failure. According to Parr et al. (1999), "*the systems are relatively new and a tradition of academic scrutiny and evaluation takes time to develop*". In this section we present a review of literature related with CSFs and their usage in ERP implementations. What follows is a summary of this literature. First, we describe the usage of the CSFs approach in general, and second we focus only on literature related to ERP implementation CSFs.

#### 3.2.2.1 General Critical Success Factors Approach

As mentioned above, Rockart (1979) was the first that applied the CSFs approach in the information systems area. As the name implies, the goal of the CSFs approach is "*the determination of the set of factors that the manager considers critical for his or her success. Once identified, these factors are stated as his or her objectives and the information required to monitor their performance is then identified*" (Dadashzadeh 1989).

Rockart further defines these factors as areas where things must go right and as key areas where favourable results are absolutely necessary if management goals are to be reached. The CSFs approach involves a series of interviews during which a CSFs analyst(s) elicits the critical success factors from individual managers (on different managerial levels). From these interviews CSFs can be identified for individuals, for projects, for systems, for functional units or for entire organizations. The initial interviews result in a list of individual factors, which are compiled into "sets" of CSFs in subsequent sessions.

The approach has been popularized by Rockart and other researchers and is now being increasingly used by information systems departments, and by consultants, as an aid to information systems planning. The concept has been discussed in the context of information systems planning and implementation (Jarvenpaa et al. 1985), executive information systems development (Rockart and DeLong 1988), and information requirements determination (Cooper 1988). The concept surfaced as Kaplan and Norton (1992) discussed the "balanced scorecard."

CSFs have been discussed at various levels and units of analysis:

- Some authors speak of organizational level CSFs (Ferguson and Dickinson 1982; Jenster 1987; Shank et al. 1985; McFadden and Hoffer 1991).
- Rockart (1979, 1982) speaks of industry level CSFs.
- Rademacher (1989) writes of CSFs for individual managers and users.
- Magal et al. (1988) write of CSFs for both individual managers and functional units.
- Munro and Wheeler (1980) speak of determining CSFs within the context of the corporate planning process.
- Finally, Rockart and DeLong (1988) utilize CSFs on the information systems level.

CSFs have also been studied and suggested for various uses and various projects:

- Dickinson et al. (1984) and Lumpkin and Ireland (1988) apply CSFs to small businesses.
- Boynton and Zmud (1984) recommend the CSFs methodology for MIS planning and requirements analysis.
- Several articles focus on the use of CSFs in the area of information centers (Leitherser and Wetherbe 1985; Sumner 1985; Brancheau et al. 1985).
- Munro (1983), Martin (1982) and Rockart (1982) report that CSFs have been successfully used to identify key concerns of senior IS managers.
- Khandelwal and Ferguson (1999) identify the CSFs related with the growth of IT in selected geographic regions.

Forster and Rockart (1989) published an annotated bibliography about CSFs where the main articles related with the subject until 1989 where analyzed.

According to Williams and Ramaprasad (1998), "*there is a great deal of attention devoted to the concept in the IS literature as many argue that the use of CSFs can have a major impact on the design, development, and implementation of IS. Many practitioners are shown to have embraced the concept early on, however more recent data on the utilization of CSFs has not surfaced*".

#### 3.2.2.2 ERP Implementation Critical Success Factors

We tracked the recent academic and trade literature to find research in this field. In the trade press there are some studies of this nature based on one or two ERP implementation case studies, such as Barranco 1998. Also, some consultants have developed CSFs from their accumulated expertise (e.g. Deloitte Consulting 1998; Godwin 1998). Other studies are more a set of advises where some critical factors are proposed rather than a CSFs analysis done.

During the last years several rellevant papers in the academic press were published: Bancroft (1996); Bancroft et al. (1998); Brown and Vessey (1999); Clemons (1998); De Bruin (1997); Holland and Light (1999); Holland et al. (1999); Gibson and Mann (1997); Kale (2000); Parr et al. 1999; Stefanou (1999); Sumner (1999). They analyzed the CSFs of ERP implementations:

- Bancroft (1996) and Bancroft et al. (1998) provide nine CSFs for ERP implementations based in interviews and researchers' experience on ERP implementations.
- Brown and Vessey (1999) defined the variables that appear to be critical to successful ERP implementations, based in a trade and academic literature review.
- Clemons (1998) define three CSFs based in a case study.
- De Bruin (1997) analyzed a study of benchmarking partners where the consultancy firm surveyed over 270 SAP implementations in the United States.
- Kale (2000)
- Parr et al. (1999) identified ten CSFs based in interviews with ten senior members of multiple ERP implementation teams.
- Gibson and Mann (1997) analyzed the implementation phase of nine companies and, based in interviews, they created a list of 6 CSFs.
- Stefanou (1999) identified three CSFs by analyzing a large number of cases that were published during the last few years in respected periodicals or reported by leading IT and management consulting firms.
- Sumner (1999) presented four lists of CSFs, each one representing a specific case study and the related CSFs found.

- The most extensive study whose subject is the definition of CSFs in ERP implementations is the Holland and Light model (Holland and Light 1999; Holland et al. 1999). They conducted some case studies, across a range of industries, looking in particular at organizations implementing ERP software. Holland and Light proposed a CSFs research framework based on a review of literature and the experiences of the organizations in their study. The model groups the CSFs into strategic and tactical factors.

# 4 Coding CSFs in ERP implementations

Next, we describe the codes we developed during the open coding step of our research and the different concepts found in the primary documents that support each code.

## 4.1 Sustained Management Support

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | Provide superior championship | "No successful (or unsuccessful) project manager will fail to appreciate this success factor. However, numerous executives can be supportive of a project, yet fail to provide real hands-on leadership and commitment. The difference between informal support and active leadership can be the difference between success and failure." (p. 136) |
| Brown and Vessey (1999) | Top management support | "Given the cross-functional nature and large budget of a typical ERP implementation, the extent of top management support appears to be an important characteristic. Two types of top management support roles have been associated with systems implementation projects: the sponsor and the project champion roles". |
| Clemons (1998) | | "Top management not only supported the implementation, but drove the process.". "the top management's main role in is in keeping the project focused on competitive advantages." |
| De Bruin (1997) | Top management support | "One of the key factors for any R/3 implementation is top-level management support. According to benchmarking partners, both buy-in to the project and support for it are required." (p. 8) |
| Dolmetsch et al. (1998) | | Secure management commitment (p. 6) |
| Gibson and Mann (1998) | Top management support | No definition provided |
| Holland and Light (1999) | Top management support | "Top management support is the level of commitment by the senior management in the organization to the project in terms of their own involvement and the willingness to |

| | | |
|---|---|---|
| | | allocate valuable organizational resources." |
| Kale (2000) | Direct involvement of the top management | "...SAP should get the direct attention and involvement of the senior management". "...one of the issues in which top management is required to demonstrate and encourage full commitment to the SAP project is the deputation from different departments." (p. 108) |
| Parr et al. (1999) | Management support | "Senior management delineated the functions of both the steering committee and the project team(s), and established regular reporting mechanisms. Apart from these operational functions, senior management support was crucial to overcome the inevitable setbacks and conflicts that arise during such a large undertaking." |
| Stefanou (1999) | | |
| Sumner (1999) | Management support | "Top management support is critical to the success of a project.", "Obtain and maintain top management support for the project.", "Achieve the support of senior management for accomplishing project goals and objectives and aligning these with strategic business goals." |

## 4.2 Adequate Project Team Composition

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | Choose a balanced team | "The majority of project teams studied were comprised primarily of individuals from the business departments to be affected. They configure the systems, using the tables and functions available, to run their business in the new way." |
| Brown and Vessey (1999) | Composition and leadership of the project team | "The composition and leadership of the project team have also been recognized as important variables in systems implementation." |
| Clemons (1998) | | |
| De Bruin (1997) | | |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | | |
| Kale (2000) | Full-time deputation of key managers from all departments | "...Whose staff numbers (unlike the large enterprise) are small, must allocate their best people with the conviction that after SAP is in production correctly, it will give better returns not only in terms of money, but also other resources such as materials, manpower, time, and information." (p. 109) |
| Parr et al. (1999) | Balanced team | No definition provided |
| Stefanou (1999) | | |
| Sumner (1999) | Management structure, obtain business analysts. Use a mix of consultants and internal staff | "Put someone in "charge" and centralize the management structure of the project in order to avoid duplication of effort",<br>"...ability to obtain analysts with both business and technology knowledge."<br>"Use a mix of consultants and internal staff to work on the project team, so that internal staff members can "grow" the necessary technical skills for SAP design and implementation." |

### 4.3 Adequate project Champion Role

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | Ensure project manager is capable | "Managing complex large-scale change is best done by blending the organizational and technical solutions in a process of integrated change. One approach to this blend is inherent in the skills of the project manager and subsequently the entire team. The successful project manager integrates concerns that would otherwise fall between the cracks, and communicates with all those involved. These apolitical issues require a sensitivity to the three perspectives - technical, business, and change management." (p. 137) "Unless the project leader is sensitive to the impact of each of these elements on the project as a whole, he or she is likely to get caught by the sometimes conflicting requirements." (p. 137) |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | | |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | | |
| Kale (2000) | | |
| Parr et al. (1999) | Presence of champion | "Although they did not distinguish champions from sponsors, interviewees agreed that the presence of a champion had facilitated many successful projects. ... This person was the one who was unswerving in promoting the benefits of the new system, even when users lauded (as they frequently did) the advantages of the old system." |
| Stefanou (1999) | | |
| Sumner (1999) | Role of the champion | "Understand the role of the champion in marketing the project's success throughout the organization." |

### 4.4 User Involvement and Participation

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | | |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | Other | "A related issue is that there needs to be user involvement - implementing the system without involving users throughout the project life-cycle can result in the system not meeting user requirements." (p. 9) |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | User involvement | "The number one critical success factor identified by organisations was user involvement in the project. Some of organisations felt that while considerable amounts of time and effort were spent on ensuring user involvement, they would expend even more effort in this area if given the opportunity to repeat the implementation. User support is seen as being for the success of the project and warrants considerable attention." (p. 65) |
| Holland and Light (1999) | Client consultation<br>Client acceptance | "Client consultation is the involvement of the users in the design and implementation of business process that includes formal education and training."<br>"Client acceptance is the user acceptance of the system and represents 'buy-in' from the owners of the business processes." |
| Kale (2000) | | |
| Parr et al. (1999) | | |
| Stefanou (1999) | | |
| Sumner (1999) | | |

### 4.5 Effective Organizational Change Management

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | Begin process changes first.<br>Understand your corporate culture | "Both readiness for change and the capability to make that change must be present for success in choosing the right technical/business solution and implementing it." (p. 134)<br>"There is a difference between seeing the need for a change and being willing to leap right into it. Time and increased understanding, particularly of the opportunity to change and the cost of not changing, will help readiness."<br>"The more change involved, the greater the potential implementation challenge will be. Excellent project leaders prepare for a change effort by understanding the degree of difficulty they face." (p. 134)<br>"Place this understanding within the context of your company's risk profile to define your project approach. Be sure not to underestimate the complexity of the initiative." (p. 134) |
| Brown and Vessey (1999) | Attention to change management | "The trade literature suggests that attention to change management will be a critical success factor, given the large-scale process and system changes associated with enterprise-wide ERP implementations." |
| Clemons (1998) | | |
| De Bruin (1997) | Effective change management | "When any new system is introduced, an effective change management process is required. This is particulaly important with an R/3 implementation as more than one functional area is typically involved. Effective change management requires effective communication with users, dealing with user resistance to the change, managing user expectations about the new system (ensuring that their expectations are realistic so that when the system is implemented they are not disappointed) and, finally, ensuring that the project team are visible within the organisation." (p. 8) |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | Change management | "Another issue that was mentioned by several organisations was that of change management. This was seen as being essential for the successful transition of the organisation." (p. |

| | | |
|---|---|---|
| | | 65) |
| Holland and Light (1999) | | |
| Kale (2000) | Instituting a company-wide change management plan | "In parallel with the SAP implementation effort, it makes sense to undertake a change management program to address the disorientation and lost sense of direction that might be experienced by a large number of members." (p. 110) |
| Parr et al. (1999) | Commitment to change | Same as Bancroft definition |
| Stefanou (1999) | Transformational leadership | "A transformational leadership, committed to continuous effort needed for the successful implementation of ERP systems, must resolve conflicts, and properly manage resistance not only to new technology but also to new work relationships. Coordination of individual needs and goals must be planned carefully first, then it is easier to coordinate individual technical skills required for successful ERP implementation." |
| Sumner (1999) | | |

## 4.6 Good Project Scope Management

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | | |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | "The company specifically wrote out the goals of the project and managed toward them... These goals need to be reviewed by top management and the implementation team on a regular basis or the project can easily get off target." |
| De Bruin (1997) | Project management | "For the management of an R/3 implementation to be successful, the organisation must ensure that it has sufficient resources of the requisite quality. Organizations should provide incentives to encourage their project team to perform and to encourage them to remain with the organisation" (p. 8) |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | Managing scope | No definition provided |
| Holland and Light (1999) | | |
| Kale (2000) | Clear project scope | "It is very important for a project to have a well-defined scope. Any ambiguities lead only to diffusion of focus and dissipation of effort. There are always adherents for increased scope and a series of such increments in scope would render any project unsuccessful. This is also referred as 'scope creep'." (p. 108) |
| Parr et al. (1999) | Definition of scope and goals, roles and responsibilities | "Successful system implementations means that the steering committee determines the scope of the project in advance and then adheres to it." |
| Stefanou (1999) | | |
| Sumner (1999) | | "Address 'scope expansion' requests with information on the time, cost, and business impacts of these changes", "Bring all 'related' projects together and manage them." |

### 4.7 Dedicated Staff and Consultants

| **Author** | **Title** | **Definition (and/or justification)** |
|---|---|---|
| Bancroft et al. (1998) | | |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | "The company committed 100% of some of their people's time to the project. For this company this meant user-led development." |
| De Bruin (1997) | Other | "It is important that the organisation has resources committed to the project full-time, particularly from the user community. Having people involved in the project while still involved in their work within the organisation is not advised." (p. 9)<br>"The project team also needs to be totally honest, both with users and with senior project management. Not doing so can result in a loss of support, both from users and management, and user distrust of the R/3 system." (p. 10) |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | Having the project team sit together | "...such 'super users' should be fully committed to the R/3 project for the duration of the implementation. The authors believe that only through full and committed user participation in the R/3 implementation will the project be truly business driven." (p. 65) |
| Holland and Light (1999) | Personnel | "Personnel, as a factor, is concerned with developing a project team with the requisite skills and commitment to perform their function." (Pinto and Slevin 1987) |
| Kale (2000) | | |
| Parr et al. (1999) | The best people full-time on the project team | "The members of the company who are released to provide the business expertise, which forms the foundation for the new system configuration, should be the best available and should be released from all other duties to work on implementation." |
| Stefanou (1999) | | |
| Sumner (1999) | Maintaining excellent staff.<br>Obtain and retain team members | "...both by developing internal personnel and by using external consultants."<br>"Obtain and retain team members with knowledge of the business processes, as well as an understanding of the technical aspects."<br>"Understand and appreciate the criticality of high-tech worker turnover, recruitment, and retention issues." |

## 4.8 Adequate Training Program

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | Train everyone | "A new system inevitably means new ways of operating. In Battco, the requirements of the client/server SAP R/3 environment have initiated a project to reengineer the business process. Users must be informed as to the business needs for such change as well as 'which keys to press when.'" (p. 138) |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | Training | "As with any system implementation, users need to receive training in the use of R/3. Key to this is timing - some organisations embark upon training programs several months before R/3 goes live, by which time users have forgotten their training. The content of training also needs to be aimed at the specific users' needs (in particular they need to be taught how to perform particular business processes rather than training in how to use a particular R/3 module)." (p. 8) |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | User training | No definition provided |
| Holland and Light (1999) | | |
| Kale (2000) | Training of user members, Training of SAP team members | "All training needs for all the members of the team should be identified and corporate training programs should be arranged, either on site or members should be nominated for external training programs." (p. 110) "Training plans should not only have training programs, but should also budget refresher courses for all members." (p. 111) |
| Parr et al. (1999) | | |
| Stefanou (1999) | | |
| Sumner (1999) | Training and re-skilling<br>Emphasize user-training | "Invest in training, re-skilling, and professional development of the IT workforce." |

## 4.9 Strong Communication Inwards and Outwards

| **Author** | **Title** | **Definition (and/or justification)** |
|---|---|---|
| Bancroft et al. (1998) | Communicate | "Employees at all levels who are affected by the new system need to be informed by a rigorous communications program. The key to success in this effort is repetition and accurate setting of expectations. People need to be told several times about a change." (p. 136) |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | "It is extremely important for these goals (ERP project goals) to be written and published, both for the implementation team and the user departments." |
| De Bruin (1997) | | |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | Communication.<br>Monitoring and feedback | "Communication is the formal promotion and advertisement of the project's progress from the project management team to the rest of the organisation."<br>"Monitoring and feedback is the exchange of information amongst members of the project team and the analysis of feedback from organisation users." |
| Kale (2000) | Proper visibility and communication at all stages | "It is important to give proper visibility to the SAP project. This might entail communicating about the strategic direction of the company, the relevance of SAP, the SAP implementation project and team, and the implementation plan and schedule. Either there could be a bulletin exclusively focused on the SAP project or the company's in-house newsletter must have regular features and articles on SAP project-related issues and milestones." (p. 109) |
| Parr et al. (1999) | | |
| Stefanou (1999) | Teamwork - communication skills | "Team-work is an important implementation issue of ERP systems". For instance, " a technical issue at first sight can sometimes only be resolved through teamwork and sincere work relationships." |
| Sumner (1999) | Effective communication | "Another important CSF is to tell everyone in advance what is happening, including the scope, objectives, and activities of the project. Admit that there will be change." |

### 4.10 Formalized Project Plan/Schedule

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | | |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | Revisit, modify and communicate | "As with any project, at key points the project plan must be revisited to ensure that management support is still in place" (p. 9) |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | Project management | No definition provided |
| Holland and Light (1999) | Project schedule/plans | "Project schedule/plans is the formal definition of the project in terms of milestones, critical paths and a clear view of the boundary of the project" |
| Kale (2000) | Allocation of appropriate budget and resources, Transition plan for cut-over | "After the company has made the strategic decision to undertake the SAP implementation effort, it must also prepare and approve the budget plan and estimates for the complete SAP project. Because the project schedules are dependent nonlinearly on the prerequisite at all stages, any changes or deferment of release of funds, and therefore resources, will always have an adverse effect on the successful commencement of the project." "The company must have a subsidiary project plan for transitioning from the earlier systems, whether they are computerized or manual, to the SAP system." (p. 109) |
| Parr et al. (1999) | Deliverable dates | "Interviewees stressed that implementation was more likely to fail when the dates for deliverables were fluid and/or not communicated well in advance." |
| Stefanou (1999) | | |
| Sumner (1999) | | "Don't add people to a project, if it is already behind schedule." |

## 4.11 Preventive Trouble Shooting

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | Commit to the change | "In a project of the scale and complexity generally found with R/3, it is natural that problems will arise. The technical architecture may not be adequate, the system may not have been configured to accomplish some set of tasks, the requirements or scope may change, the users may revolt. It takes management persistence and consistency to maintain focus on the project goals and to overcome all obstacles." |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | | |
| Dolmetsch et al. (1998) | | "Do not underestimate the time and effort involved in the transfer of old data." |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | Trouble shooting | No definition provided |
| Kale (2000) | | |
| Parr et al. (1999) | | |
| Stefanou (1999) | | |
| Sumner (1999) | | "Address "tough" issues squarely. Surprises hurt trust" |

## 4.12 Meaningful Business Process Reengineering

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | Begin process changes first | "Battco intends to use R/3 implementation process to identify the changes in business processes and in skills and attitudes that must be made. While the company is willing to do this, it does not have a complete understanding of the implications of the changes it is adopting. It will be useful for Battco to engage in a brief business process redesign effort prior to engaging in implementation." (p. 134)<br>"Most companies have discovered the advantages of understanding the package software and completing process changes in that context." (p.134)<br>"Contrary to the indications of some writers, most managers we interviewed indicated they had completed some level of business process revaluation or redesign in conjunction with the implementation of R/3. Many had set up specific decision-making processes, knowing that the choices would affect the company, sometimes significantly." (p.135) |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | Business process reengineering | "According to benchmarking partners, organisations should only reengineer those areas of the organisation that really need it","...the organisation should also evaluate whether the BPR exercise should take place before, during or after the ERP system implementation. It must also be decided whether the process change will be based upon the 'best business practices' contained within R/3 or whether the change is going to be independent of R/3." (p. 9) |
| Dolmetsch et al. (1998) | | "Consider the range of variants during the integration test and concentrate on the most important business processes" (p. 6) |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | Business vision | "Business vision is the clarity of the business model behind the implementation of the project." |
| Kale (2000) | | |
| Parr et al. (1999) | | |

| | | |
|---|---|---|
| Stefanou (1999) | | |
| Sumner (1999) | | |

## 4.13 Adequate Software Configuration

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | | |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | | |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | | |
| Kale (2000) | Completing infrastructural activities in time and with high availability<br>Scheduling and managing interfaces with other systems | "... the infrastructure for a SAP project whether it's the computers and networking infrastructure or human infrastructure in terms of skills acquisition and training - must not be treated as an IS/IT infrastructure." (p. 110)<br>"There are many legacy systems, non-SAP systems, external systems, and even manual functions that might be considered out of the scope of the SAP project. SAP does not address all the functional requirements of the company...SAP has a complete program of interfacing with, and qualifying, third-party products to leverage on companies with special expertise and products. Interfacing these systems should be scheduled in such a way that the interfaces are operational when SAP goes into production." (p. 111) |
| Parr et al. (1999) | | |
| Stefanou (1999) | | |
| Sumner (1999) | | |

## 4.14 Adequate ERP Implementation Strategy

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | Select a good methodology | "You may not follow every step in the process you choose, but it is extremely helpful to have a road map. Project leaders must be set out clear, measurable objectives at the beginning of the process, and review the progress at intervals. Realise that client/server projects are systems integration projects. This means that they are complicated and require attention to the implications of the slightest change." (p. 138) |
| Brown and Vessey (1999) | Manage complexity | "Implementation choices reported in the trade press that appear to be related to project complexity include the extent of process innovation, the degree of package customization and the conversion strategy: phased, big-bang, or pilot, or some combination of these strategies." |
| Clemons (1998) | | |
| De Bruin (1997) | | |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | ERP strategy | "The management decisions required with ERP software concern how the software package is to be implemented." |
| Kale (2000) | Covering as many functions as possible within the scope of the implementation | "I have mentioned that the more functions are integrated and performed in real time, the more competitive the organization would be. For this, it is essential that as many functions as possible should go productive together on SAP. This "big bang" strategy will have to be adopted in a beginning stage of the projects, such as the business blueprint stage." (p. 108) |
| Parr et al. (1999) | | |
| Stefanou (1999) | | |
| Sumner (1999) | | |

### 4.15 Usage of Appropriate Consultants

| Author | Title | Definition (and/or justification) |
| --- | --- | --- |
| Bancroft et al. (1998) | | |
| Brown and Vessey (1999) | Usage of third-party consultants | |
| Clemons (1998) | | "Consultants were used sparingly by the company. The people available often lack the depth of training and experience to really add value to the project." |
| De Bruin (1997) | | |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | | |
| Kale (2000) | | |
| Parr et al. (1999) | | |
| Stefanou (1999) | | |
| Sumner (1999) | External consultants | "When didn't have needed expertise internally, Monsanto brought in the consultants they needed",<br>"Obtain consultants who are specialists in specific application modules" |

### 4.16 Avoid Customization

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | | |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | | |
| Dolmetsch et al. (1998) | | View R/3 processes as "best practices", i.e. avoid software modifications (p.6) |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | Business process change and configuration | "The additional factor business process change and software configuration recognises the critical role of aligning business process to the ERP software in implementation."<br>"There are process modelling tools which help organizations to align business processes with the standard package." |
| Kale (2000) | | |
| Parr et al. (1999) | "Vanilla ERP": minimal customization and uncomplicated option selection | "Where possible, the business should adopt the processes and options built into the ERP, rather than seek to modify the ERP to fit the business" |
| Stefanou (1999) | | |
| Sumner (1999) | Avoid customization.<br>Re-design of business processes.<br>Discipline and standardization | "Avoid customization (e.g. don't touch the software, don't touch the Oracle tables, don't touch the Oracle interfaces)."<br>"Avoid trying to modify the software; instead, redesign or reengineer existing business processes to "fit" what the software will support."<br>"Rather than attempting to modify the software, Monsanto reengineered their business processes to be consistent with the software."<br>"Re-design business processes to be consistent with system specifications."<br>"Another CSF "which is closely associated with the software itself is the need to adhere with the standardized specifications that the software supports." |

## 4.17 Trust Between Partners

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | | |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | Partnerships | "Before implementing R/3 implementation organisations need to form partnerships with SAPSA, hardware vendors and consultants. It is the view of SAPSA that an R/3 implementation cannot be done without the organisation using external consultants. This is due to the size of the system and its complexity." (p. 9) |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | | |
| Kale (2000) | | |
| Parr et al. (1999) | | |
| Stefanou (1999) | Trust between partners | "This is an important factor with two main aspects: a technological and a corporate culture aspect."<br>"The willingness to share information inside a company requires trust between partners (employees, managers, and corporations) and is a key factor in implementing ERP systems successfully across the supply chain." |
| Sumner (1999) | | |

### 4.18 Empowered Decision Makers

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | | |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | Other | "An R/3 implementation is typically a long project and so there is a temptation to deliberate over decisions. It has been found that the opposite is needed - organisations should attempt to make decisions as rapidly as possible, as even small delays can have an impact on such a long-term project." (p. 10) |
| Dolmetsch et al. (1998) | | "Ensure that ample capacity is available amongst internal staff and make important decisions quickly" (p. 6) |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | | |
| Kale (2000) | | |
| Parr et al. (1999) | | "...However, most interviewees stressed that whatever the mechanics of the team, one factor was crucial: the members of the project team(s) must be empowered to make quick decisions. Many reflected that delays in implementation had been due to slow decision making, because the decision had to be moved up the line, and/or wait upon senior management meetings. A related factor was the establishment of streamlined, publicly known decision-making processes. Determining and publishing the decision-making processes is an initial function of the steering committee." |
| Stefanou (1999) | | |
| Sumner (1999) | | |

## 4.19 Adequate ERP Version

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | | |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | Which version of SAP R/3 | "An organisation needs to determine which version of R/3 it will implement. Frequent upgrades can cause problems. This particularly relevant when the organisation has to wait for a future release that includes the functionality required." (p. 9) |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | | |
| Kale (2000) | | |
| Parr et al. (1999) | | |
| Stefanou (1999) | | |
| Sumner (1999) | | |

### 4.20 Legacy Systems Management

| Author | Title | Definition (and/or justification) |
|---|---|---|
| Bancroft et al. (1998) | | |
| Brown and Vessey (1999) | | |
| Clemons (1998) | | |
| De Bruin (1997) | | |
| Dolmetsch et al. (1998) | | |
| Gibson and Mann (1998) | | |
| Holland and Light (1999) | Legacy systems | "Legacy systems are the business and IT systems that encapsulate the existing business processes, organization structure, culture and information technology...it determines the amount of IT and organizational changed that is required to successfully implement an ERP system. Business and IT legacy are not separate problems since many components of a business (e.g. work flow and processes) are bound up in the design and operation of the existing IT systems." |
| Kale (2000) | | |
| Parr et al. (1999) | | |
| Stefanou (1999) | | |
| Sumner (1999) | | |

## 5 Towards a CSFs Model

We collected all the CSFs listed in the literature above and then, we determined the similarities, or patterns of communality, between them. The next step was to map them in a matrix (see Fig. 1). In our view, the nature of the ERP implementation problems includes strategic, tactical, organizational, and technological perspectives. Therefore, we propose that the CSF model should have these four perspectives. The organizational perspective is related with organizational concerns like organizational structure and culture, business processes. The technological perspective focuses on aspects related to the particular ERP product in consideration and on other related technical aspects, such as hardware and base software needs. The strategic perspective is related with core competencies accomplishing the organization's mission and long-term goals, while the tactical perspective affects the business activities with short-term objectives.

Although we have organized and structured in a matrix, we note that the several CSFs are inter-related. In our description of the CSFs we will try to clarify the relationship between them. Wherever necessary, we have provided a common name for the same concept named differently by the various authors. In the sequel, we provide a detailed description of the several CSFs, classified according to their respective perspective.

| | Strategic | Tactical |
|---|---|---|
| Organisational | • Sustained management support<br>• Effective organisational change management<br>• Good project scope management<br>• Adequate project team composition<br>• Meaningful business process reengineering<br>• Adequate project champion role<br>• User involvement and participation<br>• Trust between partners | • Dedicated staff and consultants<br>• Strong communication inwards and outwards<br>• Formalised project plan/schedule<br>• Adequate training program<br>• Preventive trouble shooting<br>• Usage of appropriate consultants<br>• Empowered decision-makers |
| Technological | • Adequate ERP implementation strategy<br>• Avoid customisation<br>• Adequate ERP version | • Adequate software configuration<br>• Legacy systems management |

**Fig. 1.** Unified critical success factors model.

### 5.1 Organizational Perspective

**Strategic Factors:**

Sustained management support. Sustained management commitment, both at top and middle levels during the implementation, in terms of their own involvement and the willingness to allocate valuable organisational resources (Holland et al. 1999). Management support is important for accomplishing project goals and objectives and aligning these with strategic business goals (Sumner 1999).

Effective organisational change management. Organisational change refers to the body of knowledge that is used to ensure that a complex change, like that associated with a new big information system, gets the right results, in the right timeframe, at the right costs. The change management approach will try to ensure the acceptance and readiness of the new system, allowing the organisation to get the benefits of its use. A successful organisational change approach relies in a proper integration of people, process and technology.

Good project scope management. This factor is related with concerns of project goals clarification and their congruence with the organisational 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.

Adequate project team composition. 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. Two important factors are the integration of third-party consultants within the team and the retention within the organisation of the relevant ERP knowledge.

Meaningful business process reengineering. 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 organisation needs, as well as the improvement of certain organizational practices according to the software functionality. Managers have to decide if they do business process reengineering before, during or after ERP implementation.

Adequate project champion role. 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 organisational change

(Parr et al. 1999). The role of the project champion is very important for marketing the project throughout the organisation (Sumner, 1999).

User involvement and participation. User participation refers to the behaviours and activities that users perform in the system implementation process. User 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). User involvement and participation will result in a better fit of user requirements achieving better system quality, use and acceptance.

Trust between partners. During the implementation phase there are different partners involved such as consultants and software and hardware vendors. An adequate partnership between them will ease achievement of the goals defined.

**Tactical Factors:**

Dedicated staff and consultants. Usually, in many cases the time dedicated to the implementation project is shared with other activities. It is also important to ensure that the staff believes in the project success. Consultants should be involved in a way that helps the implementation process while also sharing their expertise with the internal staff involved. This is related with the recruitment and motivation of staff and consultants.

Strong communication inwards and outwards. Communication should be of two kinds: 'inwards' the project team and 'outwards' to the whole organisation. This means not only sharing information between the project team but also communicating to the whole organisation the results and the goals in each implementation stage. The communication effort should be done in a regular basis during the implementation phase.

<u>Formalised project plan/schedule</u>. 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. To ensure the project completion according with the plan/schedule, close monitoring and controlling of time and costs should be done, as well as implementation project scope and plan/schedule review, whenever justified.

<u>Adequate training program</u>. The training plan should take into consideration both technical staff and end-users, and its scope will depend on the type of implementation approach selected (see bellow). Some organisations use an in-house training approach while others prefer using training consultants.

<u>Preventive trouble shooting</u>. This factor is related with the problem and risk areas that exist in every implementation. Trouble-shooting mechanisms should be included in the implementation plan. Two important aspects are the adaptation and transfer of old data and the 'go live' moment. The time and effort involved in the transfer of data from previous systems should not be underestimated.

<u>Usage of appropriate consultants</u>. Determining the number, how and when to use external consultants appropriate to the ERP implementation needs. The usage of external consultants will depend on the internal know-how that the organisation has at the moment.

<u>Empowered decision-makers</u>. Project team members must be empowered to make quick decisions to reduce delays in implementation related with slow

decision-making (Parr et. al, 1999). Organisations should attempt to make decisions as rapidly as possible, as even small delays can have an impact on such a long-term project (De Bruin, 1997).

## 5.2 Technological Perspective

**Strategic Factors:**

Adequate ERP implementation strategy. This includes management decisions concerning how the software package is to be implemented (Holland et al, 1999). There are different approaches to ERP implementation strategy ranging from 'skeleton' to 'big-bang' implementations (Gibson et al, 1997). While 'skeleton' implementations are phased and provide usable functionality incrementally, 'big-bang' ones offer full functionality all at once at implementation end. The advantages and disadvantages of these extreme approaches should be measured, especially at a functionality level.

Avoid customisation. Wherever and as far as possible, the ERP-hosting organisation should try to adopt the processes and options built into the ERP, rather than seek to modify the ERP to fit the particular business practices (Parr et al, 1999). Thus, it is recommended that customisation adheres to the standardised specifications that the software supports (Sumner 1999). In this sense, a good business vision is helpful because it reduces the effort of capturing the functionality of the ERP business model and therefore minimises the customisation effort.

Adequate ERP version. An organisation needs to determine which ERP version it will implement. Frequent upgrades can cause problems. This is particularly relevant when the organisation has to wait for a future release that includes the functionality required (De Bruin, 1997).

**Tactical Factors:**

Adequate software configuration. Software configuration involves adapting the generic functionality of a package to the needs of a particular organisation (Markus and Tanis, 2000). Also, there is the need to configure the interfaces according to the user's needs. Nowadays, there are some modelling tools that can help in all these tasks. Before going life, validation tests should be applied.

Legacy systems management. Legacy systems are the business and IT systems prior to the ERP that encapsulate the existing business processes, organisation structure, culture and information technology (Holland et al, 1999). They are a good source of information for ERP implementations and the possible problems that can be found during the implementation. Another aspect is to decide which legacy systems will be replaced and the need to interface with those legacy systems for which the ERP does not provide an adequate replacement.

## 6 Analysis of Results

In this section we analyze the CSFs model. This analysis is made according to the different perspectives with which CSFs were categorized.

An important aspect is that most of the factors found can be considered "*classics*" since they are not specific to ERP implementations. Nonetheless, given the complexity of these projects, each factor "*takes on greater significance*" (Bancroft et al, 1998, p.67).

The above CSFs may be categorized in people, process and technology (or product) according to the dimensions that are relevant in ERP systems analysis, defined by Esteves and Pastor (1999). Fig. 2 shows such categorization. People is the most important dimension in determining the success of an ERP implementation according to CSFs citations.

The factors more relevant in terms of people are management support, an effective change management and a strong communication. In terms of process, a good project plan/schedule, the management of the project scope and business process reengineering have almost the same significance to the success of ERP implementation. In terms of technology, the ERP implementation strategy and avoid making few changes as possible to the software are the most relevant factors.

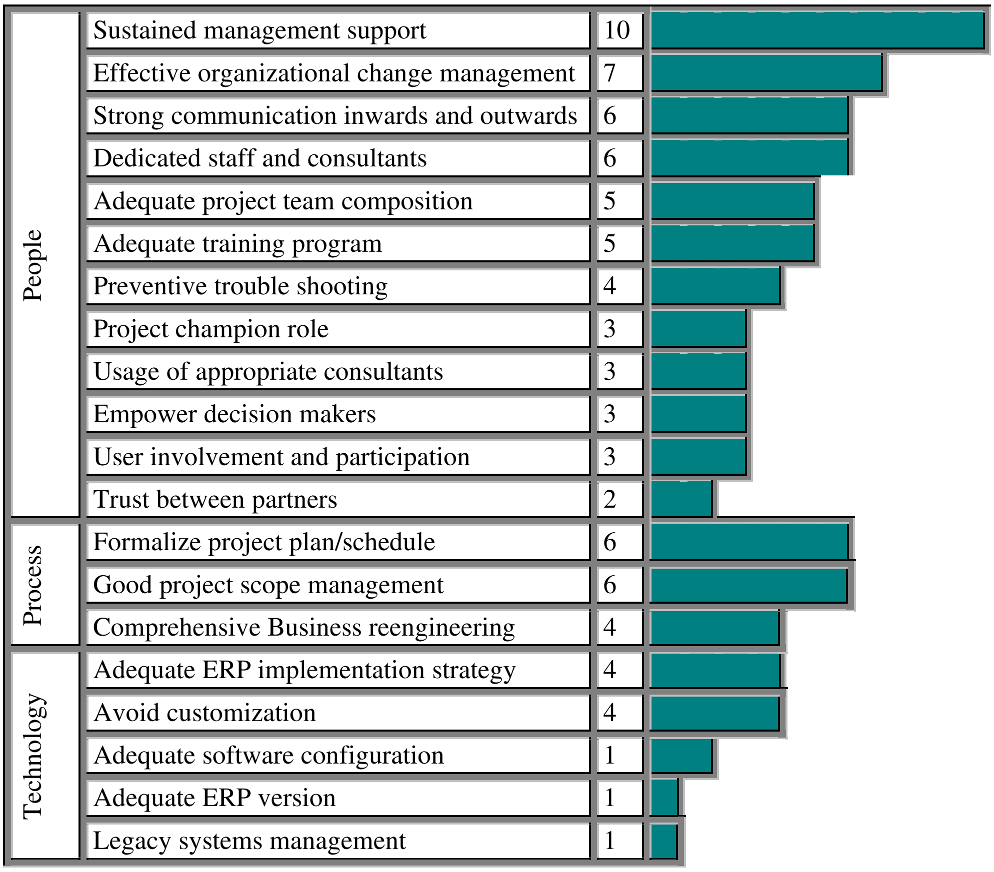


**Fig. 2.** CSFs categorized by people, process and technology perspectives.

Fig. 3 and fig. 4 corroborate the evidence that organizational aspects are more important rather the technological ones. The strategic perspective seemed to be the most important due to the effort that the whole organization has to make. Given the cross-functional nature and large budget of a typical ERP implementation, the extent of top management support appears to be the most important factor.

| | | | |
|---|---|---|---|
| Organizational | Strategic | Sustained management support | 10 |
| | | Effective organizational change management | 7 |
| | | Good project scope management | 6 |
| | | Adequate project team composition | 5 |
| | | Meaningful business reengineering | 4 |
| | | User involvement and participation | 3 |
| | | Project champion role | 3 |
| | | Trust between partners | 2 |
| | Tactical | Dedicated staff and consultants | 6 |
| | | Strong communication inwards and outwards | 6 |
| | | Formalize Project Plan/schedule | 6 |
| | | Adequate training program | 5 |
| | | Preventive trouble shooting | 4 |
| | | Usage of appropriate consultants | 3 |
| | | Empower decision makers | 3 |
| Technological | Strategic | Adequate ERP implementation strategy | 4 |
| | | Avoid customization | 4 |
| | | Adequate ERP version | 1 |
| | Tactical | Adequate software configuration | 1 |
| | | Legacy systems management | 1 |

**Fig. 3.** CSFs relevance by perspective

The evidence show us that CSFs are seen as arising separately, but as often having strong influence on each other. For example, project plan/schedule has a strong relationship with project scope management, management support with champion role and champion role with project team composition. This evidence will be analyzed through the last step of grounded theory, the comparative analysis, whose goal is to describe the relationship between the different categories.

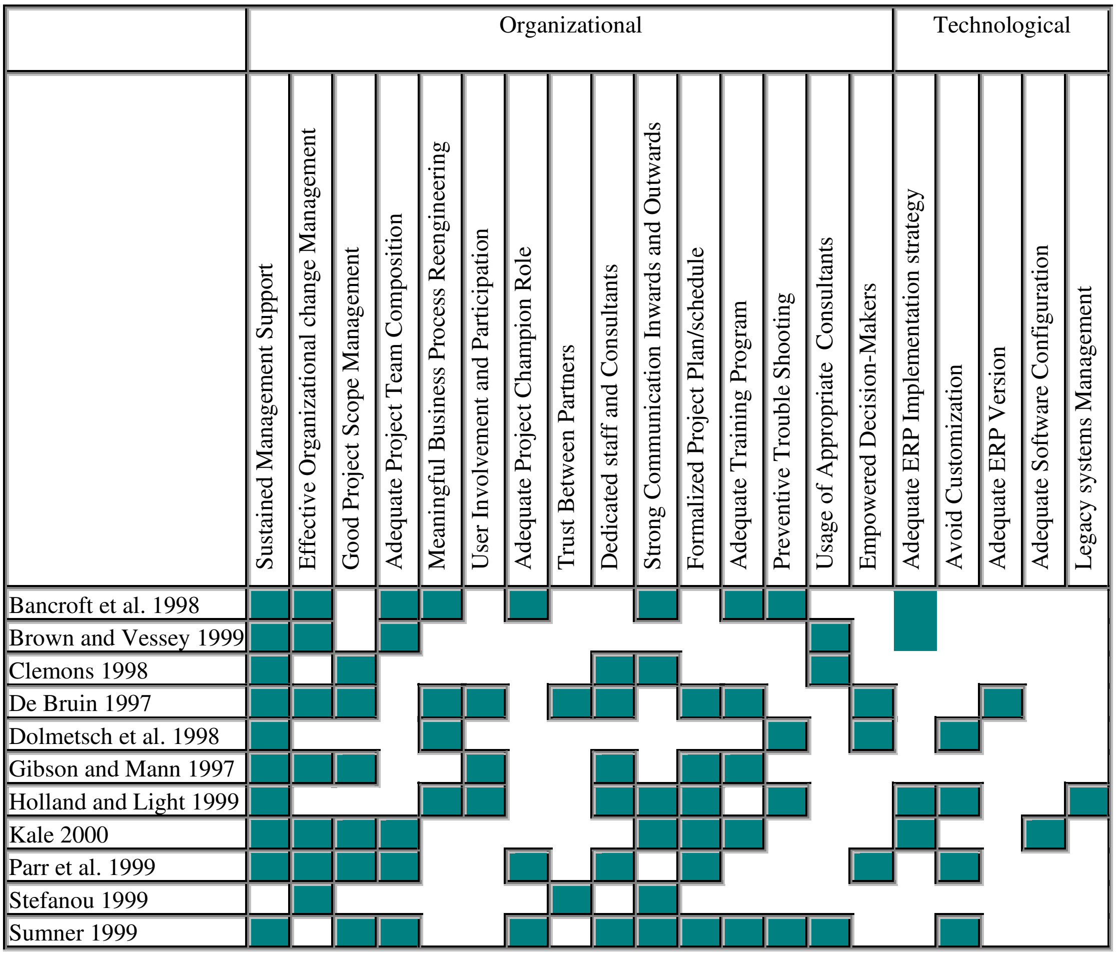


**Fig. 4.** CSFs citations along organizational and technological perspective.

We do not have much information about some of the case studies used to develop the CSFs in some of the research projects. In future work we want to control some variables like the type of ERP implementation. Recent studies have highlighted the differences between ERP implementations. Parr and Shanks (2000) argue that the concept of an ERP implementation is not a generic concept, and they proposed a taxonomy of ERP implementations with three broad categories:

Comprehensive - this category represents the most ambitious implementation approach. Typically, it involves a multi-national company, which decides to implement an ERP in multiple sites, often across national boundaries. Apart from the physical scope of the project, there is implementation of the full functionality of the ERP.

Middle-road - this category is, as the name suggests, mid-way between comprehensive and a vanilla implementation. Characteristically, there are multiple sites although there may be only one extensive site and a major decision is to implement a selection only of core ERP modules.

Vanilla - this the least ambitious and least risky implementation approach. Typically, the implementation is on one site only, and the number of prospective system users is small (less than 100).

In future research we want to use this taxonomy to develop our case studies, and see the relationship between the CSFs found and the type of ERP implementation.

# 7 Conclusions and Further Work

This technical research report defines a unified CSFs model for ERP implementations. This model was developed through the application of grounded theory, based upon a set of previous CSFs lists. The number of CSFs is large but they are divided in four perspectives: strategic and tactical perspectives, and organisational and technological perspectives.

An important aspect is that most of the factors found can be considered "*classics*" since they are not specific to ERP implementations. Nonetheless, given the complexity of these projects, each factor "*takes on greater significance*" (Bancroft et al, 1998 p.67). The analysis of the CSFs literature shows that management support is the most important factor in an ERP implementation followed by organisational change management. These CSFs have almost nothing to do with technology and almost everything to do with people and process, due to the effort that has to be undertaken by the whole organisation in a project of this nature.

This technical research report only provides the results of the open coding process from our application of the grounded theory method. The next steps will be axial and selective coding. We have not yet done these steps because the considered primary documents do not provide enough information to do so. We pretend to make some case studies to validate the model we created through open coding and then proceed with the other two steps. With axial coding we hope to develop some relationships between the factors, some affecting positively and/or negatively others. Since the several factors do not necessarily have the same importance along the implementation phase, we want to distribute their relative importance along the various stages of the implementation stages.

In the development of case studies we pretend to take into account some recent studies that categorised the different types of ERP implementations (Parr and Shank, 2000). The model developed here constitutes the basis for further research, in which the goals will be to validate the model, to represent the CSFs proposed using a formal modelling language, and to develop for each CSF a set of key performance indicators that will help in using the model.

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