Critical Success Factors for ERP System Implementation Projects: A Literature Review

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Abstract. The aim of our study was to gain insight into the research field of critical success factors (CSF) of enterprise resource planning (ERP) implementation projects. Therefore, we conducted a literature review, more specifically a systematic review of relevant articles in five different databases and among several international conference proceedings. Ultimately, we identified 185 relevant papers (95 single or multiple case studies, 55 surveys, and 35 literature reviews or articles from which CSFs can be derived). From these existing studies, we discovered 31 different CSFs for ERP implementation. The top three factors identified are Top management support and involvement, Project management, and User training. However, most of the relevant papers focus on large enterprises. Only 12 papers explicitly focus on smaller and medium-sized enterprises (S&MEs), which is clearly a research gap in this field.

Keywords: ERP systems, critical success factors, CSF, literature review, small and medium-sized companies, S&ME

1 Introduction

Today's enterprises are faced with the globalization of markets and fast changes in the economy. In order to be able to cope with these conditions, the use of information and communication systems as well as technology is almost mandatory. Specifically, the adoption of enterprise resource planning (ERP) systems as standardized systems that encompass the actions of whole enterprises has become an important factor in today´s business [1]. Therefore, during the last few decades, ERP system software represented one of the fastest growing segments in the software market; indeed, these systems are one of the most important recent developments within information technology. Due to the saturation of ERP markets targeting large-scaled enterprises, ERP system manufacturers today are also now concentrating on the growing market of small and medium-sized enterprises (S&MEs) [2], [3]. This has resulted in a highly fragmented ERP market and a great diffusion of ERP systems throughout enterprises of nearly every industry and every size [4], [5], [6].

The demand for ERP applications has increased for several reasons, including competitive pressure to become a low cost producer, expectations of revenue growth,

and the desire to re-engineer the business to respond to market challenges. A properly selected and implemented ERP system offers several benefits, such as considerable reductions in inventory costs, raw material costs, lead time for customers, production time, and production costs [7]. Therefore, current standardized ERP systems are used in a majority of enterprises around the world. For example, according to a survey conducted in Germany in 2009, ERP systems are used in more than 92 percent of all German industrial enterprises [8]. Due to the strong demand and the high fragmentation of the market, there are many ERP systems with different technologies and philosophies available on the market. This multitude of software manufacturers, vendors, and systems implies that enterprises that use or want to use ERP systems must strive to find the "right" software as well as to be aware of the factors that influence the success of the implementation project. Remembering these so called critical success factors (CSFs) is of high importance whenever a new system is to be adopted and implemented or a running system needs to be upgraded or replaced. Errors during the selection, implementation, or maintenance of ERP systems, wrong implementation approaches, ERP systems that do not fit the requirements of the enterprise can all cause financial disadvantages or disasters, perhaps even leading to insolvencies. Several examples of such negative scenarios can be found in the literature (e.g., [9], [10]). Especially, S&MEs must be aware of the CSFs since they lack the financial, material, and personnel resources of larger companies [11]. Thus, they are under greater pressure to implement and run ERP systems without failure and as smoothly as possible.

In order to identify the factors that affect the success or failure of ERP system implementation projects, several case studies, surveys, and literature reviews have already been conducted by different researchers (e.g., [12], [13], [14]). Regarding these literature reviews, most of them cannot be reproduced, because of missing descriptions of the review methods and procedures. Thus, some researchers clearly point out the drawbacks of the current literature review articles, specifically that they lack methodological rigor [15]. Therefore, in order to update the existing reviews by including current ERP literature, we conducted a literature review, more specifically a systematic review of articles in five different databases and among several international conference proceedings. The CSFs reported in this paper were derived from 185 papers identified as relevant, and the frequency of the occurrence of each CSF was counted. The aggregated results of this review will be presented in this paper. Additionally, we will focus CSFs specifically for S&MEs within the identified papers.

Therefore the paper is structured as follows: The next section presents the CSFs on which we focused during the review. Afterwards, our literature review methodology will be outlined in order to make our review reproducible. The fourth section deals with the results of the literature review. We will point out which factors are the most important and which factors seem to have little influence on the success of an ERP project. Finally, the paper concludes with a summary of the results as well as critical acclaim for the conducted literature review.

2 Critical Success Factors Identified

A CSF for ERP projects has been defined by Finney and Corbett [13] as a reference to any condition or element that was deemed necessary in order for the ERP implementation to be successful. The goal of the performed literature review is to gain an in-depth understanding of the different CSFs already identified by other researchers. The identified papers consist of papers that present single or multiple case studies, survey results, literature reviews, or CSFs conceptually derived from chosen literature. From these papers, we identified the following 31 noted CSFs:

- Available resources (e.g., budget and employees)
- Balanced project team
- Business process reengineering
- Change management
- Clear goals and objectives (e.g., vision and business plan)
- Communication
- Company's strategy / strategy fit
- Data accuracy (i.e., data analysis and conversion)
- Environment (e.g., national culture and language)
- ERP system acceptance / resistance
- ERP system configuration
- ERP system tests
- External consultants
- Interdepartmental cooperation
- Involvement of end-users and stakeholders
- IT structure and legacy systems
- Knowledge management
- Monitoring and performance measurement
- Organizational culture
- Organizational fit of the ERP system
- Organizational structure
- Project champion
- Project team leadership / empowered decision makers
- Project management
- Skills, knowledge, and expertise
- Top management support and involvement
- Troubleshooting
- Use of a steering committee
- User training
- Vendor relationship and support
- Vendor's tools and implementation methods

To provide a comprehensive understanding of the different CSFs and their concepts, they are described in this section before presenting the research methodology and discussing the results. However, only the top eight CSFs are described subsequently. An explanation for how they were chosen is given in section 3. The detailed definitions of the other 23 CSFs can be found in [16]. The top eight factors are: Balanced project team, Change management, Clear goals and objectives (e.g., vision and business plan), Communication, Organizational fit of the ERP system, Project Management, Top management support and involvement, and User training.

Balanced project team: In general, a project team consists of at least two persons working together for a common goal; additionally, each team member has defined responsibilities and functions [17]. The characteristics of the team members should complement each other with respect to their experience, their knowledge, and their soft skills [18]. An ERP implementation must be based on a solid core

implementation team that is comprised of the organization's best and brightest individuals [13]. Moreover, these team members should be assigned to the project on a fulltime basis. Only then can they fully concentrate on the project and not be disturbed or distracted with other daily business [19].

Change management: Change management indicates early participation of all persons affected by a change process in order to reduce resistance against these changes. An important component is adequate training as well as early communication of the changes to provide employees with an opportunity to react [20]. Change management strategies help to ease enterprise-wide cultural and structural changes. Therefore, training and education for the employees is necessary. As such, change management is not only designed for preventing rejection and supporting acceptance. Instead, its goal is to help employees understand and want the changes. Integrating the employees early in the planning and implementation process is important to achieve this goal. Also, during the user training sessions a support team should be available to answer all questions regarding the new processes and function. Furthermore, an additional evaluation with the end users should be accomplished after the system "goes live" to uncover problems and to avoid discord [21].

Clear goals and objectives (e.g., vision and business plan): Clear goals and objectives are seen as CSFs by many researchers (e.g., [7], [12], [22). This requires the formulations of a business vision, calculations of a business case, identification and communication of clear goals and objectives regarding the ERP implementation, and provision of a clear link between the business goals and the company's information system (IS) strategy [13], [23] in order to steer the direction of the project throughout the whole ERP implementation. Therefore, a good business plan that outlines proposed strategic and tangible benefits, includes resources, calculates costs and risks, and specifies a clear timeline is critical to an ERP project. These instruments can be very helpful to maintain the focus on project benefits and outcomes [21].

Communication: The CSF of communication represents one of the most difficult and challenging tasks during the implementation of an ERP system. A clear concept addressing communication is very important and involves a communication strategy as well as the respective communication channels and methods. This strategy should be aligned with the goals and requirements of the ERP project and should enable open and free communication (e.g., by providing an adequate communication platform) [23]. Expectations at every level need to be communicated [21]. Communication between the management, the project team, and the employees should be clear and occur on a regular basis. Detailed information about the project status, achieved results, and decisions made by the management are as essential as direct discussion of fears and conflicts.

Organizational fit of the ERP system: The fact that the organizational fit of an ERP system should be examined and considered comprehensively before its implementation sounds logical. Nevertheless, ERP manufacturers often try to create blind confidence in their ERP package even if when the organizational fit is obviously low. Hong and Kim [24] empirically examined the extent to which the implementation success of an ERP system depends on the fit between the company and the ERP system and found that the adaptation and configuration effort negatively

correlates with the implementation success. Therefore, the careful selection of an ERP system with consideration of its company specific organizational fit, such as company size or industry sector, is essential. Thus, appropriate ERP system selection is an important factor in the effort to ensure a good fit between the company and the ERP system.

Project management: Project management refers to the ongoing management of the implementation plan [13]. The implementation of an ERP system is a unique procedure that requires enterprise-wide project management. Therefore, it involves the planning stages, the allocation of responsibilities, the definition of milestones and critical paths, training and human resource planning, and the determination of measures of success [20], [22]. This enables fast decisions and guarantees that such decisions are made by the "right" company members. Furthermore, continuous project management allows focus to remain on the important aspects of the ERP implementation and ensures that timelines and schedules are met [20]. Within project management, comprehensive documentation of the tasks, responsibilities, and goals is indispensable for the success of an ERP implementation [25].

Top management support and involvement: Top management support and involvement is one of the most important success factors for an ERP implementation [26]. Committed leadership at the top management level is the basis for the continuous accomplishment of every project [13]. Thus, innovations, in particular new technologies, are more quickly accepted by employees if these innovations are promoted by top management. Before the project starts, top management has to identify the peculiarities and challenges of the planned ERP implementation. Since many decisions that have to be made during the project can affect the whole enterprise, these decisions will need the acceptance and the commitment of the senior managers and often can only be made by them [27]. The commitment of top management is important in order for the allocation of necessary resources, quick and effective decision making, solutions of conflicts that need enterprise-wide acceptance, and supporting cooperation from all different departments [23].

User training: Missing or inadequate end user training is often a reason for failures in the implementation of new software. The main goal of end user training is to provide an effective understanding of the new business processes and applications as well as the new workflows that are created by the ERP implementation. Therefore, establishing a suitable plan for the employees' training is important [23]. Furthermore, during such an extensive project, management must determine which employee is the best fit for which position or for which application of the new software. This strongly depends on the employee's already acquired knowledge and/or additional training courses [28].

3 Research Methodology – Literature Review

The literature review to identify the aforementioned CSFs was performed via several steps similar to the approach suggested by Webster and Watson [29]. In general, it was a database-driven review with an additional search in the proceedings of several IS conferences.

The steps of our review procedure are presented in the following paragraphs. An overview is given in Figure 1.

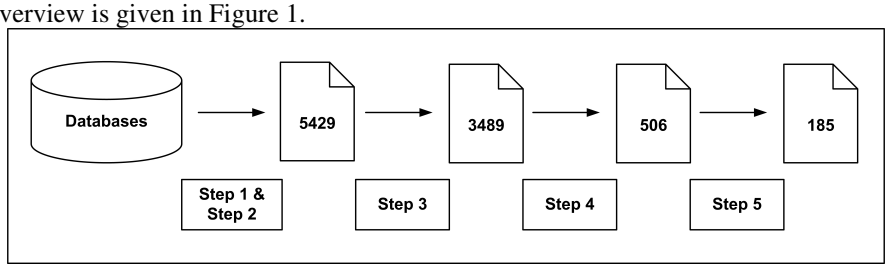

Figure 1. Progress of the literature review

Step 1: The first step involved defining the sources for the literature review. Through this approach, several databases and conference proceedings were identified (cp. Table 1).

Table 1. Sources for the literature review

Databases	Conferences
Academic Search Complete	AMCIS (2009 – 1998)
Business Source Complete	ECIS (2009 – 1998)
Science Direct	HICSS (2009 – 1998)
SpringerLink	ICIS (2009 – 1998)
WISO	Wirtschaftsinformatik (2009 – 1998)

Step 2: Within this step, we had to define the search terms for the database-driven review. Keywords selected for this search were mostly derived from the keywords supplied and used by the authors of some of the relevant articles identified in a preliminary literature review. Table 2 shows the search terms used for the database search.

Table 2. Search fields and search terms

Database + Search fields	Search terms / Keywords
Academics Search Complete: "TI Title" OR "AB Abstract or Author supplied abstract"	ERP + success* ERP + failure ERP + crit* ERP + CSF ERP + CFF ERP + fact* "Enterprise system*" + success* "Enterprise system*" + failure "Enterprise system*" + crit* "Enterprise system*" + CSF "Enterprise system*" + CFF "Enterprise system*" + fact*
Business Source Complete: "TI Title" OR "AB Abstract or Author supplied abstract"	
Science Direct: "Abstract, Title, Keywords"	
SpringerLink: "Title" OR "Abstract"	
WISO: "General search field"	

Since the WISO database also provides German papers, we additionally used the German translation for most of the search terms.

For the conferences, only inappropriate search fields were provided. Hence, we decided to manually review the abstracts and titles of the papers in this step.

Step 3: During this step, we performed the initial search according to steps 1 and 2 and afterwards eliminated duplicates. The initial search provided 5,429 papers from the databases. After eliminating the duplicates, 3,419 articles remained. From the conference search, 79 papers remained. Together, 3,498 papers were identified during the initial search step.

Step 4: The next step included the identification of irrelevant papers. During the initial search, we did not apply any restrictions. The search was not limited to the research field of IS; therefore, papers from other research fields were included in the results as well. For example the abbreviation "ERP" has also been used in the field of neuropsychology. Thus, these papers had to be excluded. This was accomplished by reviewing the abstracts of the papers and, if necessary, by looking into the papers' contents. 427 papers stemming from the database search and all 79 conference papers remained after this step; in total, this approach yielded 506 papers that were potentially relevant to the field of CSFs for ERP system implementations.

Step 5: The fifth and final step consisted of a detailed analysis of the remaining 506 papers and the identification of the CSFs. Therefore, the content of all 506 papers was reviewed in depth for the purpose of categorizing the identified success factors. Emphasis was placed not only on the wording of these factors but also on their meaning. After this step, 185 relevant papers that suggested, discussed, or mentioned CSFs remained. The results of the analysis of these 185 papers are described in the following section.

The detailed literature lists created from every step of this process are not included in the references of this paper. They will be provided by the author upon request.

4 Results of the Literature Review

As stated previously, 185 papers (e.g., single or multiple case studies, surveys, and literature reviews) that referred to CSFs of ERP implementation projects were identified. These papers were reviewed again in depth in order to determine the various concepts associated with CSFs. Overall, 31 factors (as described previously and in [16]) were identified. In most previous literature reviews, the CSFs were grouped without as much attention to detail; therefore a lower number of CSFs was used (e.g., [7], [13], [21]). However, our approach was different in our review. For the 31 factors, we used a larger number of categories than other researchers as we expected the resulting distribution to be more insightful. If more broad definitions for some CSFs might be needed at a later time, further aggregation of the categories is still possible.

After identifying the relevant papers as well as the factors stated within those papers, we developed a table for the analysis, i.e., to match the factors with the papers. Figure 2 shows a snapshot of this CSF table. For each paper, the CSFs were captured as well

as the publication year, the type of data collection used, and the companies (i.e., the number and size) from which the CSFs were derived.

ACADEMIC SOURCE COMPLETE								
ID	YEAR	FORMS OF DATA COLLECTION	NUMBER OF COMPANIES & COMPANY SIZE	ERP SYSTEM CONFIGURATION	BALANCED PROJECT TEAM	PROJECT MANAGEMENT	EXTERNAL CONSULTANTS	USER TRAINING
1936.	2008	Literature-based, survey	91 responses from companies which have implemented ERP systems	X			X	X
1685.	2008	Literature-based, survey	281 responses		X	X	X	X
1777.	2003	Literature review, survey	54 responses from CIOs of companies which have implemented ERP systems		X	X		
1733.	2007	CSFs derived from literature and proven by field studies / survey	48 Mexican companies		X	X	X	X
1785.	2004	Case studies	5 large companies		X		X	X
1659.	1999	Literature review & case studies	8 large companies	X		X		
1977.	2008	Survey	130 responses, SME	X				X

Figure 2. Snapshot of the CSF results

All 185 papers were published between the years 1998 and 2010. Table 3 shows the distribution of the papers based on publication year. Most of the papers were published between 2009 and 2004. Starting in 2004, around 20 papers about CSFs were published each year. Therefore, a review every 2 or 3 years would be reasonable in order to update the results of previously performed literature reviews.

Table 3. Paper distribution

Year	Papers	Year	Papers
2010	6	2003	11
2009	29	2002	12
2008	23	2001	5
2007	23	2000	6
2006	25	1999	3
2005	18	1998	1
2004	23		

The small number of papers reported for 2010 was a result of the fact that we conducted the database review in June of 2010. Additionally, some databases provide access to certain journal articles only if they were published more than 12 months

previously. Thus, these articles were not included in our review as well as the AMCIS 2010 and the ICIS 2010.

Figure 3 shows the results of our review, i.e., the identified CSFs and each factor's total number of occurrence in the reviewed papers. The factors "Top management support and involvement," "Project management," and "User training" are the three most named factors with each being mentioned in around or above 100 articles.

Comparing these results with other literature reviews (e.g., [13]), the top five factors are obviously similar with the ranked positions only being different. Due to our large literature base, the total numbers of observed mentions are much higher (cp. Table 4). Therefore, the differences in the CSF frequencies are much higher as well. So, the distinction between the significance of the several factors becomes clearer.

Regarding the data collection method, we must note that the papers we analyzed for CSFs were distributed as follows: single or multiple case studies – 95, surveys – 55, and literature reviews or articles where CSFs are derived from chosen literature – 35.

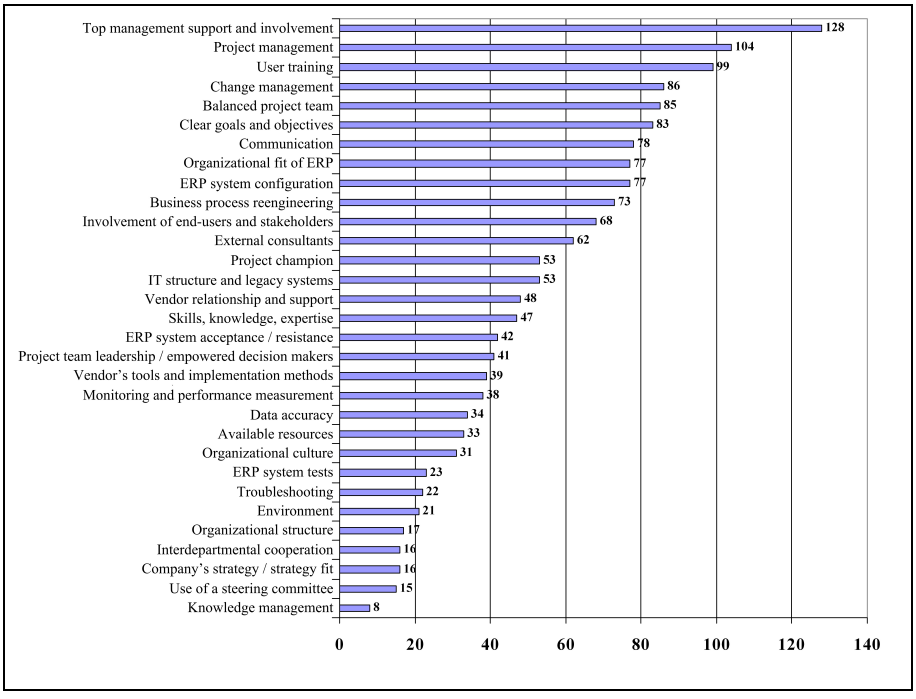

Figure 3. CSFs in rank order based on frequency of appearance in analyzed literature

Concerning the company size, only 12 papers explicitly focused on S&MEs, mostly in the form of single or multiple case studies. In some surveys, S&MEs are included and analyzed as well, but they only make up a minor portion of the respective samples. The results of the 12 papers focusing on S&MEs are shown in Figure 4.

Table 4. Literature review comparison

	Finney and Corbett [13]		Our review	
	Factor	**Number of instances**	**Factor**	**Number of instances**
Rank #1	Top management commitment and support	25	Top management support and involvement	128
Rank #2	Change management	25	Project management	104
Rank #3	BPR and software configuration	23	User training	99
Rank #4	Training and job redesign	23	Change management	86
Rank #5	Project team: the best and brightest	21	Balanced project team	85

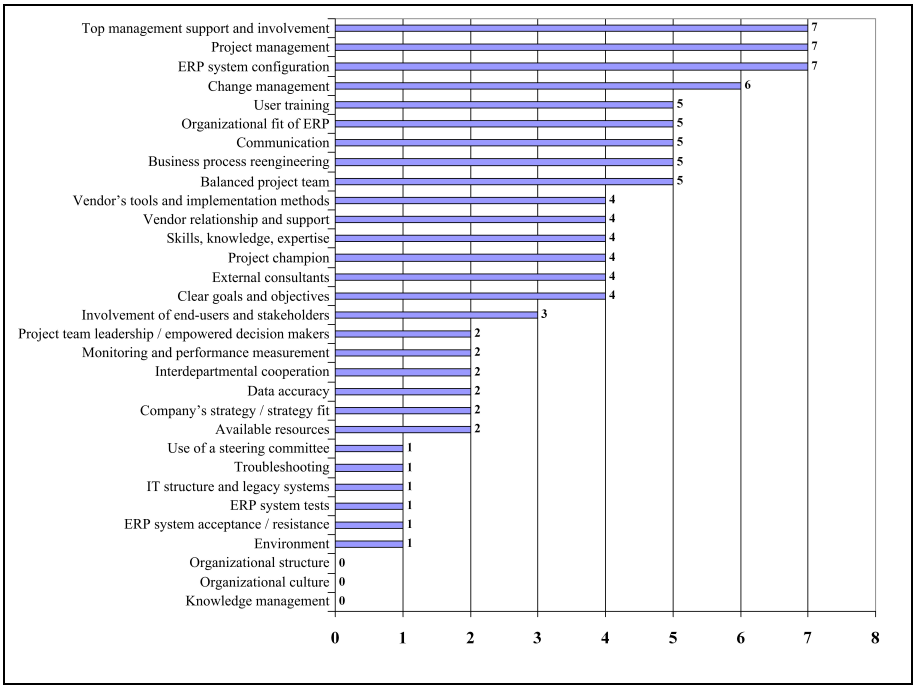

Figure 4. CSFs of S&MEs

As is shown by Figure 4, “Top management support and involvement” as well as “Project management” are again the most frequently named factors. However, “ERP system configuration” is also a top ranked CSF for S&MEs; this CSF is only ranked #8 within the overall results for all sized corporations (cp. Figures 3 and 4). However, the differences in the CSF frequencies are only minimal and may be related to the small number of identified papers. Therefore, deriving CSFs that are important for S&MEs is difficult due to the small number of studies focusing solely on them. This clearly is a research gap in ERP CSF research area.

Considering the different years in which the identified papers were published (cp. Table 3), we have analyzed three different time spans (1998 – 2003, 2004 – 2006, and 2007 – 2010) to identify changes of the CSF ranking. The results of this analysis are shown in Table 5 in the Appendix and the respective top five factors of each time span are shown in Figure 5. As is shown, “Top management support and involvement” is again the most frequently named factor with rank #1 in each time span. Additionally, “Project management” and “User training” are always in the top five throughout the different time spans (cp. Figure 5).

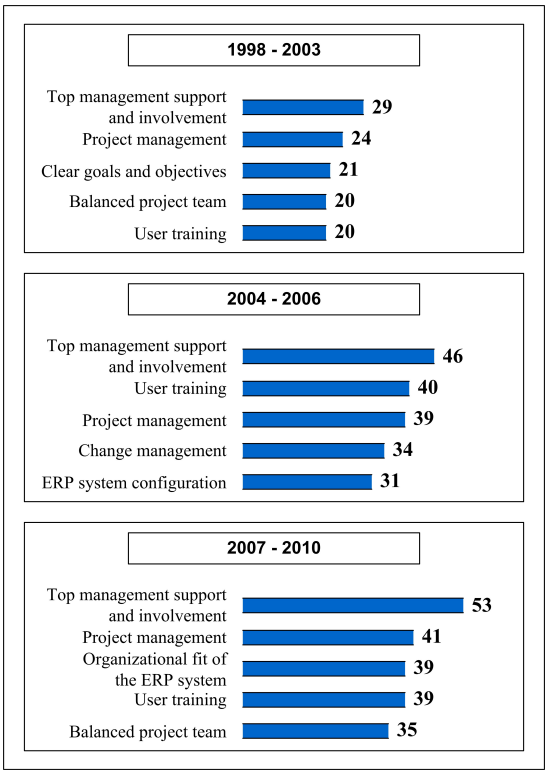

Figure 5. Time span analysis of the CSFs

Most of the factors do not change there ranks throughout the time spans significantly (cp. Table 5). However, the CSFs “External consultants” and “Organizational fit of

the ERP system" have gained more importance whereas others have lost some importance throughout the years (e.g., "Clear goals and objectives" and "Monitoring and performance measurement"). The factor "Organizational fit of the ERP system" has even gained a rank in the top five in time span 2007 – 2010 (cp. Figure 5). Reasons for this can be seen in the highly fragmented ERP system market as well as in the increasing multitude of software manufacturers and ERP systems. Enterprises are facing more and more difficulties to identify the best fitting ERP system. Therefore, more emphasis is laid on the selection of the "right" ERP system with a high "Organizational fit" as well as on the support and the consulting service of "External consultants".

5 Conclusion and Future Research

The aim of our study was to gain insight into the research field of CSFs for ERP implementation projects. Research on ERP implementation and CSFs is a valuable step toward enhancing an organization's chances for implementation success [13]. Our study reveals that several papers, i.e., case studies, surveys, and literature reviews, focus on CSFs. All in all, we identified 185 relevant papers. From these existing studies, we derived 31 different CSFs. The following are the top three CSFs that were identified: "Top management support and involvement," "Project management," and "User training."

This ranking is similar to the rankings found in other literature reviews (e.g., [7], [13]). Compared to those other reviews, the number of papers included in our study generally far exceeds their numbers. One reason for this discrepancy is that these reviews are older than ours. As shown in Table 3, around 20 or even more CFS-papers were published every year since 2004. Thus, one conclusion suggests that new literature reviews on the CSFs of ERP systems should be completed every two or three years in order to update the results. Another conclusion is related to the size of the companies from which the data was collected in the empirical studies. Most of these studies focus on large companies. S&MEs are usually underrepresented, if included at all, in quantitative studies. Studies exclusively focusing on S&MEs are rare. We identified 12 out of the 185 articles with this explicit focus. This clearly represents a lack of research, which has been mentioned by other authors as well (e.g., [25]).

Since the ERP market for large companies became saturated at the beginning of this century, many ERP manufacturers have shifted focus to the S&MEs segment due to low ERP penetration rates within this segment. This low penetration rate is also supported by a study conducted in 2009 of 124 German S&MEs. Only 35 of the participating companies had implemented an ERP system [30]. Therefore, large market potential awaits any ERP manufacturers addressing these markets. Hence, CSF research should also focus on S&MEs due to the remarkable differences between large-scaled companies and S&MEs [11]. Therefore, ERP implementation projects must be adapted to the specific needs of S&MEs. Also, the importance of certain CSFs might differ depending on the size of the organization. Thus, we have concluded that an explicit focus on CSFs for S&MEs is necessary in future research.

Regarding our literature review, a few limitations must be mentioned as well. We are aware that we cannot be certain that we have identified all relevant papers published in journals and conferences since we made a specific selection of five databases and five international conferences. Therefore, journals not included in our databases and the proceedings from other conferences might also be relevant articles. Another limitation is the coding of the CSFs. We tried to reduce any subjectivity by formulating coding rules and by discussing the coding of the CSFs among three independent researchers. Hence, other researchers may code the CSFs in another way. Therefore, to repeat or reproduce our procedure, the list of all identified papers from every step can be requested from the author.

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Appendix – Time span analysis of the critical success factors

Table 5. CSFs' ranks and frequencies in different time spans

	1998 – 2003		2004 – 2006		2007 – 2010	
Factor	**Number of in-stances**	**Rank**	**Number of in-stances**	**Rank**	**Number of in-stances**	**Rank**
Available resources	5	**24**	9	**23**	19	**17**
Balanced project team	20	**4**	30	**6**	35	**5**
Business process reengineering	18	**7**	27	**8**	28	**12**
Change management	19	**6**	34	**4**	33	**6**
Clear goals and objectives	21	**3**	30	**6**	32	**8**
Communication	18	**7**	27	**8**	33	**6**
Company's stra-tegy / strategy fit	3	**28**	6	**28**	7	**28**
Data accuracy	8	**20**	12	**20**	14	**20**
Environment	3	**28**	9	**23**	9	**25**
ERP system acceptance / resistance	11	**14**	11	**22**	20	**16**
ERP system configuration	15	**9**	31	**5**	31	**9**
ERP system tests	6	**23**	9	**23**	8	**26**
External consultants	10	**17**	22	**12**	30	**10**
Interdepartmental cooperation	2	**30**	7	**27**	7	**28**
Involvement of end-users and stakeholders	11	**14**	27	**8**	30	**10**

IT structure and legacy systems	14	**10**	17	**15**	22	**14**
Knowledge management	2	**30**	5	**29**	1	**31**
Monitoring and performance measurement	12	**13**	16	**16**	10	**23**
Organizational culture	7	**21**	13	**19**	11	**22**
Organizational fit of the ERP system	14	**10**	24	**11**	39	**3**
Organizational structure	4	**27**	3	**30**	10	**23**
Project champion	14	**10**	15	**17**	24	**13**
Project team leadership / empowered decision makers	9	**18**	18	**14**	14	**20**
Project management	24	**2**	39	**3**	41	**2**
Skills, knowled-ge, and expertise	7	**21**	22	**12**	18	**18**
Top management support and involvement	29	**1**	46	**1**	53	**1**
Troubleshooting	5	**24**	9	**23**	8	**26**
Use of a steering committee	5	**24**	3	**30**	7	**28**
User training	20	**4**	40	**2**	39	**3**
Vendor's relationship and support	11	**14**	15	**17**	22	**14**
Vendor's tools and implemen-tation methods	9	**18**	12	**20**	18	**18**