

# Critical Success Factors for ERP Projects in Small and Medium-Sized Enterprises—The Perspective of Selected ERP System Vendors

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**Abstract** The aim of our study was to provide a contribution to the research field of the critical success factors (CSFs) of ERP projects, with specific focus on smaller enterprises (SMEs). Therefore, we conducted a systematic literature review in order to update the existing reviews of CSFs. On the basis of that review, we led several interviews with ERP consultants experienced with ERP implementations in SMEs. As a result, we showed that all factors found in the literature also affected the success of ERP projects in SMEs. However, within those projects, technological factors gained much more importance compared to the factors that most influence the success of larger ERP projects. For SMEs, factors like the Organizational fit of the ERP system as well as ERP system tests were even more important than Top management support or Project management, which were the most important factors for large-scale companies.

**Keywords** ERP systems · Critical success factors · CSF · SME

## 1 Introduction

Today's enterprises are faced with the globalization of markets and fast changes in the economy. In order to cope with these conditions, the use of technology, as well as information and communication systems is almost mandatory. Specifically, the adoption of enterprise resource planning (ERP) systems as standardized systems that encompass the activities of entire enterprises has become an important factor for today's businesses. The demand for ERP applications has increased for several reasons, including competitive pressure to become low-cost producers, expectations of revenue growth, and the desire to re-engineer businesses to respond to market

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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 [1–4]. Therefore, the majority of enterprises around the world use ERP systems. For example, according to a survey conducted in Germany from 2010 to 2011, ERP systems are used in more than 92 % of all German industrial enterprises [5].

Due to the saturation of ERP markets targeting large-scale enterprises, ERP system manufacturers today are also now concentrating on the growing market of small and medium-sized enterprises (SMEs) [3, 6]. 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 [7–9]. 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.

The implementation of an information system (e.g., an ERP system) is a complex and time-consuming project during which companies face great opportunities, but at the same time also face enormous risks. To take advantage of the potential opportunities rather than get caught by the risks of these implementation projects, it is essential to focus on those factors that support a successful implementation of an information system [10, 11]. Being aware of these factors, a company can positively influence the success of the implementation project and effectively minimize the project’s risks [10]. Recalling 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, and 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., [12, 13]). SMEs must be especially aware of the CSFs since they lack the financial, material, and personnel resources of larger companies. Thus, they are under greater pressure to implement and run ERP systems without failure and as smoothly as possible.

These critical success factors have already been considered in numerous scientific publications. Several case studies, surveys, and literature reviews have already been conducted by different researchers (e.g., [4, 14–16]). However, the existing ERP system success factor research has focused mostly on the selection and implementation of ERP systems in large enterprises. Less attention has been paid to the implementation projects in SMEs, despite the fact that research focusing on CSFs in smaller companies has been recommended in the research community for several years (e.g., [17, 18]).

Therefore, the aim of our study was to focus on the implementation of ERP systems in SMEs, especially focusing on the differences in CSFs of larger ERP projects and smaller projects. Prior to this study, we conducted a systematic literature review in order to update the existing reviews of CSFs. On the basis of the

CSFs identified, we conducted multiple interviews with German ERP consultants with specific experience in smaller ERP projects to obtain insights into the similarities and differences in CSFs for ERP system implementations in SMEs. Overall, our study was driven by the following research question:

Q1: What similarities and differences exist between critical success factors for ERP implementation projects in larger and smaller enterprises?

Therefore, the paper is structured as follows. The next section gives a short overview of the later discussed and important CSFs before the following section deals with the results of our literature review. There, we will point out which factors are the most important and which factors seem to have little influence on the success of an ERP implementation project. Next, our data collection methodology is described before the results of the interviews are presented and the research question is answered. Finally, the paper concludes with a summary of the results and discusses the limitations of our study.

## 2 Critical Success Factors Identified

A CSF for ERP projects has been defined by [15] as a reference to any condition or element that was deemed necessary in order for the ERP implementation to be successful. 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 most important and later-on discussed factors are described subsequently. The detailed definitions of the other CSFs can be found in [7, 19].

**Balanced project team:** In general, a project team consists of at least two persons working together for a common goal whereby each team member has defined responsibilities and functions [20]. The characteristics of the team members should complement each other, on their experience, their knowledge as well as their soft skills [21]. For an ERP implementation it is important to have a solid, core implementation team that is comprised of the organization's best and brightest individuals [15]. These team members should be assigned to the project on a fulltime basis. Only then they can fully concentrate on the project and are not disturbed or distracted with their daily business [22].

**Change management:** Change management involves early participation of all persons affected by a change process in order to reduce resistance against these changes. An important component is adequate training especially of the IT-department as well as an early communication of the changes to provide employees with an opportunity to react [23]. Change management strategies are responsible for handling the enterprise-wide cultural and structural changes. Therefore, it is necessary to train and educate the employees in various ways. Thereby, change management not only aims towards preventing rejection and supporting acceptance. Moreover, its goal is making employees understand and

want the changes. Integrating the employees early in the planning and implementation process is important to achieve this understanding. Also, during the user training sessions a support team should be available in order to clarify and answer questions regarding the new processes and function. Furthermore, an additional evaluation with the end users should be accomplished after the “go live” to uncover problems and to avoid discords [24].

**ERP system configuration:** Since the initial ERP system version is based on best practices, a configuration or adaption of the system according to business processes is necessary in every ERP implementation project. Hence, as far as possible, the company should try to adopt the processes and options built into the ERP, rather than seek to modify the ERP [25]. Following [26], the more strongly the original ERP software is modified (e.g., even beyond the “normal” configuration) the smaller the chance is for a successful implementation project. Hence, a good business vision is helpful because it reduces the effort of capturing the functionality of the ERP business model and therefore minimizes the effort needed for the configuration [25]. Again, extensive system modifications will not only cause implementation problems, but also harm system maintenance. Therefore, fewer adjustments reduce the effort of integrating new versions, releases or updates [24].

**ERP system tests:** In ERP implementation, “go live” on the system without adequate and planned system testing may lead to an organizational disaster. Tests and validation of an ERP system is necessary to ensure that the system works technically correct and that the business process configurations were done in the right way [27]. Therefore testing and simulation exercises for both, the whole system and separate parts/functions, have to be performed during and in the final stages of the implementation process [15, 28].

**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 the organizational fit is obviously low. In [26] is 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 [15]. 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 [23, 29]. 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 [23]. Within

project management, comprehensive documentation of the tasks, responsibilities, and goals is indispensable for the success of an ERP implementation [17].

**Top management support and involvement:** Top management support and involvement is one of the most important success factors for an ERP implementation [14]. Committed leadership at the top management level is the basis for the continuous accomplishment of every project [15]. 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 [30]. 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 [28].

**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 [28]. 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 [31].

### 3 Literature Review of Critical Success Factors

In order to identify these factors that affect the success or failure of ERP projects, several case studies, surveys, and literature reviews have already been conducted by a number of researchers (e.g., [4, 15, 16, 24–26]).

However, most of the literature reviews cannot be reproduced, because descriptions of the review methods and procedures are lacking. Some researchers have pointed out the limitations of literature review articles, specifically noting that they lack methodological rigor [32]. Therefore, in order to update the existing reviews by including current ERP literature, we conducted a literature review by systematically reviewing articles in five different databases as well as papers drawn from several international conference proceedings. More specifically, we conducted two separate literature reviews according to the same search procedures and steps. The first was performed in mid-2010 [7, 19]. Since we identified 20 or more papers published each year, it was essential for us to update this review every 2 or 3 years. Therefore, we conducted the second review in mid-2013. The overall procedure for the literature review will not be part of this paper. It is described in detail in [7, 19, 33].

**Table 1** Paper distribution

Year	Papers	Year	Papers
2013	30	2005	15
2012	31	2004	20
2011	39	2003	11
2010	37	2002	11
2009	42	2001	5
2008	22	2000	5
2007	24	1999	3
2006	24	1998	1

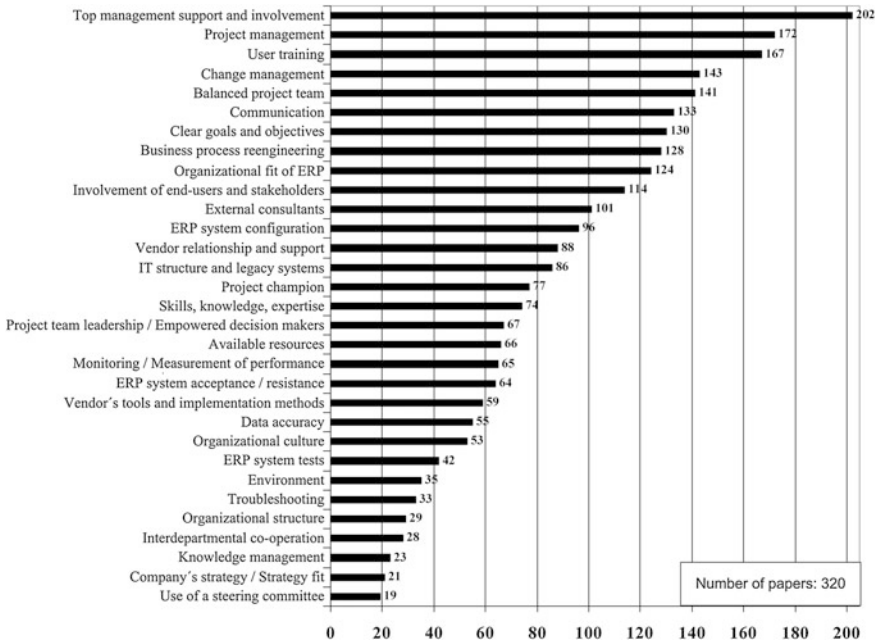
We identified 320 papers that referred to CSFs of ERP projects. These papers were reviewed again in depth in order to determine the various concepts associated with CSFs. For each paper, the CSFs were captured along with the publication year, the type of data collection used, and the companies (i.e., the number and size) from which the CSFs were derived. All 320 papers were published between 1998 and mid-2013. Table 1 shows the distribution of the papers by publication year. As is shown, most of the papers were published between 2006 and 2013.

Since 2004, each year around 20 papers and since 2009 each year around 30 papers or more papers about CSFs have been published. Therefore, it can be argued that a review every 2 or 3 years is reasonable in order to update the results of previously performed literature reviews, especially when considering the rapidly evolving technology and the changing system availability like the “Software-as-a-Service”-concept or ERP systems provided in the cloud.

Overall, 31 factors influencing the success of ERP system implementation were identified. Figure 1 shows the results of our review, i.e., the CSFs identified, their ranks and each factor’s total number of occurrences in the reviewed papers. *Top management support and involvement*, *Project management*, and *User training* are the three most-named factors, with each being mentioned in more than 160 articles. Therefore, the factor *Top management support and involvement* is the outstanding rank #1 referred to in more than 200 papers. As mentioned above, we will not describe each factor and its concepts in detail in this paper. However, to provide a full understanding of the different CSFs and their concepts, we describe all 31 factors in [19] as well as the top eight factors again in more detail in [7].

Regarding the form of data collection, it must be stated that the papers consist of 144 single or multiple case studies, 118 surveys and 58 literature reviews or articles where CSFs are derived from the chosen literature.

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., [4, 15]). However, we took a different approach in our review. For the 31 factors, we used a larger number of categories than other researchers, as we expected the resulting distribution to offer more insight. If broader definitions for some CSFs might be needed at a later time, further aggregation of the categories is still possible. Comparing these results with other literature reviews (e.g., [15]), the top five factors are obviously similar, with only the ranked positions differing. Due to our large



**Fig. 1** Literature review—CSFs in rank order based on frequency of appearance in analyzed literature

literature base, the total numbers of observed mentions are much higher. Therefore, the differences in the CSF frequencies are much higher as well, making the distinctions in the significance of the factors clearer.

Concerning the company size during review 1 (conducted in mid-2010), only 12 papers explicitly focus on small and medium-sized enterprises (SMEs), mostly within single or multiple case studies. Within the review update (conducted in mid-2013), 25 articles dealt with SMEs explicitly. In some surveys, SMEs are included and analyzed as well, but they are a minority in these surveys. Therefore, deriving CSFs which are important for SMEs is difficult and can be seen as still lacking in the CSF research.

Within these 37 papers focusing on SMEs, *Top management support and involvement* (mentioned in 25 articles), *Project management* (mentioned in 25 articles) as well as *User training* (mentioned in 22 articles) are again the most frequently named factors for ERP projects in smaller enterprises (see Fig. 2).

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 SMEs is difficult due to the small number of studies focusing solely on them. This clearly is a research gap in the ERP CSF research area. Therefore, our study focuses on this gap. We investigated these CSFs by interviewing German ERP consultants with specific experience in smaller ERP projects. The results will be part of the next sections.

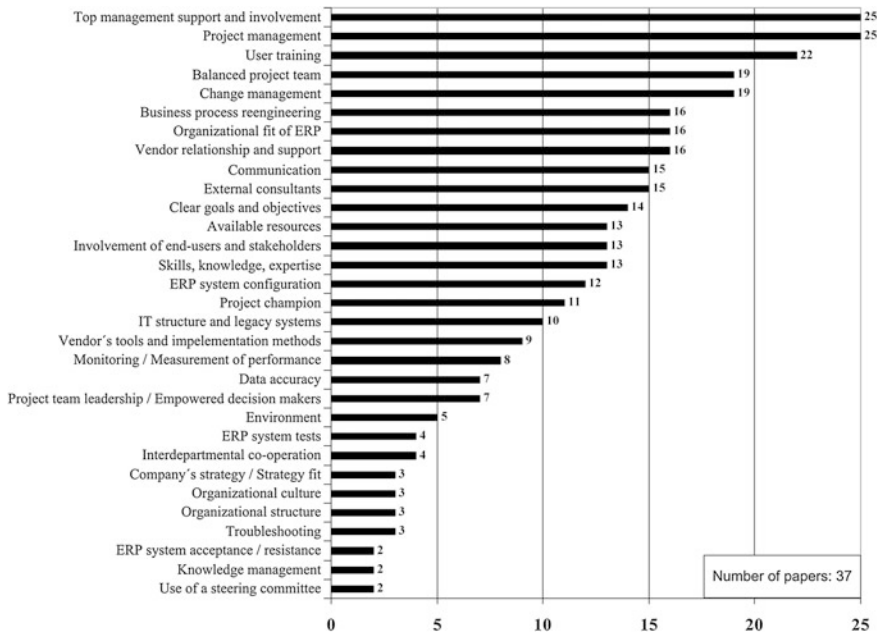


Fig. 2 Literature review—CSFs of ERP projects in SMEs

## 4 Critical Success Factors for SMEs’ ERP Projects

### 4.1 Study Design—Data Collection Methodology

To gain an understanding of the differences in the CSFs for ERP system projects in large-scale enterprises and SMEs, we used a qualitative exploratory approach within German ERP system vendors.

The units of analysis in our study are the ERP projects for SMEs that the ERP consultants have performed so far in their career. For the data collection, we conducted several interviews with ERP consultants from German ERP system vendors to identify the factors that they determined to be relevant for the projects’ success.

Therefore, we interviewed ten ERP consultants from six ERP system vendors. Table 5 in the Appendix gives an overview of the interviewed ERP consultants. Among the ERP consultants, we were able to interview some consultants with longtime experience in more than 100 ERP projects as well as some consultants who had been working in this field for only a few years and had experience with fewer than 10 ERP projects (see Table 5).

To gain a deep and detailed view of the consultants’ experiences, we chose direct structured interviews as our method of data collection. The interviews were conducted in retrospect to the ERP projects between April and July 2013. The interviews were designed as partially standardized interviews using open to semi-open



questions as initial starting points for the conversation. Both personal (face-to-face) interviews, as well as telephone interviews, were conducted by the author. An interview guideline was developed, based on the questions of [34], who conducted a similar study, as well as on the basis of one of our previous CSF studies that had another focus [35]. We changed the questions to align with our identified CSFs (see Fig. 1) to ensure that all of the factors were discussed in the interviews. The interview guideline consisted of 52 main questions with further sub-questions which referred to the 31 identified CSFs. These questions were formulated in an open way so that it would be possible to identify “new” CSFs which were not resulting from the literature review. This questionnaire was sent to interviewees before the interviews took place to allow them to prepare for their interviews.

For a better analysis of the results, we recorded all interviews (the interviews typically took between 70 and 180 min) and transcribed them afterwards (resulting in about 250 pages of written text). As a first step, non-verbal and para-linguistic elements and other elements that were not relevant to the study were excluded. Afterwards, to evaluate the CSFs, the interviews were analyzed with reference to each CSF question block. We matched the answers and statements of the interviewees to the respective factor. Then, each CSF was ranked according to a three-tier scale (2-very important factor; 1-important factor; 0-less/non-important factor), and, for a finer classification, according to a five-tier scale (4-very important factor; 3-important factor; 2-factor was seen as relevant; 1-factor was mentioned but not seen as being very relevant; 0-factor was not seen as relevant or important/factor was not mentioned at all). This rating was done regarding the respective statements of the interviewees. We used these two scales to gain a preliminary understanding of whether differences would occur by using a finer/more detailed scale. Here, the five-tier-scale could be seen as more appropriate for determining the importance of the factors. After setting up this ranking of CSFs, we discussed the factor rating with other researchers in this field to reduce the subjectivity of the rating. Finally, this procedure resulted in a ranking of all 31 CSFs according to the interviewees’ statements and answers.

## 4.2 Results of the Interviews

For each interview, a ranking of the critical success factors was set up by the author. A final ranking was created including all interviews and all individual rankings (see Table 2). As shown, the most important factors for ERP implementation projects in small and medium-sized companies according to our study are *ERP system tests* and *Organizational fit of the ERP system* with more than 30 out of a possible 40 points. Also, no further factors could be identified during the interviews. Each of the 31 factors stemming from the literature review was mentioned by at least one interviewee. However, the factors *Organizational structure*, *Troubleshooting* and *Interdepartmental cooperation* were in fact mentioned by some interviewees but these factors were not seen as really important. They were rated with less than five out of 40 possible points.

**Table 2** CSFs according the five-tier-scale rating

Rank	Factor	Factor rating	Rank	Factor	Factor rating
1	Organizational fit of the ERP system	31	17	External consultants	18
	ERP system tests	31		Involvement of end-users and stakeholders	18
3	Balanced project team	28	20	Data accuracy	18
	Project management	28		Organizational culture	17
5	Change management	27	21	Vendor relationship and support	15
6	Clear goals and objectives	26		Vendor's tools and implementation methods	15
	Communication	26	23	Project champion	13
8	Top management support and involvement	25		Environment	13
	User training	25	Knowledge management	13	
10	ERP system configuration	24	23	Skills, knowledge, and expertise	13
11	Use of a steering committee	23		27	IT structure and legacy systems
12	Company's strategy/strategy fit	22	28	Business process reengineering	10
13	Monitoring and performance measurement	20	29	Troubleshooting	4
14	Available resources	19	30	Organizational structure	1
	Project team leadership/empowered decision makers	19	31	Interdepartmental cooperation	0
	ERP system acceptance/resistance	19			

4-very important factor; 3-important factor; 2-factor was seen as relevant; 1-factor was mentioned but not seen as being very relevant; 0-factor was not seen as relevant or important/factor was not mentioned at all) / maximum possible rating on basis of 10 interviews = 40

Neither of the two most important factors were part of the top 5 within the ranking of the literature review (see Table 3). The factor *ERP system tests* was not even part of the top 20 within the literature review (see Figs. 1 and 2). Also, *Organizational fit of the ERP system* has gained more importance, according to our interviewees. The importance of both factors indicates that SMEs are forced to find the right ERP system that fits their needs and to test the system properly before the Go-Live. As mentioned in the first section, due to their lack of the financial, material, and personnel resources compared to larger companies', failures during or

**Table 3** Comparison of the top five factors

Rank	Results of the literature review (all company sizes)	Results of the literature review (only SMEs)	Factors from the interviews
1	Top management support and involvement	Top management support and involvement	Organizational fit of the ERP system ERP system tests
2	Project management	Project management	
3	User training	User training	Balanced project team Project management
4	Change management	Balanced project team Change management	
5	Balanced project team		Change management

after the Go-Live can easily cause financial disadvantages or disasters, perhaps even leading to the insolvency of such small companies. Therefore, this is supported by the importance of the top two factors in our study.

Reasons for this can also 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 in identifying the best fitting ERP system. Therefore, more emphasis is laid on the selection of the “right” ERP system with a high *Organizational fit of the ERP system*. This also supports the statement that SMEs strongly depend on ERP systems that fit their needs even more than large companies may. SMEs cannot afford to be restricted by stiff ERP processes; moreover, it is important that the system is adapted according to their own processes. This can also be seen by looking at *Business process reengineering*. This factor was part of the top 10 in the literature review (see Figs. 1 and 2) but is ranked at #28 in our study with only 10 out of 40 possible points (see Table 2). Here, SMEs seek more to adapt the system than to change the business processes.

To categorize critical success factors, in [25] a matrix scheme is suggested. Here, the authors consider the tactical or strategic direction of the CSFs and divide them into organizational and technological factors. Thus, tactical CSFs rather relate to short-term aspects and goals of the system implementation project itself, whereby strategic factors aim towards long-term impacts of activities with strong connections to the development of the organization in relation to mission, vision and core competencies of the business activity. Considering the technological and organizational character of the CSFs, the specificity and significance of technological factors are strongly dependent on the ERP systems themselves, whereas organizational factors focus on corporate culture and its environment with its specific processes and structures [25, 36, 37]. Table 4 gives an overview of the categorization of the identified CSFs in our study with a focus on their ranking.

We oriented the classification and categorization of the factors according to [36, 37]. The factors of the top 10 are highlighted. It is shown that only a few CSFs (six out of 31) are technological factors whereas more than 50 % of the factors (17 out

**Table 4** Categorization of CSFs (Model adapted from [25, 36, 37])

	Strategic		Tactical	
Organizational	<b>Critical Success Factors</b>	<b>Rank</b>	<b>Critical Success Factors</b>	<b>Rank</b>
	Balanced project team	3	Project management	3
	Change management	5	Communication	6
	Clear goals and objectives	6	User training	8
	Top management support and involvement	8	Monitoring/measurement of performance	13
	Use of a steering committee	11	External consultants	17
	Company's strategy/strategy fit	12	Skills, knowledge and expertise	23
	Available resources	14	Troubleshooting	29
	Project team leadership/empowered decision makers	14	Interdepartmental cooperation	31
	ERP system acceptance/resistance	14		
	Involvement of end-users and stakeholders	17		
	Organizational culture	20		
	Vendor relationship and support	21		
	Project champion	23		
	Environment	23		
	Knowledge management	23		
Business process reengineering	28			
Organizational structure	30			
Technological	<b>Organizational fit of the ERP system</b>	<b>1</b>	<b>ERP system tests</b>	<b>1</b>
	<b>ERP system configuration</b>	<b>10</b>	Data accuracy	17
			Vendor's tools and implementation methods	21
			IT structure and legacy systems	27

of 31) are organizational factors with a strategic characteristic. Though the top 10 factors are spread out among all four categories, most of them are part of the organizational category. Remarkably, the two most important factors are part of the technological view. This supports the statement above that the technological aspects of ERP projects and their impact on the enterprises are considered more important for SMEs than for larger companies. However, smaller enterprises and ERP vendors should consider both the organizational and technological aspects when implementing an ERP system.

## 5 Conclusion and Limitations

The aim of our study was to gain insight into the research field of CSFs for ERP implementation projects, with a focus on ERP projects in small and medium-sized enterprises. Research in the field of ERP system projects and their CSFs provides valuable information that may enhance the degree to which an organization's implementation project succeeds [15]. As a first step, we carried out a systematic literature review to identify CSFs and to update existing reviews. Our review turned up a variety of papers, i.e., case studies, surveys, and literature reviews, focusing on CSFs. All in all, we identified 320 relevant papers dealing with CSFs of ERP system projects. From these existing studies, we derived 31 different CSFs (see Fig. 1). Most of the identified papers and studies focus on large companies. Small and medium-sized enterprises are—if included at all—usually underrepresented in quantitative studies. Studies exclusively focusing on SMEs are rare. We identified 37 of the 320 articles with this explicit focus. These are only nearly 12 % of all published papers with a focus on CSF. Even if research focusing on CSFs in smaller companies has been recommended in the research community for several years (e.g., [17, 18]), our reviews reveal that SMEs are still not the primary focus of CSF research. Therefore, this can still be seen as a clear lack of research.

To this end, we set up a study with a specific SME focus. We conducted several interviews with ERP consultants experienced with ERP implementations in SMEs. Using a guideline consisting of 52 initial questions about CSFs, we conducted ten interviews. We found that all 31 factors found in the literature review were mentioned by at least one interviewee, and therefore all 31 factors also somehow affect the success of the ERP system projects in SMEs, except the factor *Interdepartmental cooperation* that was mentioned by some interviewees but not seen as relevant for ERP projects in SMEs. However, contrary to the ranking resulting from the literature review, we identified factors with a more technological focus being important for those ERP projects. Here, the factors *ERP system tests* and *Organizational fit of the ERP system* as the most important factors as well as *ERP system configuration* that is also part of the top 10 factors refer to more technological aspects. Hence, factors with an organizational characteristic could also be identified as part of the top 5 factors in our study (*Balanced project team*, *Project management*, and *Change management*).

Regarding the research question, our study could show that most of the factors which influence the success of ERP system implementation projects in large-scale enterprises also have influence on ERP projects in SMEs. We could not identify any further factors that were not already referred to in the literature. However, we could show that the importance of the factors differs a lot and that SMEs and also the ERP manufacturers have to be aware of these differences in the factors' characteristics, focusing also on technological aspects of the ERP implementations rather than focusing mainly on the organizational factors, as they are more important for the large-scale companies.

A few limitations of our study must be mentioned as well. For our literature review, 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 provide 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 with several independent researchers. However, other researchers may code the CSFs in other ways. For the interview study, the interviews conducted and data evaluated represent only an investigation of sample ERP projects in SMEs based on the experiences of the ERP consultants. These results are limited to the specifics of these projects. In light of this, we will conduct further case studies and some larger surveys to broaden the results of this investigation.

## Appendix

**Table 5** Overview of the ERP consultants and their experience

ERP manufacturer	ERP consultant	ERP consultant since	Experience with ERP projects
Manufacturer 1	Consultant 1	Active in the ERP business for more than 30 years	Carried out more than 100 ERP projects
Manufacturer 2	Consultant 2	User support and project support for three years	Carried out three ERP projects
Manufacturer 3	Consultant 3	ERP consultant since 2008	Carried out eight ERP projects
	Consultant 4	ERP consultant and Head of project management for Manufacturer 3 since 2013	More than 30 years of experience with ERP topics and ERP projects as employee of several SMEs
Manufacturer 4	Consultant 5	ERP consultant for Manufacturer 4 since 2011	More than 30 years of experience with ERP topics and ERP projects as employee of several SMEs and other ERP manufacturers
	Consultant 6	ERP consultant since 2000; by now Head of Branch Office for Manufacturer 4	Carried out seven ERP projects; by now as Head of Branch Office support for 50 parallel ERP projects
Manufacturer 5	Consultant 7	ERP consultant for more than 16 years	Carried out more than 100 ERP projects
	Consultant 8	ERP consultant for more than 13 years	Carried out around 130 ERP projects
Manufacturer 6	Consultant 9	ERP consultant for several years	Carried out several ERP projects (detailed number was not stated)
	Consultant 10	ERP consultant since 2010	Carried out five ERP projects

## References

1. Davenport, T.H.: *Mission Critical: Realizing the Promise of Enterprise Systems*. Harvard Business School Press, Boston (2000)
2. Grabski, S.V., Leech, S.A.: Complementary controls and ERP implementation success. *Int. J. Acc. Inf. Syst.* **8**(1), 17–39 (2007)
3. Koh, S.C.L., Simpson, M.: Change and uncertainty in SME manufacturing environments using ERP. *J. Manuf. Technol. Manag.* **16**(6), 629–653 (2005)
4. Somers, T.M., Nelson, K.: The impact of critical success factors across the stages of enterprise resource planning implementations. In: *Proceedings of the 34th Hawaii International Conference on System Sciences (HICSS 2001)*, 3–6 Jan 2001, Hawaii, USA (2001)
5. Konradin GmbH: *Konradin ERP-Studie 2011—Einsatz von ERP-Lösungen in der Industrie*. Konradin Mediengruppe, Leinfelden-Echterdingen, Germany (2011)
6. Deep, A., Guttridge, P., Dani, S., Burns, N.: Investigating factors affecting ERP selection in the made-to-order SME sector. *J. Manuf. Technol. Manag.* **19**(4), 430–446 (2008)
7. Leyh, C.: Critical success factors for ERP system implementation projects: a literature review. In: Møller, C., Chaudhry, S. (eds.): *Advances in Enterprise Information Systems II*, pp. 45–56. CRC Press/Balkema, Leiden, The Netherlands (2012)
8. Winkelmann, A., Klose, K.: Experiences while selecting, adapting and implementing ERP systems in SMEs: a case study. In: *Proceedings of the 14th Americas Conference on Information Systems (AMCIS 2008)*, 14–17 Aug 2008, Paper 257. Toronto, Ontario, Canada (2008)
9. Winkelmann, A., Leyh, C.: Teaching ERP systems: a multi-perspective view on the ERP system market. *J. Inf. Syst. Educ.* **21**(2), 233–240 (2010)
10. Jones, A., Robinson, J., O’Toole, B., Webb, D.: Implementing a bespoke supply chain management system to deliver tangible benefits. *Int. J. Adv. Manuf. Technol.* **30**(9/10), 927–937 (2006)
11. Ngai, E.W.T., Cheng, T.C.E., Ho, S.S.M.: Critical success factors of web-based supply-chain management systems: an exploratory study. *Prod. Plan. Control* **15**(6), 622–630 (2004)
12. Barker, T., Frolick, M.N.: ERP Implementation Failure: a case study. *Inf. Syst. Manag.* **20**(4), 43–49 (2003)
13. Hsu, K., Sylvestre, J., Sayed, E.N.: Avoiding ERP pitfalls. *J. Corp. Acc. Finan.* **17**(4), 67–74 (2006)
14. Achanga, P., Nelde, G., Roy, R., Shehab, E.: Critical success factors for lean implementation within SMEs. *J. Manuf. Technol. Manag.* **17**(4), 460–471 (2006)
15. Finney, S., Corbett, M.: ERP implementation: a compilation and analysis of critical success factors. *Bus. Process Manag. J.* **13**(3), 329–347 (2007)
16. Nah, F.F-H., Zuckweiler, K.M., Lau, J.L-S.: ERP implementation: chief information officers’ perceptions of critical success factors. *Int. J. Hum.-Comput. Interact.* **16**(1), 5–22 (2003)
17. Snider, B., da Silveira, G.J.C., Balakrishnan, J.: ERP implementation at SMEs: analysis of five Canadian cases. *Int. J. Oper. Prod. Manag.* **29**(1), 4–29 (2009)
18. Sun, A.Y.T., Yazdani, A., Overend, J.D.: Achievement assessment for enterprise resource planning (ERP) system implementations based on critical success factors (CSFs). *Int. J. Prod. Econ.* **98**(2), 189–203 (2005)
19. Leyh, C.: Critical success factors for ERP system selection, implementation and post-implementation. In: Léger, P.-M., Pellerin, R., Babin, G. (eds.): *Readings on Enterprise Resource Planning*, Chap. 5, pp. 63–77. ERPSim Lab, HEC Montreal, Montreal (2011)
20. Humphrey, W.S.: *Introduction to the Team Software Process*. Addison-Wesley, Amsterdam (1999)
21. Hesseler, M., Goertz, M.: *Basiswissen ERP-Systeme—Auswahl, Einführung & Einsatz betriebswirtschaftlicher Standardsoftware.W3 1*, Witten, Germany (2007)

22. Shanks, G., Parr, A.: A model of ERP project implementation. *J. Inf. Technol.* **15**(4), 289–303 (2000)
23. Al-Mashari, M., Al-Mudimigh, A.: ERP Implementation: lessons from a case study. *Inf. Technol. People* **16**(1), 21–33 (2003)
24. Loh, T.C., Koh, S.C.L.: Critical elements for a successful enterprise resource planning implementation in small-and medium-sized enterprises. *Int. J. Prod. Res.* **42**(17), 3433–3455 (2004)
25. Esteves-Sousa, J., Pastor-Collado, J.: Towards the unification of critical success factors for ERP implementations. In: *Proceedings of the 10th Annual Business Information Technology Conference (BIT 2000)*. Manchester, UK (2000)
26. Hong, K.-K., Kim, Y.-G.: The critical success factors for ERP implementation: an organizational fit perspective. *Inf. Manag.* **40**(1), 25–40 (2002)
27. Appelrath, H., Ritter, J.: *SAP R/3 Implementation: Method and Tools*. Springer, Berlin (2000)
28. Al-Mashari, M., Al-Mudimigh, A., Zairi, M.: enterprise resource planning: a taxonomy of critical factors. *Eur. J. Oper. Res.* **146**(2), 352–364 (2003)
29. Nah, F.F.-H., Lau, J.L.-S., Kuang, J.: Critical factors for successful implementation of enterprise systems. *Bus. Process Manag. J.* **7**(3), 285–296 (2001)
30. Becker, J., Vering, O., Winkelmann, A.: *Softwareauswahl und-einführung in Industrie und Handel: Vorgehen bei und Erfahrungen mit ERP- und Warenwirtschaftssystemen*. Springer, Berlin (2007)
31. Teich, I., Kolbenschlag, W., Reiners, W.: *Der richtige Weg zur Softwareauswahl*. Springer, Berlin (2008)
32. Vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R., Cleven, A.: Reconstructing the giant: on the importance of rigour in documenting the literature search process. In: *Proceedings of the 17th European Conference on Information Systems (ECIS 2009)*, 8–10 June 2009, Verona, Italy (2009)
33. Leyh, C.: Which factors influence ERP implementation projects in small and medium-sized enterprises? In: *Proceedings of the 20th Americas Conference on Information Systems (AMCIS 2014)*, 7–9 Aug 2014, Savannah, Georgia, USA (2014)
34. Nah, F.F.-H., Delgado, S.: Critical success factors for enterprise resource planning implementation and upgrade. *J. Comput. Inf. Syst.* **46**(29), 99–113 (2006)
35. Leyh, C., Muschick, P.: Critical success factors for ERP system upgrades—The case of a German large-scale Enterprise. In: *Proceedings of the 19th Americas Conference on Information Systems (AMCIS 2013)*, 15–17 Aug 2013, Chicago, Illinois, USA (2013)
36. Esteves-Sousa, J.: *Definition and Analysis of Critical Success Factors for ERP Implementation Projects*. Barcelona, Spain (2004)
37. Remus, U.: Critical success factors for implementing enterprise portals: a comparison with ERP implementations. *Bus. Process Manag. J.* **13**(4), 538–552 (2007)