Critical Success Factors for ERP System Implementation Projects: An Update of Literature Reviews

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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) system implementation projects. Therefore, we conducted two literature reviews, more specifically systematic reviews of relevant articles in five different databases and among several international conference proceedings. Ultimately, we identified 320 relevant papers (144 single or multiple case studies, 118 surveys, and 58 literature reviews or articles from which CSFs can be derived). From these existing studies, we discovered 31 different CSFs for ERP system implementation projects. 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 37 papers explicitly focus on smaller and medium-sized enterprises (SMEs), which is clearly a research gap in this field.

Keywords: ERP systems · Critical success factors · CSF · Literature review · Small and medium-sized companies · SME

1 Motivation

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 activities of whole enterprises has become an important factor in today's business [1]. Therefore, during the last decades, the segment of ERP systems was one of the fastest growing segments in the software market, and these systems are one of the most important developments in information technology. The demand for ERP applications arises from several sources, for example, competitive pressures to become a low-cost producer, expectations of revenue growth, and the desire to re-engineer the business to respond to market challenges. There are several benefits of a properly selected and implemented ERP system such as considerable reductions in inventory costs, raw material costs, lead time for customers, production time, and production costs [2].

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Due to the saturation of ERP markets targeting large-scaled enterprises, ERP system manufacturers today are also concentrating on the growing market of small and medium-sized enterprises (SMEs) [3, 4]. 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 [5–7].

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 face enormous risks. To take advantage of the potential, rather than getting caught by the risks of these implementation projects, it is essential to the study / to focus on those factors that support a successful implementation of an information system [8, 9]. If aware of these factors, a company can positively influence the success of the implementation project and effectively minimize the project`s risks [8]. Recalling these so-called critical success factors (CSFs) is of high importance whenever a new system is to be adopted and implemented or whenever a running system needs to be upgraded or replaced. Errors during the selection, implementation, or maintenance of ERP systems; wrong implementation approaches; or ERP systems that do not fit the requirements of the enterprise can all cause financial disadvantages or disasters, perhaps even leading to insolvency. Several examples of such negative scenarios can be found in the literature (e.g., [10, 11]). SMEs especially must be aware of the CSFs since they lack the financial, material, and personnel resources of larger companies [12]. 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., [13–15]). Most of these literature reviews cannot be reproduced, because descriptions of the review methods and procedures are lacking. Thus, some researchers clearly point out the drawbacks of the current literature review articles. Specifically, critics note the lack of methodological rigor [16]. Therefore, in order to update the existing reviews by including current ERP literature, we conducted two literature reviews (the first one in 2010, the second one in 2013). More specifically, these were two systematic reviews of articles from five different databases and from several international conference proceedings. The CSFs reported in this paper were derived from 320 papers identified as relevant, and the frequency of the occurrence of each CSF was counted. The aggregated results of these reviews will be presented in this paper. Additionally, we will focus on CSFs specifically for SMEs within the identified papers.

Therefore, the paper is structured as follows. The next section presents a short overview of our data collection methodology in order to make our review reproducible. Afterwards, in section 3 the critical success factors that were focused on during the review will be explained in detail. 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 ERP project success. Finally, the paper concludes with a summary of the results as well as a critical acclaim of the conducted literature review.

2 Data Collection Methodology – Literature Review

The literature review to identify the CSFs was performed in several steps similar to the approach suggested by Webster & Watson [17]. In general, it was a database-driven review with an additional search in the proceedings of several IS conferences. To make our review reproducible, we listed tables with the databases and search terms in the Appendix (see Tables 4 and 5).

Here, we conducted two separate literature reviews according to the same search procedure and steps. The first one was done in the mid-2010 (see also [5, 18]). Since we identified 20 papers or more published each year it is essential for us to update this review every two or three years. Therefore, we conducted the second review in the mid-2013.

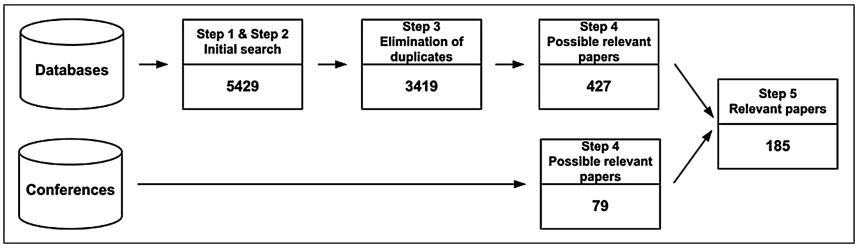

Fig. 1. Progress of the literature review from 2010

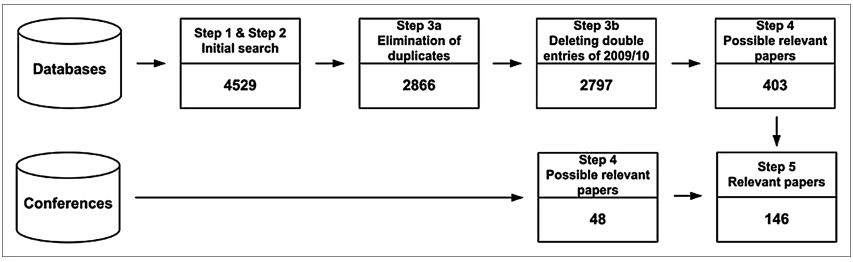

Fig. 2. Progress of the literature review from 2013

The steps of our review procedure are presented in the following paragraphs. An overview is given in Fig. 1 and Fig. 2 with regard to the numbers of papers identified or remaining during/after each step. With each step, the number of papers was reduced according to the assembly of different criteria.

Step 1: The first step was to define the sources for the literature review. Therefore, several databases and conference proceedings were identified (see Appendix - Table 4).

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. The search terms that we used are listed in Table 5. Since the WISO database also provides German papers, we additionally used the German translation of most of the search terms. For the conference papers, only inappropriate search fields were provided. Hence, we decided to review the abstracts and titles of the papers in this step manually.

Step 3: During step 3 we performed the initial search according to step 1 and step 2 and then eliminated duplicates.

- Review 1: 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. Altogether, 3,498 papers were identified during the initial search step.
- Review 2: During the initial search step, 4,529 articles were found. After deleting the duplicates (step 3a) and deleting double entries resulting from papers from review 1 (step 3b), 2,797 papers remained. From the conferences, 48 papers remained. Therefore, altogether a total of 2,845 papers were found during these steps.

Step 4: Step 4 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, too. Thus, these papers had to be excluded. This was done by reviewing the abstracts of the papers and if necessary by examining the paper content.

- Review 1: Of the papers, 427 stemming from the database search and all 79 conference papers remained. Altogether, this review yielded 506 papers potentially relevant to the field of CSFs for ERP system implementations (see Fig. 1).
- Review 2: Here, 403 papers resulting from the databases and all conference papers remained as potentially relevant. Altogether, 451 had to be read in depth according to step 5 (see Fig. 2).

Step 5: The fifth and final step consisted of a detailed analysis of the remaining 506 and 451 papers and the identification of the CSFs. Therefore, the content of all papers was reviewed in depth for the purpose of categorization of the identified success factors. Emphasis was placed not only on the wording of these factors but on their meaning. Following this step, 185 relevant papers that suggested, discussed or mentioned CSFs remained from review 1 and 146 articles remained from review 2.

Step 6: Additionally, while conducting review 2, we added a sixth step. Within this step, we cross-checked papers from the same authors or with similar author composition from review 1 and review 2 regarding their content (despite the duplicates check of steps 3a and 3b). Since often papers which are published at conferences are subsequently published as extended versions in journals, these papers should not be counted twice within the reviews. We identified eleven papers which were such extended journal versions. So these relevant papers were deleted, too. This led to a final

sum of 320 relevant papers. The results of the analysis of these papers that mentioned CSFs are described in the following sections.

3 Critical Success Factors of ERP Implementation Success

A critical success factor for ERP projects is defined according to Finney and Corbett [14] as reference to any condition or element that was seen 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, conducted surveys, literature reviews or articles where CSFs are derived from chosen literature. Within these papers, the following 31 CSFs were identified:

- 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 (e.g., 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

Available Resources (e.g., budget, employees, etc.): ERP implementation projects require a lot of resources such as money, time and employees. These requirements need to be determined early in the project or even before the project starts [19]. It is very difficult to secure resource commitment in advance [20] to ensure the success of the implementation project. An appropriate budget is the basis for a solid execution of projects. If the budget allocated is too small other success factors can be affected negatively [21].

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 [22]. The characteristics of the team members should complement each other, on their experience, their knowledge as well as their soft skills [23]. 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 [14]. 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 [24].

Business Process Reengineering: Business process reengineering (BPR) is a crucial project phase in ERP projects although it often leads to delays in ERP implementations [25]. During ERP projects companies have to review their business processes and explore new ways of doing things relatively to the best practices embedded in the ERP system. The deeper and more detailed this review is, the better the outcome of the BPR will be [26, 27]. Changing activities and workflows in business processes before, during or after the ERP implementation may lead to a different and maybe minimized level of ERP system configuration [19]. It is advisable to minimize the extent of the ERP system modification. This reduces errors and the company can more easily take advantage of newer versions and releases. Therefore, the project team or the top management should decide to what extent the company has to change their business processes to fit the ERP system [28].

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 [29]. 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 [30].

Clear Goals and Objectives (e.g., vision, business plan, etc.): Clear goals and objectives are seen as CSF by many researchers (e.g., [2, 13, 31]). This requires formulating a business vision, calculating a business case, identifying and communicating clear goals and objectives regarding the ERP implementation, and providing a clear link between business goals and the company's IS strategy [14, 32]. This is needed 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 as well as specifies a clear timeline that is critical to an ERP

project. These instruments can be very helpful to maintain the focus on project benefits and outcomes [30].

Communication: The CSF communication is one of the most difficult and most challenging tasks during the implementation of an ERP system. The existence of a clear concept addressing communication, which contains a communication strategy as well as the respective communication channels and methods, is very important. This strategy should match with the goals and requirements of the ERP project and should enable open and free communication by providing an adequate communication platform [32]. Expectations at every level need to be communicated [30]. The communication between the management, the project team and the employees should be clear on a regular basis. Detailed information about the project status, achieved results or decisions made by the management is as essential as the direct discussion, for example, of fears and conflicts.

Company's Strategy / Strategy Fit: To ensure the success of an ERP implementation, the changes caused by the ERP system have to be linked with the company's longtime strategic goals. The ERP system should support this strategy or even be one of the important factors for the strategy´s success. The implementation project as part of the enterprise-wide strategy (e.g., the implementation as a method of strategic goal achievement) is mandatory [33].

Data Accuracy (e.g., data analysis and conversion): A fundamental requirement for the effectiveness and the success of ERP systems is the availability of accurate data. Problems concerning data can cause heavy implementation delays. Therefore, the management of data migration represents a critical factor throughout the whole implementation [2, 34]. Identifying which data has to be loaded into the system and which is extraneous as well as converting all disparate data structures into a single, consistent format is an important challenge. The conversion process is often underestimated. In addition, interfaces with other internal and external systems (between departments such as accounting and production, data warehouses, etc.) have to be considered, too [2].

Environment (e.g., national culture, language, etc.): The effects and the relevance of national cultures to the ERP implementation are pointed out in several studies (e.g., [35, 36]). Basic values, beliefs and norms in different countries are factors that influence the organizational culture, and in turn, affect the practices of professional activities including ERP implementation [35]. Cultural differences can cause problems during an ERP project such as different beliefs in providing access to information, miscommunication due to language difficulties or problems in reengineering organizational processes [37].

ERP System Acceptance / Resistance: Every person and department should be responsible and accountable for the whole ERP system and the key users from different departments have to be committed to the implementation project on a fulltime basis [38]. Therefore, a lack of user and stakeholder inputs and acceptance may reduce the chance of a successful implementation [39]. In case employees are not psychologically

ready for change and do not accept the new ERP system, their attitudes and behaviors will hinder them from working and resolving conflicts with consultants, as well as from acquiring the necessary ERP knowledge [40]. Accordingly, a higher user and stakeholder support should positively affect the communication and conflict resolution in the ERP consulting process [41].

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 [13]. Following Hong & Kim [42], 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 [13]. 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 [30].

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 [43]. 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 [14, 32].

External Consultants: The use of external consultants depends on the internal know-how and experience at the moment of the project initiation [13]. Many organizations use consultants to facilitate the implementation process. Consultants are experienced in specific industries, have comprehensive knowledge about certain modules and may be better able to determine what will work best for a given company [44]. Consultants are often involved in all stages of the implementation: performing requirements analysis, recommending a suitable solution and managing the implementation [2]. Therefore, it is necessary to determine the number of consultants, how and when to use them as well as their responsibilities within the implementation project [13].

Interdepartmental Cooperation: To successfully implement an ERP system it is necessary that all departments cooperate at the same level of intensity and engagement since an ERP system affects all business units and business processes across functional and departmental boundaries. This requires the sharing of common goals instead of emphasizing individual pursuits. Also, to share information within a company and between different companies requires cooperation between partners, employees, managers and corporations based on trust and the willingness to cooperate. Issues such as prestige, job security and control feelings or departmental politics are also involved and have to be considered and managed [2, 45].

Involvement of End-Users and Stakeholders: This factor is one of the most frequently cited CSFs [46]. Users and stakeholders must perceive the system as being important and necessary to their work [47]. Therefore, end-user involvement and participation during the ERP project and the involvement of all stakeholders that are affected by the ERP implementation is mandatory and will result in a better fit of user requirements achieving better system quality, use and acceptance [13]. It is important to get users and stakeholders involved during the system implementation and to make use of their knowledge in areas where the project team lacks expertise and knowledge [26]. According to Ghosh [48], this involvement in the project, from start to finish, is just as crucial as the involvement of top management.

IT Structure and Legacy Systems: It is critical to assess the IT readiness of the company including the IT architecture and skills of the employees [2, 14]. If necessary, infrastructure might need to be upgraded or changed considering the requirements of the ERP system [49, 50]. Also, the current legacy systems need attention. It is important that an organization approaches the transition of a legacy system carefully and develops a comprehensive plan. Within ERP projects, the existing legacy systems have to be exactly reviewed, defined and evaluated to encounter possible problems and hindrances during the ERP implementation [31, 32, 51].

Knowledge Management: Knowledge management during ERP implementation projects is an important factor. Sharing knowledge is somewhat unique since ERP projects redefine jobs and blur traditional intra-organizational boundaries [52]. It is crucial to exchange knowledge and problems within the organization. Employees possess a base of knowledge that is indispensable to the company [26]. During ERP implementation knowledge must be shared among departments and functional and divisional boundaries [53]. Thus, a knowledge management process has to be established to ensure that information will be correctly exchanged within the project team and with all other involved people of the ERP project (e.g., external consultants or employees of the ERP vendor). In addition, the organization must ensure the transfer of as much knowledge as possible from consultants or ERP vendors in order to be able to use the new ERP system autonomously [26].

Monitoring and Performance Measurement: In the context of project management mechanisms for performance measurement have to be established. Measuring and evaluating performance is a critical factor for ensuring the success of any business organization [32]. Constant measurement and monitoring of the progress enables early discovery of errors and gaps as well as their removal or correction [29].

Organizational Culture: Organizational culture is embedded within the national culture and therefore it is a critical factor affecting ERP system implementation. Every company has its own, unique organizational culture, which may or may not be strong and enduring, and which may be reflected in either openness for changes or the opposite [38]. An organization that implements an ERP system has to change its business processes to achieve a better fit with the ERP best-practice processes. These changes both impact the organization´s culture and are constrained by it [35, 38]. Some researchers argue that a successful technological innovation requires that either the

technology be designed to fit the organization's current structure and culture or that the organization's structure and culture has to be redesigned and changed to fit the new technology [54, 55].

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 vendors tend to set up blind confidence in their ERP package even if it is obvious that the organizational fit is low. Hong & Kim [42] empirically examined to what extent the implementation success of an ERP system depends on the fit between company and ERP system and found out that the adaptation and configuration effort negatively correlates with the implementation success. Therefore, it is essential to select an ERP system carefully by considering its specific organizational fit such as company size or industry sector. Thus, the right ERP system selection is an important factor to ensure the fit between the company and the ERP system.

Organizational Structure: Organizational structure is a determining factor concerning ERP system implementations. Since ERP systems are designed according to the principle of "best practice," they aim towards a fit for the greatest possible number of companies. Therefore, the configuration becomes essential to map the functions of the systems with the structure of the company [56]. So, the company´s structure should enable the implementation and use of ERP systems as well as other IT systems. Nevertheless, BPR can also become mandatory, since not all of the company's structure can be mapped with the ERP system and so the structure has to be adapted. Many organizations underestimate the lack of alignment between the ERP system and their organizational structure, and thus the effort required for system configuration or BPR during the implementation [26].

Project Champion: A project champion can be seen as an imperturbable advocate of the respective ERP implementation project – necessary in order to enable better and faster agreements within the project and to oversee the entire processes and the whole project life cycle. The main tasks of the project champion are to be the first contact person for any issues concerning the ERP project and to ensure the project progress within the enterprise. Therefore with having a project champion resistances and conflicts can be solved promptly and in a slighter manner as he also serves as a mediator [30]. In many ERP implementations the leader of the ERP project takes the position of project champion, but this is not the only solution. Also some other member of the senior management, who is not a direct project team member, can act as project champion, too.

Project Leadership / Empowered Decision Makers: The project leader should be a strong and charismatic person with experience in project management and expertise in directing employees. He has to manage the project according to the project plan and react on problems that can arise during an ERP implementation. Therefore, the project leader can take the role as project champion as well. In general, project team leaders have to be empowered to make quick decisions, which reduce delays during implementation. This is important since even small delays can heavily impact such a

long-term project like ERP implementations [13]. With empowered decision makers and a strong project leadership, effective timing with respect to the implementation is enhanced [14, 24, 57].

Project Management: Project management refers to the ongoing management of the implementation plan [14]. The implementation of an ERP system is a unique procedure that requires an enterprise-wide project management. Therefore, it involves the planning stages, the allocating of responsibilities, the definition of milestones and critical paths, training and human resource planning, and the determination of measures of success [29, 31]. This enables a better organized approach to decision making and it guarantees that these are made by the most suitable company members. Furthermore, a continuous project management makes it possible to focus on the important aspects of the ERP implementation and ensures timeliness and that schedules are met [29]. Within project management, a comprehensive documentation of the tasks, responsibilities and goals is indispensable for the success of ERP implementations [58].

Skills, Knowledge and Expertise: The existing knowledge and the experiences of the companies' employees play a central role while implementing an ERP system. Better knowledge, experience and education as well as personal skills can improve the ERP project's accomplishment and enable an easier handling of the implementation. This factor is often influenced and affected by the companies' strategy as well as by the financial budget. The acceptance of and the readiness for changes is substantially higher in enterprises, where a philosophy of constant improvement and knowledge enhancement prevails [21].

Top Management Support and Involvement: Top management support and involvement is one of the most important success factors for an ERP implementation [21]. A committed leadership at the top management level is the basis for the continuous accomplishment of every project [14]. Thus, innovations, in particular new technologies, are better accepted by employees if they 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 affect the whole enterprise, they will need the acceptance and the commitment of the senior managers and often can only be made by them [59]. Commitment of top management is important in order to allocate necessary resources, to make quick and effective decisions, solve conflicts that need enterprise-wide acceptance and to reach and support a co-operation of all different departments [32].

Troubleshooting: Troubleshooting is essential and starts at the shakedown phase. This factor is related to the problem and risk areas of ERP projects [13, 30]. Quick responses, patience, perseverance and problem solving capabilities are important during an ERP system implementation [28]. There should be an implementation plan that includes various troubleshooting mechanisms. Two important critical "moments" are the migration of old data as well as the "go live" [13].

Use of a Steering Committee: To make ERP projects succeed, it is necessary to form a steering committee. A steering committee enables the senior management to directly

monitor the project team's decision making, thereby ensuring adequate control mechanisms. Therefore, this committee should consist of members of the senior management (from different departments or corporate functions), representatives from the project management and end users (as well as from different departments). Such a composition will guarantee appropriate involvement across the whole company [2, 60].

User Training: Often, missing or lacking end user training is a reason for the failure during 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 result from the ERP implementation. Therefore, it is important to set up a suitable plan for the training and education of the employees [32]. Furthermore, during such an extensive project it has to be determined which employee fits best for which position or for which application of the new software. This depends strongly on his/her knowledge already acquired and/or for which employee additional training courses are necessary [61].

Vendor Relationship and Support: ERP systems may be a lifelong commitment for many companies. There will always be new modules and versions to install, bug fixes to be rolled out and changes to achieve a better fit between business and system. Therefore, good vendor support (technical assistance, emergency maintenance and updates) is an important factor. Accordingly, the relationship/partnership with the vendor is vitally important to successful ERP projects. This relationship should be strategic in nature with the ERP provider enhancing an organization's competitiveness and efficiency [2, 62].

Vendor's Tools and Implementation Methods: Implementation technologies, programs and methods provided by the vendors can significantly reduce the cost and time of deploying ERP systems [2]. Depending on the chosen implementation and roll-out method (e.g., big bang strategy, satellite strategy, etc.) there are advantages and risks that have to be considered. Also, not every strategy is applicable in every ERP project or company. Hence, the choice has to be made carefully. An additional goal of implementation tools is the knowledge transfer of using the software, understanding the business processes within the organization and recognizing industry best practices [2].

4 Literature Review – Results

As stated above, 320 papers (single- or multiple-case studies, surveys, literature reviews, etc.) were identified that referred to critical success factors of ERP implementation projects. These papers were reviewed again in-depth in order to determine the different concepts of CSFs. Overall, 31 factors (as described above) were identified. In most previous literature reviews, the CSFs were grouped more coarsely so that a lower number of CSFs was used (e.g., [2, 14, 30]). The grouping was not done within our review. With 31 factors, we used a larger number than earlier researchers had because we expected the resulting distribution to be more insightful. If wider definitions of some CSFs might be needed later on, a further aggregation is still possible.

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

Fig. 3. Snapshot of the CSF results

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

After identifying the relevant papers as well as the factors stated within them, we developed a table to match the factors with the papers for the analysis. Figure 3 shows a snapshot of this CSF table. As it is shown for each paper the CSFs were captured as well as the year, the type of data collection used within, and additionally the number and size of companies from which the CSFs were derived.

All 320 papers were published between the years 1998 and 2013. Table 1 shows the distribution of the articles per year. Most of the papers were published between 2013 and 2006. Since 2004, around 20 papers were published each year. Since 2009 around 30 papers were published each year or even more papers were published about CSFs. Therefore, it can be argued that a review every two or three years is reasonable in order to update the results of previous literature reviews, especially considering evolving technology and the changing system availability like the “Software-as-a-Service” concept and ERP systems provided in the cloud.

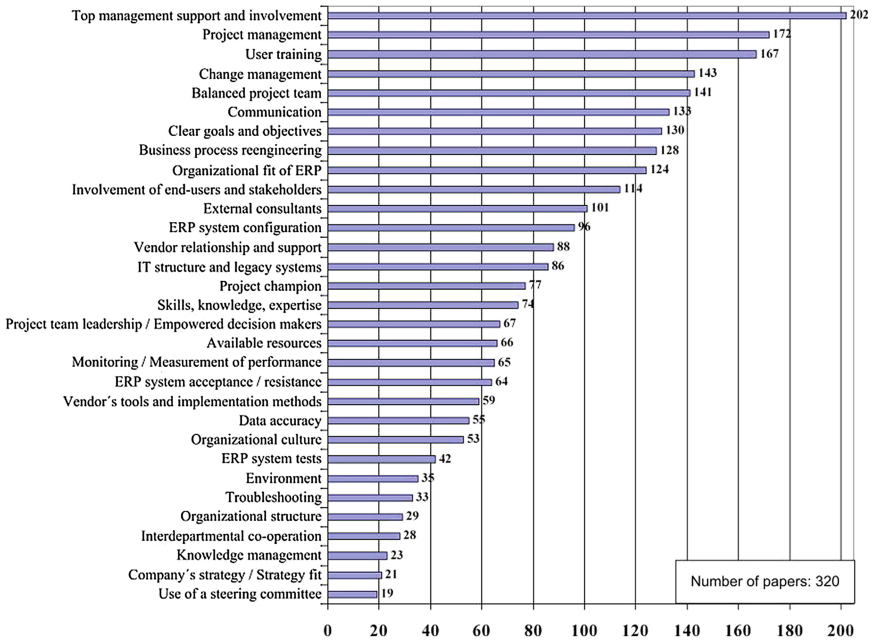

Fig. 4 CSFs Ordered by Frequency

It has to be emphasized that we conducted review 2 in mid-2013. Therefore, not all papers published in 2013 were part of this review. Additionally, some databases provide access to some journal articles only if they are older than 12 months. Thus, such articles were not included in our review nor those presented at ICIS 2013, since that conference had not taken place until the date of our review.

Figure 4 shows the results of our review: the identified CSFs and their total numbers. The figure shows that *Top management support and involvement*, *Project management* and *User training* are the three most named factors, numbering around and above 160. The factor *Top management support and involvement* ranked number one, having been referred to in more than 200 papers.

Comparing these results with other literature reviews, such as Finney and Corbett's [14], it became obvious that the top five factors were similar while only the ranks differed. Due to our large literature base, our total numbers are much higher (see Table 2).

Regarding the form of data collection, it has to be stated that the papers consisted of 144 single- or multiple-case studies, 118 surveys and 58 literature reviews or articles where CSFs were derived from chosen literature.

To categorize critical success factors, Esteves-Sousa & Pastor-Collado [13] suggested a matrix scheme. Here, they consider the tactical or strategic direction of the CSFs and divide them into organizational and technological factors. Thus, tactical CSFs tend to relate to short-term aspects and goals of the system implementation whereby strategic factors aim for long-term impacts of activities with strong connections to the

Table 2. Literature review comparison

	Finney & Corbett [14]		Our review	
	Factor	Number of instances	Factor	Number of instances
Rank #1	Top management commitment and support	25	Top management support and involvement	202
Rank #2	Change management	25	Project management	172
Rank #3	BPR and software configuration	23	User training	167
Rank #4	Training and job redesign	23	Change management	143
Rank #5	Project team: the best and brightest	21	Balanced project team	141

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 strongly depend on the ERP systems themselves, whereas organizational factors focus on corporate culture and its environment with its specific processes and structures [13, 19, 63].

Table 3 gives an overview of the categorization of the CSFs identified in our literature review with a focus on their ranking and the incidence in the literature. It is shown that only a few CSFs (6 out of 31) are technological factors whereas more than 50% of the factors (17 out of 31) are organizational factors with a strategic characteristic. Also, most of the top 10 factors belong to the organizational category. Only one of the top 10 factors (*Organizational fit of the ERP system*) is part of the technological category. Therefore, enterprises and ERP manufacturers should especially consider organizational aspects when implementing an ERP system.

Considering the different years in which the identified papers were published, we have analyzed four different time spans (1998–2003, 2004–2007, 2008–2010 and 2011–2013) to identify changes in the CSF ranking. The results of this analysis with the respective top five factors of each time span are shown in Fig. 5.

As shown, *Top management support and involvement* is again the most frequently named factor, ranking number one in each time span. Additionally, *Project management* and *User training* are always in the top five positions throughout the different time spans. However, the CSF *Business process reengineering* has gained more importance whereas others have lost some importance throughout the years (e.g., *Clear goals and objectives* and *Monitoring and performance measurement*). *Business process reengineering* has even gained a rank in the top five in time span 2011–2013. 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 reengineering of business structures to use the whole functionality of the ERP systems in efficient and effective way.

Table 3. Categorization of CSFs (Model Adapted from [13, 19, 63])

Perspectives		Critical Success Factors	Rank	Number of instances in literature
Organizational	Strategic	Top management support and involvement	1	202
		Change management	4	143
		Balanced project team	5	141
		Clear goals and objectives	7	130
		Business process reengineering	8	128
		Involvement of end-users and stakeholders	10	114
		Vendor relationship and support	13	88
		Project champion	15	77
		Project team leadership / Empowered decision makers	17	67
		Available resources	18	66
		ERP system acceptance / resistance	20	64
		Organizational culture	23	53
		Environment	25	35
		Organizational structure	27	29
		Knowledge management	29	23
		Company's strategy / Strategy fit	30	21
		Use of a steering committee	31	19
	Tactical	Project management	2	172
		User training	3	167
		Communication	6	133
		External consultants	11	101
		Skills, knowledge and expertise	16	74
		Monitoring / Measurement of performance	19	65
		Troubleshooting	26	33
		Interdepartmental co-operation	28	28
Technological	Strategic	Organizational fit of the ERP system	9	124
		ERP system configuration	12	96

(*Continued*)

Table 3. (*Continued*)

Perspectives		Critical Success Factors	Rank	Number of instances in literature
	Tactical	IT structure and legacy systems	14	77
		Vendor´s tools and implementation methods	21	59
		Data accuracy	22	55
		ERP system tests	24	42

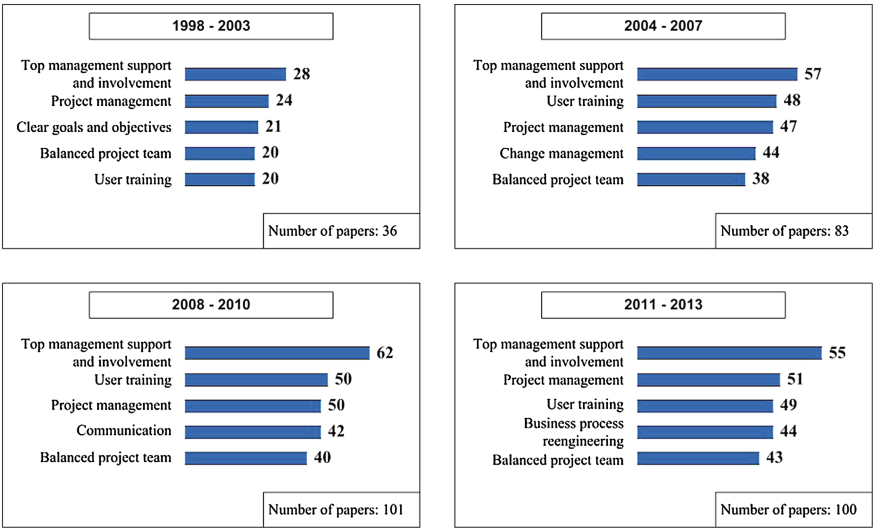

Fig. 5. Time span analysis of the CSFs

Concerning the company size during review 1, only 12 papers explicitly focus on small and medium-sized enterprises (SMEs), and there mostly within single- or multiple-case studies. Within review 2, 25 articles deal 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. As is shown by Fig. 6, *Top management support and involvement*, *Project management* as well as *User training* are again the most frequently named factors for ERP projects in smaller enterprises.

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.

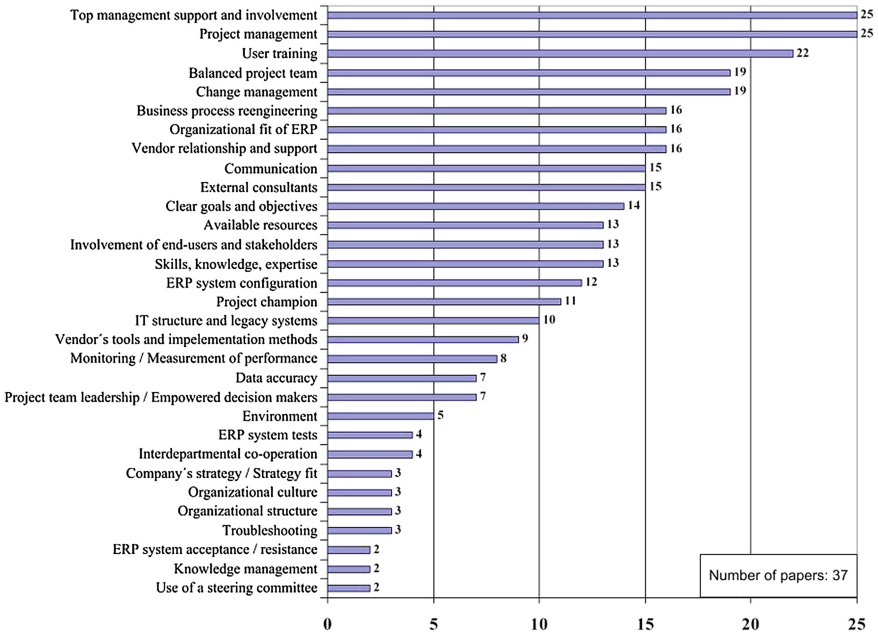

Fig. 6. CSFs of SMEs

5 Conclusion

The aim of our study was to gain an insight into the research field of critical success factors in ERP implementation projects. Research on ERP implementation and critical success factors can be seen as a valuable step toward enhancing chances of implementation success [14]. Our study reveals that there are several papers – case studies, surveys as well as literature reviews – that are focusing on CSFs. All in all, we identified 320 relevant papers. From these existing studies, we derived 31 different CSFs. We identified the following top three CSFs: *Top management support and involvement*, *Project management* and *User training*.

This ranking is similar to the ranking of other literature reviews (e.g., [2, 14]). Compared to these other reviews, the number of papers included in our study exceeds their numbers. One reason that these reviews included fewer papers is simply that they were conducted earlier than ours. As shown in Table 1, every year since 2004 at least 20 CSF papers have been published. This is not surprising considering the fast evolving technologies and the changes throughout the ERP market. Thus, one conclusion is that it is advisable to renew literature reviews on ERP system CSFs every two or three years in order to update the results as we did by conducting review 2 as an update for our first review. Another conclusion is related to the size of the companies. 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 out of the 320 articles with an explicit SME focus. These are just less than 12% of all published papers with CSF

focus. Even if research focusing on CSFs in smaller companies is recommended in the research community for several years (e.g., [58, 64]), our reviews reveal that SMEs are still not the primarily focus of CSF research. Therefore, SMEs still can be seen as in need of further research.

Regarding our literature review procedure, there are limitations that have to be mentioned, too. We are aware that we cannot be certain to have identified all relevant papers published in journals and conferences, since we made a selection of five databases and five international conferences. Therefore, journals not included in our databases and proceedings of other conferences might also comprise relevant articles. Another limitation is the coding of the CSFs. We tried to reduce this 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.

Appendix

Table 4. Sources for the literature review

Databases	Conferences
Academic Search Complete	AMCIS
Business Source Complete	ECIS
Science Direct	HICCS
SpringerLink	ICIS
WISO	Wirtschaftsinformatik

Table 5. 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"	

References

1. Gronau, N.: Industrielle Standardsoftware: Auswahl und Einführung. Oldenbourg Verlag, Muenchen, Germany (2001)
2. 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), January 3-6, Hawaii, USA (2001)
3. Deep, A., Guttridge, P., Dani, S., Burns, N.: Investigating factors affecting ERP selection in the made-to-order SME sector. Journal of Manufacturing Technology Management **19**(4), 430–446 (2008)
4. Koh, S.C.L., Simpson, M.: Change and uncertainty in SME manufacturing environments using ERP. Journal of Manufacturing Technology Management **16**(6), 629–653 (2005)
5. 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)
6. 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), August 14-17, Paper 257. Toronto, Ontario, Canada (2008)
7. Winkelmann, A., Leyh, C.: Teaching ERP systems: A multi-perspective view on the ERP system market. Journal of Information Systems Education **21**(2), 233–240 (2010)
8. Jones, A., Robinson, J., O'Toole, B., Webb, D.: Implementing a bespoke supply chain management system to deliver tangible benefits. International Journal of Advanced Manufacturing Technology **30**(9/10), 927–937 (2006)
9. 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. Production Planning & Control **15**(6), 622–630 (2004)
10. Barker, T., Frolick, M.N.: ERP Implementation Failure: a case study. Information Systems Management **20**(4), 43–49 (2003)
11. Hsu, K., Sylvestre, J., Sayed, E.N.: Avoiding ERP Pitfalls. The Journal of Corporate Accounting & Finance **17**(4), 67–74 (2006)
12. Welsh, J.-A., White, J.-F.: A small business is not a little big business. Harvard Business Review **59**(4), 18–32 (1981)
13. 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)
14. Finney, S., Corbett, M.: ERP implementation: A compilation and analysis of critical success factors. Business Process Management Journal **13**(3), 329–347 (2007)
15. Nah, F.F-H., Zuckweiler, K.M., Lau, J.L-S.: ERP implementation: Chief information officers' perceptions of critical success factors. International Journal of Human-Computer Interaction, vol. 16, no. 1, pp. 5-22 (2003)
16. 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), June 8-10. Verona, Italy (2009)
17. Webster, J., Watson, R.T.: Analyzing the past, preparing the future: Writing a literature review. MIS Quarterly **26**(2), 13–23 (2002)

18. 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, Chapter 5. ERPsim Lab, HEC Montreal, Montreal (2011)
19. Remus, U.: Critical Success Factors for Implementing Enterprise Portals: A Comparison with ERP Implementations. Business Process Management Journal **13**(4), 538–552 (2007)
20. Reel, J.S.: Critical Success Factors in Software Projects. IEEE Software **16**(3), 18–23 (1999)
21. Achanga, P., Nelde, G., Roy, R., Shehab, E.: Critical success factors for lean implementation within SMEs. Journal of Manufacturing Technology Management **17**(4), 460–471 (2006)
22. Humphrey, W.S.: Introduction to the team software process. Addison-Wesley, Amsterdam (1999)
23. Hesseler, M., Goertz, M.: Basiswissen ERP-Systeme – Auswahl, Einführung & Einsatz betriebswirtschaftlicher Standardsoftware.W3 l, Witten, Germany (2007)
24. Shanks, G., Parr, A.: A model of ERP project implementation. Journal of Information Technology **15**(4), 289–303 (2000)
25. Kumar, V., Maheshwari, B., Kumar, U.: An Investigation of Critical Management Issues in ERP Implementation: Empirical Evidence from Canadian Organizations. Technovation **23** (10), 793–807 (2003)
26. Francoise, O., Bourgault, M., Pellerin, R.: ERP Implementation by Critical Success Factor Management. Business Process Management Journal **15**(3), 371–394 (2009)
27. Rajagopal, P.: An Innovation-Diffusion View of Implementation of Enterprise Resource Planning (ERP) Systems and Development of a Research Model. Information and Management **40**(2), 87–114 (2002)
28. Rosario, J.G.: On the Leading Edge: Critical Success Factors in ERP Implementation Projects. Business World, May, pp. 15–29 (2000)
29. Al-Mashari, M., Al-Mudimigh, A.: ERP Implementation: Lessons from a Case Study. Information Technology & People **16**(1), 21–33 (2003)
30. Loh, T.C., Koh, S.C.L.: Critical Elements for a Successful Enterprise Resource Planning Implementation in Small-and Medium-Sized Enterprises. International Journal of Production Research **42**(17), 3433–3455 (2004)
31. Nah, F.F-H., Lau, J.L-S., Kuang, J.: Critical Factors for Successful Implementation of Enterprise Systems. Business Process Management Journal, vol. 7, no. 3, pp. 285-296 (2001)
32. Al-Mashari, M., Al-Mudimigh, A., Zairi, M.: Enterprise Resource Planning: A Taxonomy of Critical Factors. European Journal of Operational Research **146**(2), 352–364 (2003)
33. Soja, P.: Success Factors across ERP Implementation Phases: Learning from Practice. In: Wojtkowski, W., Wojtkowski, W.G., Zupancic, J., Magyar, G., Knapp, G. (eds.) Advances in Information Systems Development: New Methods and Practice for the Networked Society, pp. 275–286. Springer, New York (2007)
34. Umble, E.J., Haft, R.R., Umble, M.M.: Enterprise Resource Planning: Implementation Procedures and Critical Success Factors. European Journal of Operational Research **146**(2), 241–257 (2003)
35. Krumbholz, M., Maiden, N.: The Implementation of Enterprise Resource Planning Packages in Different Organizational and National Cultures. Information Systems **26**(3), 185–204 (2001)
36. Zhang, L., Lee, M.K.O., Zhang, Z., Banerjee, P.: Critical Success Factors of Enterprise Resource Planning Systems Implementation Success in China. In: Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS 2003), January 6-9, Hawaii, USA (2003)

37. Xue, Y., Liang, H., Boulton, W.R., Snyder, C.A.: ERP Implementation Failures in China: Case Studies with Implications for ERP Vendors. International Journal of Production Economics **97**(3), 279–295 (2005)
38. Zhang, Z., Lee, M.K.O., Huang, P., Zhang, L., Huang, X.: A Framework of ERP Systems Implementation Success in China: An Empirical Study. International Journal of Production Economics **98**(1), 56–80 (2005)
39. Soh, C., Sia, S.K., Tay-Yap, J.: Cultural Fits and Misfits: Is ERP a Universal Solution. Communications of the ACM **43**(4), 47–51 (2000)
40. McLachlin, R.D.: Factors for Consulting Engagement Success. Management Decision **37**(5), 394–402 (1999)
41. Wang, E.T.G., Chen, J.H.F.: Effects of Internal Support and Consultant Quality on the Consulting Process and ERP System Quality. Decision Support Systems **42**(2), 1029–1041 (2006)
42. Hong, K.-K., Kim, Y.-G.: The Critical Success Factors for ERP Implementation: An Organizational Fit Perspective. Information and Management **40**(1), 25–40 (2002)
43. Appelrath, H., Ritter, J.: SAP R/3 Implementation: Method and Tools. Springer, Berlin, Germany (2000)
44. Piturro, M.: How Midsize Companies Are Buying ERP. Journal of Accountancy **188**(3), 41–48 (1999)
45. Stefanou, C.: Supply Chain Management and Organizational Key Factors for Successful Implementation of Enterprise Resource Planning (ERP) Systems. In: Proceeding of the Americas Conference on Information Systems (AMCIS 1999), August 13-15, Milwaukee, WI, USA (1999)
46. Esteves, J., Pastor, J., Casanovas, J.: A Goal/Question/Metric Research Proposal to Monitor User Involvement and Participation in ERP Implementation Projects. Paper presented at the Information Resources Management Association Conference (IRMA), Philadelphia, USA, May (2003)
47. Barki, H., Hartwick, J.: User Participation and User Involvement in Information System Development. In: Proceedings of the 24th Annual Hawaii International Conference on System Sciences, January, Kauai, Hawaii, IEEE Computer Society, vol.4, pp. 487-492 (1991)
48. Ghosh, S.: Challenges on a Global Implementation of ERP Software. In: Proceedings of the IEEE International Engineering Management Conference, Cambridge, August 18-20, IEEE International, vol. 1, pp. 101-106 (2002)
49. Kumar, V., Maheshwari, B., Kumar, U.: ERP Systems Implementation: Best Practices in Canadian Government Organizations. Government Information Quarterly **19**(2), 147–172 (2002)
50. Palaniswamy, R., Frank, T.G.: Oracle ERP and Network Computing Architecture: Implementation and Performance. Information Systems Management **19**(2), 53–69 (2002)
51. Holland, C., Light, B.: A Critical Success Factors Model for ERP Implementation. IEEE Software **6**(3), 30–36 (1999)
52. Jones, M.C., Price, L.R.: Organizational Knowledge Sharing in ERP implementation: Lessons from Industry. Journal of Organizational and End User Computing **16**(1), 21–40 (2004)
53. Baskerville, R., Pawlowski, S., McLean, E.: Enterprise Resource Planning and Organizational Knowledge: Patterns of Convergence and Divergence. In: Proceedings of the 21st International Conference on Information Systems (ICIS), December 10-13, pp. 396-406, Brisbane, Australia (2000)

54. Cabrera, A., Cabrera, E.F., Barajas, S.: The Key Role of Organizational Culture in a Multi-System View of Technology Driven Change. International Journal of Information Management **21**(3), 245–261 (2001)
55. Yusuf, Y., Gunasekaran, A., Abthorpe, M.K.: Enterprise Information Systems Project Implementation: A Case Study of ERP in Rolls-Royce. International Journal of Production Economics **87**(3), 251–266 (2004)
56. Soffer, P., Golany, B., Dori, D.: Aligning an ERP System with Enterprise Requirements: An Object-Process-Based Approach. Computers in Industry **56**(6), 639–662 (2005)
57. Gupta, A.: Enterprise Resource Planning: The Emerging Organizational Value Systems. Industrial Management & Data Systems **100**(3), 114–188 (2000)
58. Snider, B., da Silveira, G.J.C., Balakrishnan, J.: ERP implementation at SMEs: Analysis of five Canadian cases. International Journal of Operations & Production Management **29**(1), 4–29 (2009)
59. Becker, J., Vering, O., Winkelmann, A.: Softwareauswahl und –einführung in Industrie und Handel – Vorgehen bei und Erfahrungen mit ERP- und Warenwirtschaftssystemen. Springer, Berlin (2007)
60. Sumner, M.: Critical Success Factors in Enterprise Wide Information Management Systems. In: Proceedings of the Americas Conference on Information Systems (AMCIS 1999), August 13-15, pp. 232-234, Milwaukee, WI, USA (1999)
61. Teich, I., Kolbenschlag, W., Reiners, W.: Der richtige Weg zur Softwareauswahl. Springer, Berlin (2008)
62. Willcocks, L.P., Sykes, R.: The Role of the CIO and IT Function in ERP. Communications of the ACM **43**(4), 32–38 (2000)
63. Esteves-Sousa, J.: Definition and Analysis of Critical Success Factors for ERP Implementation Projects. Barcelona, Spain (2004)
64. Sun, A.Y.T., Yazdani, A., Overend, J.D.: Achievement assessment for enterprise resource planning (ERP) system implementations based on critical success factors (CSFs). International Journal of Production Economics **98**(2), 189–203 (2005)