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Critical success factors for ERP system implementation:

a user perspective

Abstract

Purpose: The purpose of this study is to evaluate critical success factors (CSFs) for the implementation of an ERP system from a user perspective.

Design/methodology/approach: The research was conducted in two successive steps. First, a literature review was conducted to derive CSFs for ERP system implementation. Second, a survey was conducted to evaluate the importance of these CSFs from a user perspective. Data was collected through a questionnaire that was distributed within a German manufacturer and was developed based on the CSFs found in the literature. Grey relational analysis (GRA) was used to rank the CSFs in order of importance from a user perspective.

Findings: The findings reveal that users regard eleven of the thirteen CSFs found in the literature as important for ERP system implementation. Seven of the CFSs were classified as the most important from a user perspective including project team, technical possibilities, strategic decision-making, training and education, minimum customization, software testing and performance measurement. Users regarded two of the thirteen CSFs as not important when implementing an ERP system, including organizational change management and top management involvement.

Research limitations/implications: One limitation of this study is that the respondents originate from one organization, industry and country. The findings may differ in other contexts and thus future research should be expanded to include more organizations, industries and countries. Another limitation is that this study only evaluates existing CSFs from a user perspective rather than identifying new ones and/or the underlying reasons using more qualitative research.

Practical implications: A better understanding of the user perspective towards CSFs for ERP system implementation promises to contribute to the design of more effective ERP systems, a more successful implementation and a more effective operation. When trying to successfully implement an ERP system, the project team may use the insights from the user perspective.

Originality/Value: Even though researchers highlight the important role users play during ERP system implementation, their perspective towards the widely discussed CSFs for ERP system implementation has not been investigated comprehensively. This study aims to fill this gap by evaluating CSFs derived from the literature from a user perspective.

Keywords: Enterprise resource planning, implementation, critical success factor, user, grey relational analysis.

1 Introduction

The supply chain and its management is of major importance in most industries. In essence, it concerns collection and analysis of data to provide better basis for decision-making (Hilletofth & Lättilä, 2012). Information systems are needed to achieve this due to complex supply chain structures and processes (Hilletofth, 2010). One information system that has been crucial in operating and managing supply chains efficiently and effectively is the enterprise resource planning (ERP) system (Hilletofth et al., 2010). The ERP system provides seamless integration of processes across functional areas with improved workflow and standardization as well as access to real-time and up-to-date data (Umble et al., 2003). It has become a fundamental tool in order to remain competitive on both global and local markets (Beheshti & Beheshti, 2010).

The implementation of an ERP system is a complex, difficult, costly and time-consuming task (Al-Mashari & Al-Mudimigh, 2003; Xue et al., 2005) and many ERP projects continue fail to meet their original scope, budget and schedule (Huang et al., 2004; Mu et al., 2015). The

reasons for failure have been widely discussed in the literature and research concentrates on identifying the conditions that are believed to increase the probability of success of an implementation project (e.g., Chang et al., 2014; Chen et al., 2009; Maguire et al., 2010). These conditions are commonly referred to as critical success factors (CSFs). Understanding these CSFs and how they influence the outcome of the implementation project decreases the risk of failure and provide helpful guidance for organizations (Huang et al., 2004).

The existing literature includes many studies on CSFs for ERP system implementation and most originate from the time when ERP system first started to be implemented in the industry. However, research is still being conducted within this specific field due to the constant demand of newer and more advanced systems (Saade & Nijher, 2016). The literature of CSFs for ERP system implementation may be divided into two streams where the first focuses on the adapting organisation itself and the second stream focuses on the network of actors involved during the implementation project. Within the adapting organization stream, researchers focus on four perspectives when discussing CSFs for ERP system implementation (e.g. Chang et al., 2015; Dezdar & Sulaiman, 2009; Maguire et al., 2010; Somers & Nelson, 2001; Sumner, 2000), including the generic, senior manager, project manager and user perspective.

Most research on CSFs for ERP system implementation conducted within the adapting organization stream focuses on the generic perspective. So far, very limited empirical research has been done with regard to the user perspective (Kwak et al., 2012; Young et al., 2012). Despite the absence a comprehensive investigation of the user perspective towards the CSFs for ERP system implementation, studies do illustrate the importance of user involvement during system implementation (Fearon et al., 2013; Ziemba & Oblak, 2013). The lack of user involvement has even been identified as a main factor that leads to a troubled project

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(Havelka & Rajkumar, 2006). The investigation of the user perspective towards CSFs for ERP system implementation promises to contribute to the design of more effective enterprise systems, a more successful implementation and a more effective continuous operation (e.g. Fearon et al., 2013; Eichhorn & Tukel, 2016; Ziemba & Oblak, 2013).

The purpose of this study is to evaluate CSFs for the implementation of an ERP system from a user perspective. The research was conducted in two successive steps. To begin with, a literature review was conducted to derive CSFs for ERP system implementation. After that, a survey was conducted to evaluate the importance of these CSFs from a user perspective. Data was collected through a questionnaire that was distributed within a German manufacturer and was developed based on the CSFs found in literature. Grey relational analysis (GRA) was used to rank the CSFs in order of importance from a user perspective, ultimately facilitating the extraction of the most important CSFs according to users.

The remainder of this paper is structured as follows: To begin with, a literature review on CSFs for ERP system implementation and the user perspective is provided in Section 2. After that, the research method is further explained and motivated in Section 3. Thereafter, the empirical findings are presented and discussed in Section 4. Finally, the research is concluded in Section 5.

2   Literature review

A literature review was conducted to derive CSFs for ERP system implementation. The review included 54 papers in total (Appendix 1) and in total thirteen CSFs were found in the literature (Table 1). The perspectives considered (PC) within the literature that discusses CSFs for ERP system implementation are also stated, which include the generic (G), senior

manager (SM), project manager (PM) and the user (U) perspective. Below the found CSFs are first described from a generic perspective and afterwards discussed from a user perspective.

INSERT TABLE 1 HERE

2.1 Critical success factors for ERP system implementation

The first derived CSF from the literature is 'project team' (e.g. Dezdar & Sulaiman, 2009); Wang et al., 2008; Upadhyay & Dan, 2009). The project team during ERP system implementation should consist of delegated process owners, a project champion and consultants who act as facilitators by using the knowledge of the project team members (Akkermans & van Helden, 2002; Sumner, 1999). A project team is more important in the earlier stages of the implementation and has to include senior managers from different functions, senior project managers, experienced business and technology managers and users (Somers & Nelson, 2001). The ERP system implementation team needs to consist of the best people in the organization who are selected for their skills, past accomplishments, reputation and flexibility (Umble et al., 2003).

The second derived CSF from the literature is 'top management involvement' (e.g. Aloini et al., 2007; Dezdar & Sulaiman, 2009; Sherer & Alter, 2004). During ERP system implementation, the new organizational structures, roles and responsibilities need to be determined and approved. This can be done with the creation of policies by top management and in time of conflict, top management also needs to mediate between parties (Roberts & Barrar, 1992). Top management support reinforces the commitment of all the employees in the organization, which is crucial for ERP system implementation, especially in the early stages of the implementation project (Bingi et al., 1999). Huang et al. (2004) state that the

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lack of senior management commitment to project is a major reason of unsuccessful ERP system implementation.

The third derived CSF from the literature is 'strategic decision-making' (e.g. Dezdar & Sulaiman, 2009; Motwani et al., 2005; Wang et al., 2008). The scope of an implementation plan is its initial 'blueprint' (Gargeya & Brady, 2005). A well-defined business plan and vision is vital to steer the direction of the project and has to outline proposed strategic and tangible benefits, resources, costs, risks and a timeline (Nah et al., 2003; Rosario, 2000). The best way to do this is to manage ERP system implementations as new business ventures, instead of IT projects (Austin & Nolan, 1998). This includes how the organization should operate behind the implementation effort, a justification for the investment based on a problem and the change tied directly to the direction of the company, a project mission related to business needs and identification and tracking of goals and benefits (Roberts & Barrar, 1992).

The fourth derived CSF from the literature is 'communication' (e.g. Aloini et al., 2007; Dezdar & Sulaiman, 2009; Motwani et al., 2005). Interdepartmental communication is necessary across functional boundaries in ERP context to integrate business functions (Davenport, 2000). An effective communication while implementing an ERP system is critical to the success of the entire project, meaning that project team promotions, the project's importance and management's expectations need to be communicated at every organizational level (Sumner, 2000). Additionally, user input should be managed in acquiring their requirements, comments, reactions and approval (Rosario, 2000).

The fifth derived CSF from the literature is 'project management' (e.g. Aloini et al., 2007; Dezdar & Sulaiman, 2009; Singla & Goyal, 2006). Excellent project management is necessary during ERP system implementation and should include a clear definition of

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objectives, development of both a work plan and a resource plan and careful tracking of project progress (Laughlin, 1999). Project management priorities should change and evolve over time and improvisation may also need to be part of the capabilities of ERP project managers (Snider et al., 2009). The success of an ERP system depends on effective project management principles and not understanding basic project management fundamentals has a negative impact on the implementation (Ehie & Madsen, 2005).

The sixth derived CSF from the literature is 'project support' (e.g. Dezdar & Sulaiman, 2009; Wang et al., 2008; Singla & Goyal, 2006). Project support in the form of technical assistance, maintenance, updates and user training is crucial during ERP system implementation when there is a lack of technical and transformational ERP skills in-house (Sumner, 2000). The project's implementation result is positively connected to the proper fit and compatibility with the software vendor (Akkermans & van Helden, 2002; Janson & Subramanian, 1996). Moreover, support can also be established by project sponsor commitment, which helps drive consensus and to oversee the entire implementation's life cycle (Rosario, 2000).

The seventh derived CSF identified from the literature is 'minimum customization' (e.g. Akkermans & van Helden 2002; Saini et al., 2013; Ziemba & Oblak, 2013). A stable and successful business setting is an important foundation in the initial chartering phase of ERP system implementation (Nah et al., 2003). All departments within an organization that implement an ERP system need to have access to the same data and information system, while the area of operations for ERP is unlimited and its use increases the efficiency of organizations heavily because customer information just needs to be entered once in order to make it accessible to the entire organization (Dowlatshahi, 2005). Somers and Nelson (2004) indicate that the accurate data as well as its conversion is the fundamental requirement for the efficient use of the new ERP system. In order to overcome issues between user departments as

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a result of change, the management needs to make sure that no department comprises a rearrangement of the ERP system (Huang et al., 2004).

The eight derived CSF from the literature is 'organizational change management' (e.g. Aloini et al. 2007; Dezdar & Sulaiman, 2009; Singla & Goyal, 2006). Gargeya and Brady (2005) argue that the organization has to be prepared for the change and opportunities inherent to ERP system implementation. The inherent change, which goes along with the implementation, usually confronts the project team with resistance caused by changing job content and uncertainty (Laughlin, 1999). Loh and Koh (2004) describe the change management as a necessity throughout the entire process. The change program and the changed culture involve people and the organization (Rosario, 2000). An adequate change management also strives to lower the organizational resistance against the change, thus the user has to get the possibility to co-decide about the design of new business processes (Bingi et al., 1999).

The ninth derived CSF from the literature is 'business process alignment' (e.g. Dezdar & Sulaiman, 2009; Motwani et al., 2005; Sherer & Alter, 2004). Akkermans and van Helden (2002) state that interdepartmental cooperation is of high importance and that an ERP system is really about closely integrating different business functions, which sets them apart from other IT efforts. The reengineering of the processes also results in a changed corporate culture and a process of software customization and process clean-up is necessary in order to have a balanced vendor-implementer approach (Gargeya & Brady, 2005). Whereas the adaptation increases the feature-function fit between the organization and the software, the resistance against the change decreases and less training is needed (Bingi et al., 1999).

The tenth derived CSF from the literature is 'software testing' (e.g. Dezdar & Sulaiman, 2009; Sherer & Alter, 2004; Singla & Goyal, 2006). According to Gargeya and Brady (2005),

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adequate testing of the ERP system is crucial and there are three approaches to rolling out the system, namely the big bang, the gradual and the phased approach. Not testing the system adequately can end up in delivery and inventory problems, which cost the organizations financially more in the long run (Davenport, 2000; Rosario, 2000). Loh and Koh (2004) also highlight that a proper migration and clean-up of the data aids the successful implementation.

The eleventh derived CSF from the literature is 'performance measurement' (e.g. Dezdar & Sulaiman, 2009; Motwani et al., 2005; Wang et al., 2008). In order to tackle threats like misalignment of expectations between an implementing organization and a software vendor, expectations need to be managed properly throughout the entire implementation of the ERP system (Akkermans et al., 2002). Loh and Koh (2004) and Nah et al. (2003) argue that performance measurements are needed to keep track of all occurrences and to measure the achievements against the milestones and targets. Evaluation is important, since early proof of success helps to manage scepticism (Rosario, 2000). Roberts and Barrar (1992) explain that there are two criteria of performance measurement, namely project management and operational criteria.

The twelfth derived CSF from the literature is 'education and training' (e.g. Aloini et al., 2007; Sherer & Alter, 2004; Singla & Goyal, 2006). The organization has to be prepared to utilize the ERP system in the day-to-day operations as well as the inherent change and opportunities (Gargeya & Brady, 2005). Dowlatshahi (2005) states that an effective and correct use of the system can only be guaranteed by providing sufficient training for the employees and that this training is the most important element in successful ERP system implementation. Education should be a priority from the beginning of a project and requires investments (Roberts & Barrar, 1992). Organizations have to spend money for training and education sessions in various forms (Loh & Koh, 2004). The advantage of distributing

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training is that organizations can reduce the amount of demanded consultant hours and can also let their own employees master occurring issues (Dowlatshahi, 2005).

The thirteenth derived CSF from the literature is 'technical possibilities' (e.g. Aloini et al., 2007; Dezdar & Sulaiman, 2009; Motwani et al., 2005). The current marketplace offers all kinds of differences in ERP packages for different requirements and demands and the proper package for a certain organization differs in its size, its business field, its business processes, its internal and external relationship structure and its own strategy (Janson & Subramanian, 1996). Somers and Nelson (2004) mention the importance of the careful selection of the software package and that the greater and more carefully the package is selected, the higher the chances of successful ERP system implementation. Loh and Koh (2004) also highlight the possibility of in-house software development if adequate commercial packages are not available.

2.2   User perspective towards critical success factors

The user perspective has been highlighted partially within the existing literature of CSFs for ERP system implementation. Within this study, users are defined as the front line 'soldiers' of the organization who have direct contact with the ERP system (Rasmy et al., 2005) and are those who create or collect data for the system (Strong et al., 1997; Wang, 1998).

The CSF 'project team' for ERP system implementation is investigated from a user perspective by Snider et al. (2009), who observed that users rather try to solve problems relating to ERP system implementation than asking help from a consultant who is lacking soft skills. Deng and Gupta (2005) investigated the CSF 'project team' from a user perspective within information system implementation. They identified that users agree that a project champion should be included within the project team that orchestrates information system implementation, as they should ensure adequate allocation of organizational resources and

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address the organization's business needs. These statements indicate that users understand the importance of composing a well-thought-out project team when implementing an ERP system.

The CSF 'top management involvement' for ERP system implementation has been briefly discussed by Snider et al. (2009), who state that users appreciate management's sheer gesture to support their time in the project, regardless of the actual results. The perspective of users is further discussed by Ramadhana et al. (2016), who propose that users are more than happy to do their job and improve performance through the use of the ERP system if top management sufficiently support them. Furthermore, users who know that everything they do can be seen by others would have a high self-discipline (Ramadhana et al., 2016). These insights indicate that users understand the importance of the CSF 'top management involvement' for ERP system implementation.

The CSF 'strategic decision-making' for ERP system implementation has been investigated from a user perspective by Woo (2007). Within this study, users state that senior managers should create a strategic approach to ERP system implementation. If they fail to do so, users will not understand the purpose and benefits of implementing the system and will be concerned about their benefits and position in the company and how ERP would affect them (Woo, 2007). This indicates that users understand the importance of this study's CSF 'strategic decision-making' for ERP system implementation.

The CSF 'communication' for ERP system implementation has been investigated from a user perspective by Woo (2007), who state that users frequently complained that they did not know was going on with the organization's ERP system implementation because senior managers did not communicate the ERP plans and benefits with them. The user perspective is also highlighted by Amoako-Gyampah (2004), who observed a discrepancy between the

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perceptions of users and managers, as users did not think that the communication strategy within the case company was effective (compared to the perceptions of managers). Moreover, in the study of Umble et al. (2003), users state that time will be wasted when it takes too much effort to find needed information. These statements indicate that users understand the need for effective communication during ERP system implementation, as it facilitates a structured manner for them to find out what is happening in the organization.

The CSF 'project management' for ERP system implementation been investigated from a user perspective by Chang et al. (2014), who conclude that users believe project research and development to be of high importance for successful ERP system implementation. Within the study of Maguire et al. (2010), users believe that the overall project management approach to ERP system implementation impacts knowledge sharing and transfer. These statements indicate that users understand the importance of the CSF 'project management' for ERP system implementation.

The CSF 'project support' for ERP system implementation has been investigated from a user perspective by Snider et al. (2009), who observed that users believe that a consultant from a vendor is of added value when they match business process and software capabilities and when they master the whole software package. Soft skills were often judged as even more important by users. Within the study of Maguire et al. (2010), users express that consultants should allocate time and be willing to share knowledge with them during the first stages of ERP system implementation. These statements indicate that users understand the importance of the CSF 'project support' for ERP system implementation.

The CSF 'minimum customization' for ERP system implementation has been investigated from a user perspective by Chang et al. (2014), who state that users from one case study's production department think it is unlikely that the customization of an ERP system can

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negatively impact an ERP system's implementation. Users interviewed by Snider et al. (2009) explain that, due to ERP software modifications, they were experiencing software problems of fixing one thing and unfixing another. However, users did not know that the two things were related. These statements indicate that, due to a lack of understanding the negative implications, users do not believe that it is important to avoid the customization of an ERP system.

The CSF 'organizational change management' for ERP system implementation has not been investigated clearly from a user perspective. However, this CSFs is investigated from a user perspective by Deng and Gupta (2005), who argue that most users agree that change management and managing resistance is critical for successfully implementing an information system. Jermier et al. (1994) further explain that users tend to under-use systems when changes are managed poorly. These findings within the field of information system implementation indicate that users understand that organizational change management is important for successful ERP system implementation.

The CSF 'business process alignment' for ERP system implementation has only been investigated from a user perspective by Adam and O'Doherty (2000), who observed that users believe it is important that the goal of implementing a new ERP system should be to meet business requirements rather than trying to replicate functionality from legacy system(s). This indicates that users understand the importance of this study's CSF 'business process alignment' for ERP system implementation.

The CSF 'software testing' for ERP system implementation has not been investigated from a user perspective within the current literature. However, Bettencourt et al. (2002) and Borman and Motowidlo (1993) studied the user perspective within the context of information system development and state that users tend to spend more time on testing and improving the system

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when a strong relationship of trust with developers is established. This indicates that users understand the importance of testing the ERP system, but only tend to do so when a relationship of trust is established with developers.

The CSF 'performance measurement' for ERP system implementation has been briefly discussed by Amoako-Gyampah (2004), who indicates that the concerns of users regarding the ERP system's ability to increase their productivity on the job can be alleviated when senior managers assure that productivity measures might not be focused on. This indicates that users label the CSF 'performance measurement' as not important, at least initially. However, observations made by Joshia and Laurel (1998) in the field of information system implementation indicate that users do think performance measurement is important, as they expect benefits to be shared with them when participating during the implementation.

The CSF 'education and training' for ERP system implementation has been investigated from a user perspective by Maguire et al. (2010), who observed that users perceived the training within their organization as not adequate. However, the same users still indicate that training is needed to use the ERP system properly. The study of Woo (2007) shows that users do not understand the importance of education and training, as they explain that they only attended the course because they were forced. Some users even commented they did not understand why they had to attend the course at all. However, Amoako-Gyampah (2004) and Umble et al. (2003) indicate that users understand the importance of training, as they expect this enhances their confidence and a proper understanding of the ERP system, eliminating the need to allocate time to figuring out how the system should be used.

The CSF 'technical possibilities' for ERP system implementation has been investigated by Chang et al. (2014), who state that users from most departments within their study deem it unlikely that an ERP package can negatively affect a successful system implementation.

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Furthermore, Amoako-Gyampah (2004) indicates that users tend to be less enthusiastic about an ERP system's ability to provide accurate, reliable and timely information than managers, as they have had less exposure to the technology and therefore do not see the advantages of the ERP system over the legacy system. Amoako-Gyampah (2004) further discuss that users are more concerned about the ability of the system to facilitate their daily jobs rather than the system's ability to provide integrated data. These findings indicate that users do not think that 'technical possibilities' is a CSF for ERP system implementation.

3 Research design

The purpose of this study is to evaluate the CSFs for ERP system implementation from a user perspective and was conducted in two succeeding steps: a literature review and a survey study. In the first step of the research, it was necessary to set the scene by presenting relevant research from the research field. The 'Web of Science' database was utilized and keywords such as 'ERP system implementation', 'critical success factors' and 'user' were used. The literature review showed that authors mainly discuss CSFs for ERP implementation from a generic perspective. The most recent and relevant papers were chosen to serve as the foundation of this research and in total, thirteen CSFs were deduced from these papers (Table 1).

In the second step of the research, a survey was conducted to evaluate the user perspective towards the CSFs derived from the literature. A questionnaire was developed based on the thirteen identified CSFs and each question contained an introduction that described the corresponding CSF (Appendix 2). Each CSF's introduction contained relevant content from this study's literature review. The respondents were asked to grade each questionnaire item on a Likert-scale from one to five (1 = not important and 5 = very important). The higher the score, the more important the respondents think the particular factor item is and vice versa.

The questionnaire was sent to users of an ERP system within a German manufacturer (Table 2), which has been selected due to having successfully implemented an ERP system in 2011 and senior managers supporting the distribution of questionnaire to its users. This facilitated the distribution of the questionnaires to a large number of users within the company. The study was conducted in one company to mitigate the effect of extraneous variables on the perception of respondents. A total of 127 questionnaires were sent out, from which 123 valid answers were retrieved, resulting in a response rate of 97%.

INSERT TABLE 2 HERE

The collected data was analysed with GRA to identify the most important CSFs for ERP system implementation. GRA is based on the grade of relation between the Likert-style rating scale and this study's proposed CSFs and a multi-criteria-weighted average is proposed in the decision-making process that facilitates the ranking of the CSFs in order of importance (Deng, 1986; Lee et al., 2010).

The first step is to formulate the multi-criteria problem by using a set of alternatives $(x_1, x_2, ..., x_{13})$, in this study the CSFs and criteria $(k_1, k_2, ..., k_5)$, which represent the Likert-style rating scale ($k_1 = 1 =$ not important and $k_5 = 5 =$ very important). Each criterion is assigned weightings and a preference index (PI). Since k_1 and k_2 have a negative impact on the CSFs, their PI is equal to zero. k_4 and k_5 have a positive impact on the CSFs, which makes their PI equal to one. The PI of k_3 being set to zero, as this study aims to focus on the most important CSFs for ERP system implementation. The next step is to formulate the following decision matrix D:

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$$D = \begin{Bmatrix} x_1(k_1) & \dots & x_i(k_1) & \dots & x_m(k_1) \\ \dots & \dots & \dots & \dots & \dots \\ x_1(k_j) & \dots & x_i(k_j) & \dots & x_m(k_j) \\ \dots & \dots & \dots & \dots & \dots \\ x_1(k_n) & \dots & x_i(k_n) & \dots & x_m(k_n) \end{Bmatrix}$$

where:

$$PI_j = \begin{cases} 1, & \text{Increasing} \\ 0, & \text{Decreasing} \end{cases}$$

After normalization, it turns into matrix D':

$$D' = \begin{Bmatrix} x_1(k_1)' & \dots & x_i(k_1)' & \dots & x_m(k_1) \\ \dots & \dots & \dots & \dots & \dots \\ x_1(k_j)' & \dots & x_i(k_j)' & \dots & x_m(k_j)' \\ \dots & \dots & \dots & \dots & \dots \\ x_1(k_n)' & \dots & x_i(k_n)' & \dots & x_m(k_n)' \end{Bmatrix}$$

where:

$$x_i(k_j)' = \frac{x_i(k_j) - \min_{\forall j}\{x_{i(k_j)}\}}{\max_{\forall j}\{x_{i(k_j)}\} - \min_{\forall j}\{x_{i(k_j)}\}}$$

Then, a pre-reference sequence $y_0 = \{y_{0\,(k_j)}; k = 1, 2, 3, \dots, m\}$ is determined:

$$y_0(k_j) = \begin{cases} \min_{\forall i}\{x_{i(k_j)}\} & \text{if } PI_J = 0 \\ \max_{\forall i}\{x_{i(k_j)}\} & \text{if } PI_J = 1 \end{cases}$$

The reference sequence $y'_0 = \{y_{0\,(k_j)}'\}; k = 1, 2, 3, \dots, m$ is computed by turning all decreasing criteria into opposite direction:

$$y_0(k_j)' = \begin{cases} 1 - y_{0(k_j)} & \text{if } PI_J = 0 \\ y_{0(k_j)} & \text{if } PI_J = 1 \end{cases}$$

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Finally, each sequence is compared with the reference sequence by calculating the grey relational coefficient: $y\big(y_0(k), x_i(k)\big) = \frac{\Delta \min + \zeta \Delta \max}{\Delta_{oj}(k) + \zeta \Delta\, max}$. ζ serves as the equation's contrast control and the value of 0.5 is applied (Deng, 1986). After the grey relational coefficient is obtained, the mean of this coefficient can be used as the grey relational grade: $y(y_0, x_i) = \frac{1}{n}\sum_{j=1}^{n} y\big(y_0(k), x_j(k)\big)$. To consider the unequal weights among the factors, the formula above needs to be extended to define the grey relational grade: $y(y_0, x_i) = \frac{1}{n}\sum_{j=1}^{n} \beta_k y\big(y_0(k), x_j(k)\big)$. Within this formula, β_k determines the normalized weight of criterion k, where $\sum_{k=1}^{n} \beta_k = 1$ and with equal weights.

After these steps were completed, the user perspective towards the CSFs identified in the literature review (Table 1) was identified and the CSFs were ranked in order of importance (Table 3).

4   Findings and analysis

In order to evaluate the user perspective towards the CSFs for ERP system implementation derived from the literature, the CSFs were ranked in order of importance. Looking at the ranking of the CSFs (Table 3), the GRA value of CSF11 lies closer to CSF10 than CSF9. Therefore, a total of seven CSFs are selected (CSF1, CSF13, CSF3, CSF12, CSF7, CSF10 and CSF11) and identified as 'most important' from a user perspective. CSF9, CSF6, CSF5 and CSF4 still have a GRA value above ζ 0.5, meaning that these CSFs, despite not being identified as 'most important', are important according to users. The remaining CSFs, CSF8 and CSF2, have a GRA value below ζ 0.5, which means that users deem them as 'not important' for ERP system implementation. The CSFs that are labelled as 'most important' and 'not important' CSFs are further discussed below.

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INSERT TABLE 3 HERE

The most important CSF according to users is 'project team', meaning that users agree with

the statements made from a generic perspective within the literature (e.g. Dezdar & Sulaiman,

2009; Upadhyay & Dan, 2009; Wang et al., 2008). Thus, they agree the project team needs to

consist of the best people and has to include a project champion, employees from different

functions and levels and external consultants when ERP expertise is missing internally. This

also indicates that users agree with Deng and Gupta (2005), who proposed that users agree

that a project champion should be included in the project team as he or she ensures the

adequate allocation of organizational resources and address the organization's business needs.

The second most important CSF according to users is 'technical possibilities', meaning that

users agree with the statements made from a generic perspective within the literature (e.g.

Aloini et al., 2007; Dezdar & Sulaiman, 2009; Motwani et al., 2005). Thus, they understand

the importance of the evaluation of different ERP systems offered in the marketplace based on

its own strategy, size, business field, its business processes and its internal and external

relationship structure. This also indicates that users agree with Amoako-Gyampah (2004),

who argue that users understand the importance of the system's ability to facilitate their daily

jobs. However, this finding differs from the study of Chang et al. (2014), who proposed that

users deem it unlikely that an ERP package can negatively affect the system's

implementation.

The third most important CSF according to users is 'strategic decision-making', meaning that

users agree with the statements made from a generic perspective within the literature (e.g.

Dezdar & Sulaiman, 2009; Motwani et al., 2005; Wang et al., 2008). Thus, users believe that

a well-defined business plan and vision should define how the organization operates behind

the implementation effort and has to outline proposed strategic and tangible benefits,

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resources, costs, risks and timeline is critical. This also indicates that users agree with Woo (2007), who proposed that users understand the importance of the creation of a strategic approach to ERP system implementation, as it provides an understanding of the affects, purpose and benefits of the new system.

The fourth most important CSF according to users is 'education and training', meaning that users agree with the statements made from a generic perspective within the literature (e.g. Aloini et al., 2007; Dezdar & Sulaiman, 2009; Sherer & Alter, 2004). Thus, users understand the importance of investing in education and sufficient training in the beginning of the ERP system implementation project in order to use the system effectively and correctly. This also indicates that users agree with Maguire et al. (2010), Umble et al. (2003) and Amoako-Gyampah (2004), who argued that users understand the purpose of training, as they expect this enhances their confidence and understanding of the ERP system. This finding differs from the study of Woo (2007), who observed that users regard training as not important and they only attend the training because they were forces by senior managers.

The fifth most important CSF according to users is 'minimum customization', meaning that users agree with the statements made from a generic perspective within the literature (e.g. Akkermans & van Helden, 2002; Saini et al., 2013; Ziemba & Oblak, 2013). Thus, users understand the importance of departments having the same access to the same data and ERP system and that the chosen ERP system should not be rearranged. This finding contradicts the studies of Chang et al. (2014) and Snider et al. (2009), where users argued that it is not needed to avoid customization of an ERP system, since they believe it is unlikely that this can negatively impact the implication.

The sixth most important CSF according to users is 'software testing', meaning that users agree with the statements made from a generic perspective within the literature (e.g. Dezdar &

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Sulaiman, 2009; Sherer & Alter, 2004; Singla & Goyal, 2006). Thus, users believe that the organization should establish rigorous and sophisticated testing of the software in order to simplify ERP system implementation. This also indicates that users agree with Bettencourt et al. (2002) and Borman and Motwidlo (1993), who argue that users spend more time on testing and improving an information system when there is a strong relationship of trust with developers.

The seventh most important CSF according to users is 'performance measurement', meaning that users agree with the statements made from a generic perspective within the literature (e.g. Dezdar & Sulaiman, 2009; Motwani et al., 2005; Wang et al., 2008). Thus, users believe that performance measurements should be identified to manage expectations, keep track of all occurrences and to measure the achievements against the milestones and targets. This finding also indicates that users agree with Joshia and Laurel (1998), who argued that users think performance measurement is important, as they expect benefits to be shared with when participating during information system implementation. However, this finding contradicts the work of Amoako-Gyampah (2004), who stated that users prefer that senior managers do not focus on performance measures.

Inconsistent with the literature that discusses CSFs from a generic perspective, is the finding that users deem two of the CSFs as not important for ERP system implementation. The first not important CSF according to users is 'organizational change management', meaning that they do not agree with researchers who discuss this CSF from a generic perspective (e.g. Aloini et al., 2007; Dezdar & Sulaiman, 2009; Singla & Goyal, 2006). Thus, users believe that it is not necessary for organizations to utilize change management techniques and tools that must be defined and evaluated with the best practices in the industry. This finding also contradicts the statement of Deng and Gupta (2005), who argued that most users agree that

change management and managing resistance is critical for information system implementation.

The second not important CSF according to users is 'top management involvement', meaning that they do not agree with statements from researchers who discuss this CSF from a generic perspective (e.g. Aloini et al., 2007; Dezdar & Sulaiman, 2009; Sherer & Alter, 2004). Thus, users believe that it is not important that top management reinforces the commitment of all employees in the organization and creates policies that determine and approve new organizational structures, roles and responsibilities. This outcome also indicates that users disagree with Snider et al. (2009), who argued that users appreciate management's sheer gesture to support their time in the ERP project. It further suggests that users disagree with Ramadhana et al. (2016), who proposed that users are more than happy to do their job and improve their performance through ERP system usage if there is support from top management.

These findings show that there is a level of discrepancy between this study's user perspective and the generic perspective that is dominating the literature. It also indicates that users agree with some of the authors who have already discussed their perspective towards CSFs for ERP system or information system implementation.

5   Concluding remarks

5.1   Conclusion

This study aimed to evaluate CSFs for the implementation of an ERP system from a user perspective and was conducted in two sequential steps. To begin with, a literature review was conducted to find CSFs for ERP system implementation. After that, a survey study was conducted to evaluate these derived CSFs from a user perspective. The collected data was

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analysed using GRA. The findings reveal that users regard eleven of the thirteen CSFs found in the literature (Table 1) as important for ERP system implementation. These eleven CSFs were ranked from most to least important (Table 3) and the first seven CSFs are identified as most important for ERP system implementation from a user perspective: (1) project team, (2) the technical possibilities, (3) strategic decision-making, (4) training and education, (5) minimum customization, (6) software testing, (7) performance measurement. A major difference identified compared to the literature, is that users deem 'organizational change management' and 'top management involvement' as not important for ERP system implementation.

5.2   Contribution and implications

This study has both practical and theoretical implications. Even though researchers highlight the important role users play during ERP system implementation, their perspective towards the widely discussed CSFs for ERP system implementation has not been investigated comprehensively. This study aims to fill this gap by evaluating thirteen CSFs for ERP system implementation derived from the literature from a user perspective. The generated insights into the user perspective facilitates the design of more effective ERP systems, its more successful implementation and improved management. When implementing an ERP system, the project team can use the insights to improve the system's adoption. A final strength of this study is that it identified gaps and similarities between the generic and user perspectives. The discovered gaps can be useful knowledge when implementing an ERP system.

5.3   Limitations and further research

As in all research, it is important to acknowledge its limitations. One limitation of this study is that it considers thirteen CSFs without grouping them according to different stages or phases of ERP system implementation. Another limitation is that the survey respondents originate

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from one case organization, country and industry and the outcome may vary in other contexts. These limitations should be considered when researchers attempt to replicate or further test the reported findings and each of these limitations can be addressed by further research. The next step of this research could be to send the questionnaire to users involved in ERP implementation in other organizations, countries and industries. If further research provides similar findings, it would be interesting to conduct qualitative research to find out why users perceive the presented CSFs in the way they do and whether they propose additional CSFs.

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Appendix 1 Literature review sample

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Appendix 2 Questionnaire

Please evaluate each of the following factors in terms of its importance in determining success in implementing an Enterprise Resource Planning (ERP) system. Answer each question with a number from one (not important) to five (very important).

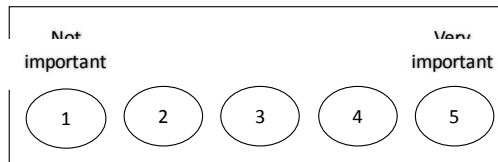## 1. How would you rate the importance of 'project team'?

The project team should consist of delegated process owners, a project champion and consultants who act as facilitators by using the knowledge of the project team members. As a project team usually disbands after installation, its role is more important in the earlier stages than during post-installation. The ERP system project team needs to consist of the best people in the organization who are selected for their skills, past accomplishments, reputation and flexibility and has to include senior management from different functions, senior project managers, experienced business and technology managers and ERP system users leading to ERP system implementation success.

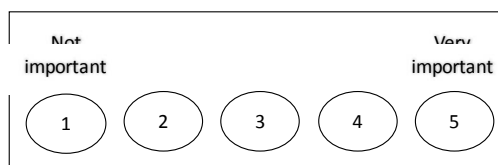## 2. How would you rate the importance of 'top management involvement'?

When implementing ERP system, the new organizational structures, roles and responsibilities need to be determined and approved. This can be done with the creation of policies by top management and in time of conflict, top management also needs to mediate between parties. Top management support reinforces the commitment of all the employees in the organization, which is a key factor in ERP system implementation. The support of top management is vital for an ERP system's success, especially in the early stages of the implementation project. The

lack of senior management commitment to project is a major reason of an unsuccessful ERP system implementation.

Not important				Very important
1	2	3	4	5

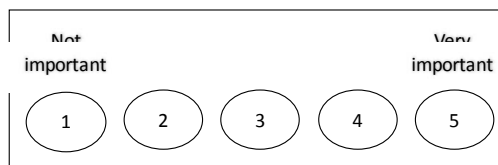**3. How would you rate the importance of 'strategic decision-making'?**

A well-defined business plan and vision is vital to steer the direction of the project and has to outline proposed strategic and tangible benefits, resources, costs, risks and timeline is critical. The best way to do this is to manage ERP system implementation as new business ventures, instead of IT projects. This includes how the organization should operate behind the implementation effort, a justification for the investment based on a problem and the change tied directly to the direction of the company, a project mission related to business needs and identification and tracking of goals and benefits. Clear goals and objectives should be specific, operational and indicate the general directions of the project.

Not important				Very important
1	2	3	4	5

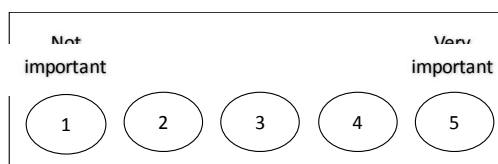**4. How would you rate the importance of 'communication'?**

Interdepartmental communication is necessary across functional boundaries in an ERP system context to integrate business functions. An effective communication while implementing an ERP system is critical to the success of the entire project, meaning that expectations need to be communicated at every organizational level and that management of communication, education and expectations throughout the organization is of high importance. Additionally,

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user input should be managed in acquiring their requirements, comments, reactions and approval. Communication includes the formal promotion of project teams, advertisement of project progress to the rest of the organization and communication of the project's importance.

Not important				Very important
1	2	3	4	5

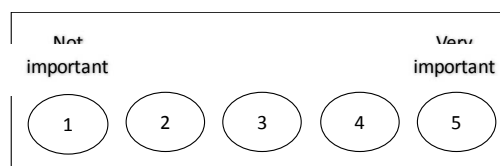## 5. How would you rate the importance of 'project management'?

Excellent project management is necessary for a successful ERP system implementation and should include a clear definition of objectives, development of both a work plan and a resource plan and careful tracking of project progress. Project management priorities should change and evolve over time and improvisation may also need to be part of the capabilities of ERP system project managers. A major aspect of ERP system project management is the identification of the equipment required to operate the system and to provide easy access for all users. The success of an ERP system depends on effective project management principles and not understanding basic project management fundamentals has a negative impact on the implementation.

Not important				Very important
1	2	3	4	5

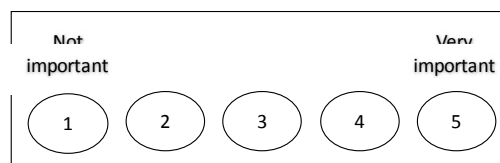## 6. How would you rate the importance of 'project support'?

The support is crucial to the project success caused by the lack of technical and transformational skills in-house to organize such a pervasive project. Since ERP systems are a

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huge investment for organizations, vendor support in the form of technical assistance, maintenance, updates and user training is important with packaged software. The project's implementation result is positively connected to the proper fit and compatibility with the software vender. Moreover, project support can also be established by project sponsor commitment, which helps drive consensus and to oversee the entire implementation's life cycle.

Not important				Very important
1	2	3	4	5

7. How would you rate the importance of 'minimum customization'?

A stable and successful business setting is an important foundation in the initial chartering phase of the project. All departments within an organization that implement an ERP system need to have access to the same data and information system, while the area of operations for ERP systems is unlimited and its use increases the efficiency of organizations heavily because customer information just needs to be entered once in order to make it accessible to the entire organization. Accurate data as well as its conversion is the fundamental requirement for the efficient use of the new ERP system. In order to overcome issues between user departments as a result of change, the management needs to intervene so that no department comprises a rearrangement of the ERP system.

Not important				Very important
1	2	3	4	5

8. How would you rate the importance of 'organizational change management'?

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The organization has to be prepared for the change and opportunities inherent to the implementation of an ERP system. The inherent change, which goes along with the implementation, usually confronts the project team with resistance caused by changing job content and uncertainty. Another reason for the existing resistance that has to be overcome is the power distribution misfit of a new information system. The change management is a necessity throughout the entire process. The change program and the changed culture involve people and the organization. An adequate change management also strives to lower the organizational resistance against the change, thus the user has to get the possibility to co-decide about the design of new business processes.

Not important				Very important
1	2	3	4	5
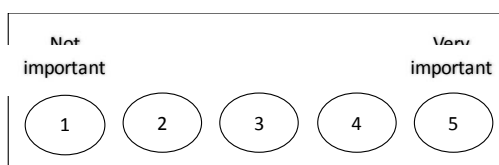
9. How would you rate the importance of 'business process alignment'?

Interdepartmental cooperation is of high importance and that ERP systems are really about closely integrating different business functions, which sets them apart from other IT efforts. The reengineering of the processes also results in a changed corporate culture. These actions have to be managed on the human and operational level. The technological adaptation is also known as the changes and necessary adjustments caused by the installation of the new ERP system. Whereas the adaptation increases the feature-function fit between the organization and the software, the resistance against the change decreases and less training is needed.

Not important				Very important
1	2	3	4	5

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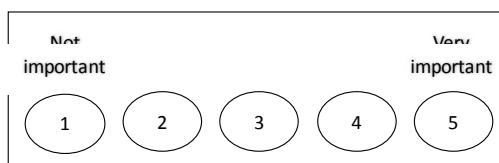
10. How would you rate the importance of 'software testing?

The process of software customization and process clean-up in order to have a balanced vendor-implementer approach. The scope of an implementation plan is its initial 'blueprint'. The rolling out approach is important and they distinguish three different approaches, namely the big bang, the gradual and the phased approach. The key element for a successful ERP system implementation is the adequate testing of the system. Not testing the system adequately can end up in delivery and inventory problems, which cost the organizations financially more in the long run. There is a possibility of in-house software development if adequate commercial packages are not available and a proper plan for migration and clean-up of the data aids the successful implementation.
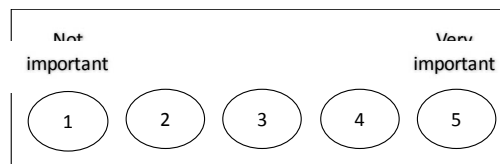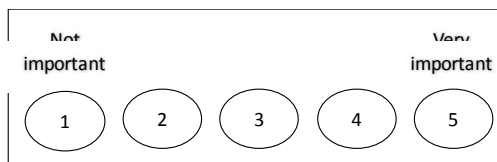

11. How would you rate the importance of 'performance measurement'?

Misalignments between expectations can occur through the created picture of the software vendor, which cannot be met, or by expecting less complexity or effort. In order to tackle those kinds of threats, a proper management of expectations is necessary throughout the entire implementation. The performance measurements are important to keep track of all occurrences and to measure the achievements against the milestones and targets. This section can be enriched with the division of two categories, which are the two criteria: (1) project management and (2) operational criteria. Project management criteria concern the checking of completion dates, costs and quality. Evaluation is important, since early proof of success helps to manage scepticism.

Not important				Very important
1	2	3	4	5
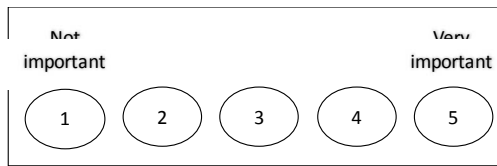
12. How would you rate the importance of 'education and training'?

An effective and correct use of the system can only be guaranteed by providing sufficient training for the employees and that this training is the most important element in a successful ERP system implementation.' Education should be a priority from the beginning of a project and requires investments. Organizations have to spend money for training and education sessions in various forms. The advantage of distributing training is that organizations can reduce the amount of demanded consultant hours and can also let their own employees master occurring issues. The organization has to be prepared to utilize the new system in the day-to-day operations as well as the inherent change and opportunities.

Not important				Very important
1	2	3	4	5

13. How would you rate the importance of 'technical possibilities'?

The current marketplace offers all kinds of differences in packages for different requirements and demands. The proper package for a certain organization differs in its size, its business field, its business processes, its internal and external relationship structure and its own strategy. The careful selection of the software package is important and that the greater and more carefully the package is selected, the higher the chances of a successful ERP system implementation.
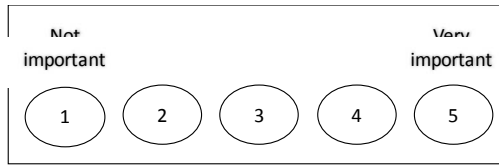
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Not important				Very important
1	2	3	4	5

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Table 1   CSFs for ERP system implementation

CSF	Definition	PC	References (see Appendix 1 for bibliographic details)
Project team	The project team needs to consist of the best people and has to include a project champion, employees from different functions and levels, and external consultants when ERP expertise is missing internally.	G	[2,7,10,12,14,15,16,17,18,19,27, 43,44,46,47,49,51,53,54,55]
		SM	[1,8,11,21,24,31]
		PM	[3,13,20,21,24]
		U	[13]
Top management involvement	Top management should reinforce the commitment of all employees in the organization and create policies that determine and approve new organizational structures, roles, and responsibilities.	G	[2,4,5,7,9,10,14,15,16,17,18,19, 22,26,27,30,33,41,43,44,46,48,4 9,51,52,53,54,55]
		SM	[1,8,11,13,21,24]
		PM	[13,21,23,24,25,31]
		U	[13,42]
Strategic decision-making	A well-defined business plan and vision should define how the organization operates behind the implementation effort and has to outline proposed strategic and tangible benefits, resources, costs, risks and timeline is critical.	G	[2,7,9,10,12,13,15,17,18,27,28, 30,32,33,43,46,47,48,49,51,52,5 3,54,55]
		SM	[8,11,24,34]
		PM	[24,34]
		U	[31]
Communication	Effective communication should be established at every organizational level and has to include the formal promotion of the project and its teams and advertisement of project progress.	G	[2,5,7,9,15,17,29,30,35,41,49, 51,53]
		SM	[1,6,8,11,24,36]
		PM	[3,6,13,20,21]
		U	[31,36,54]
Project management	Project management should include a clear definition of objectives, development of both a work and a resource plan has to focus on the identification of the equipment required to operate the system.	G	[2,5,6,7,9,10,12,14,15,16,17,19, 20,27,29,37,43,44,46,47,48,49, 51,53,54,55]
		SM	[1,8,11,24]
		PM	[3,13,24]
		U	[1,29]
Project support	Project support should be established in the form of technical assistance, maintenance, and updates, which has to be facilitated by a committed partner that oversees the entire implementation's life cycle.	G	[2,6,7,10,12,14,15,16,19,25,27, 29,34,35,43,44,46,47,50,53,55]
		SM	[1,8,24,51]
		PM	[24,34]
		U	[13,29]

Minimum customization	Departments should not rearrange the chosen ERP system in order to prevent interdepartmental issues and should have access to the same data and system.	G	[2,15,18,19,29,38,40,44,47,48,49,52]
		SM	[1,24]
		PM	[3,32,34]
		U	[1,13]
Organizational change management	The organization should utilize change management techniques and tools that must be defined and evaluated with the best practices in the industry.	G	[2,5,6,7,9,16,17,18,19,26,27,29,30,37,41,45,49,51,52,53,54]
		SM	[1,8,11,24,31,51]
		PM	[20,28,34]
		U	-
Business process alignment	A catalogue of best business processes should be selected and followed to stay on the right track and avoid conflicts with the procedural rigidity of an ERP system.	G	[2,4,7,9,14,17,18,26,29,30,33,35,37,38,44,45,46,48,49,52,53,55]
		SM	[1,8,11,24]
		PM	[3,13,28,39]
		U	[34]
Software testing	The organization should establish rigorous and sophisticated testing of the software in order to simplify ERP system implementation.	G	[2,4,6,7,9,16,17,18,29,37,43,47,51,54]
		SM	[1,6,11]
		PM	[13,39]
		U	-
Performance measurement	Performance measurements should be identified to manage expectations, keep track of all occurrences and to measure the achievements against the milestones and targets.	G	[2,7,9,10,16,17,18,19,22,25,27,30,37,40,41,46,51,52,53,54]
		SM	[11,24]
		PM	[24,34]
		U	[36]
Education and training	Education and sufficient training requires investment, promotes an effective and correct use of the ERP system, and should be provided for users from the beginning of the ERP system implementation project.	G	[2,4,5,6,7,12,16,18,19,23,24,29,39,40,41,44,45,46,47,49,53,54]
		SM	[1,6,8,24,31,36]
		PM	[3,13]
		U	[29,31,36,54]
Technical possibilities	All kinds of differences in ERP systems offered in the marketplace should be evaluated based on its own strategy, size, business field, its business processes, and its internal and external relationship structure.	G	[2,5,7,9,12,15,18,25,27,29,35,43,46,50,53,54]
		SM	[1,8,24,36]
		PM	[24,29,34]
		U	[1,36]

Table 2   Demographic profile of the respondents

Case company	Description
Country	Germany
Industry	Manufacturing
Subsidiaries	25 production plants in 16 countries
Products	Thermoplastic insulation materials, covering systems, fire protection and noise control products, and special foams
Number of employees	+-3000
Go-live year ERP system	2011
ERP provider	SAP (modules: ERP 5.0, SCM, BW, it.x-change, SAP Solution Manager)
Number of ERP system users	+-300
Number of distributed questionnaires	127
Response rate (%)	97%

Table 3   Ranking of the CSFs for ERP system implementation from a user perspective

Ranking	CSF	Code	GRA value
1	Project team	CSF1	0.807
2	Technical possibilities	CSF13	0.795
3	Strategic decision-making	CSF3	0.724
4	Education and training	CSF12	0.661
5	Minimum customization	CSF7	0.653
6	Software testing	CSF10	0.625
7	Performance measurement	CSF11	0.615
8	Business process alignment	CSF9	0.582
9	Project support	CSF6	0.571
10	Project management	CSF5	0.568
11	Communication	CSF4	0.538
12	Organizational change management	CSF8	0.454
13	Top management involvement	CSF2	0.439