Implementation of enterprise resource planning systems: a user perspective

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Abstract. The purpose of this study is to evaluate critical success factors (CSFs) for the implementation of an enterprise resource planning (ERP) system from a user perspective. Users play a vital role when implementing an ERP system, but their perspective has been neglected in the literature. A better understanding of their perspective promises to contribute to the design of more effective ERP systems, its implementation, and management. In order to identify the user perspective, a survey was conducted within three Pakistani companies that recently have implemented a new ERP system. The questionnaire was developed based on thirteen CSFs deduced from literature. Based on each CSF’s level of importance, they are ranked in order of importance and divided into three groups: most important, important and not important. Findings reveal that users believe that management should prioritize the following four CSFs when implementing an ERP system: education and training, strategic decision-making, communication, and business process alignment.

1. Introduction
Supply chain management is of major importance in most industries. In essence, it concerns collection and analysis of data to provide better basis for decision-making [1]. Information systems are needed to achieve this due to complex supply chain structures and processes [2]. One information system that has been central in operating and managing supply chains is the enterprise resource planning (ERP) system [3]. Despite ERP systems becoming a fundamental tool in many industries, the rate of failure in their implementation is high [4]. 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. These conditions are referred to as critical success factors (CSFs) and are mostly proposed from a generic perspective [5][6][7]. Understanding these CSFs and how they influence the project outcome decreases the risks of failure, and provide helpful guidance for organizations [8]. However, to be successful with an ERP system implementation, users play a vital role [9]. So far, very limited empirical research has been done with regard to the user perspective towards ERP system implementation [10].

The purpose of this paper is to evaluate CSFs for ERP system implementation from a user perspective. A better understanding of this perspective promises to contribute to the system design, its implementation, and management. Previous research has focused on one manufacturing company from Germany [11] and thus there is a need to extend the research to other industries and countries.
This research further investigates the user perspective towards CSFs for ERP system implementation in Pakistan. A survey was conducted within three companies from Pakistan that recently have implemented a new ERP system, which was developed based on CSFs deduced from literature [11]. The first case company (α) operates in the education industry, the second case company (β) operates in the manufacturing industry, and the third and final case company (γ) operates in the beverages industry.

2. Theoretical framework
Reitsma and Hilletofth [11] created a framework consisting of 13 CSFs for ERP system implementation. In addition, they investigated the user perspective towards the included CSFs and labelled them as: ‘not important’, ‘important’ or ‘very important from a user perspective’ (Table 1). Their empirical research was based on one manufacturing company from Germany [11] and thus need to be extended to other industries and countries.

| CSF                                      | Code  | User label     | Definition                                                                 |
|------------------------------------------|-------|----------------|----------------------------------------------------------------------------|
| Project team                             | CSF1  | Most important | The project team needs to consist of the best people and to include a project champion, employees from different functions and levels, and external consultants when ERP expertise is missing internally. |
| Top management involvement               | CSF2  | Not important  | 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. |
| Strategic decision-making                | CSF3  | Most important | 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. |
| Communication                            | CSF4  | Important      | 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. |
| Project management                       | CSF5  | Important      | 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. |
| Vendor support                           | CSF6  | Important      | Vendor support should be established in the form of technical assistance, maintenance, and updates, which has to be facilitated by a committed vendor that oversees the entire implementation’s life cycle. |
| Minimum customization                    | CSF7  | Most important | Departments should not rearrange the chosen ERP system in order to prevent interdepartmental issues and should have access to the same data and system. |
| Organizational change management         | CSF8  | Not important  | The organization should utilize change management techniques and tools that must be defined and evaluated with the best practices in the industry. |
| Business process alignment                | CSF9  | Important      | 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. |
| Software testing                         | CSF10 | Most important | The organization should establish rigorous and sophisticated testing of the software in order to simplify the ERP system’s implementation. |
| Performance measurement                  | CSF11 | Most important | Performance measurements should be identified to manage expectations, keep track of all occurrences and to measure the achievement against the milestones and targets. |
| Education and training                   | CSF12 | Most important | 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. |
| Technical possibilities                  | CSF13 | Most important | 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. |
3. Research methodology

The aim of this study is to evaluate CSFs for ERP system implementation from a user perspective. In the first step of the research, it was necessary to set the scene by presenting relevant research from the research field. This literature review is based on the study of Reitsma and Hilletofth [11], as they propose thirteen general CSFs for ERP system implementation and focussed on the user perspective (Table 1). In the second step of the research, a survey was conducted to identify the perspective of users towards the CSFs identified in the literature review. A questionnaire was developed based on the thirteen CSFs and each question contained a description of the corresponding CSF. 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 questionnaire was distributed within three companies from Pakistan that recently had implemented a new ERP system (Table 2).

Table 2. Summary of demographic profile of respondents.

|                         | Case company α | Case company β | Case company γ |
|-------------------------|----------------|----------------|----------------|
| Company location        | Pakistan       | Pakistan       | Pakistan       |
| Company type            | Education      | Manufacturing  | Beverages      |
| Company size in terms of employees | +1200          | +4-600         | +2000          |
| Implemented ERP system since | 2015          | 2014           | 2012           |
| ERP provider            | Microsoft      | Microsoft      | SAP ERP        |
| Dynamics                | Dynamics       | Dynamics       |                |
| Number of ERP users     | 650            | 170            | 870            |
| Number of distributed surveys | 250            | 80             | 150            |
| Response rate (%)       | 13             | 24             | 33             |

The collected data was analysed with GRA to extract the most important CSFs from a user perspective. The higher the GRA value, the more emphasis the respondents put on the particular CSF. GRA is an impact evaluation model, which measures the degree of similarity, or difference between two sequences and is based on the grade of relation [12]. When using GRA, a multi-criteria problem needs to be formulated by using a set of alternatives \((x_1, x_2, \ldots, x_{13})\), in this study the CSFs, and criteria \((k_1, k_2, \ldots, k_5)\), in this study the Likert-style rating scale. Each criterion is assigned weightings and a preference index (PI). If a higher number of respondents choosing the value of each \(k\) will have a positive impact on \(x\), the PI is equal to one. Otherwise, it is equal to zero. Since \(k_1\) and \(k_2\) represent the Likert-style rating scales that indicates that users label the corresponding CSF is ‘not important’ or ‘slightly important’, their PI is equal to zero. The PI of \(k_3\), which represents the median Likert-style rating scale outcome ‘moderately important’ is also equal to zero, as it not clearly indicates a positive outcome for \(x\). \(k_4\) and \(k_5\) are equal to one, since they represent the Likert-style rating scales ‘important’ and ‘very important’, which clearly indicate a positive outcome for \(x\). The next step is to formulate the following decision matrix D:

\[
D = \begin{bmatrix}
x_1(k_1) & \ldots & x_i(k_1) & \ldots & x_m(k_1) \\
\vdots & \ddots & \vdots & \ddots & \vdots \\
x_1(k_i) & \ldots & x_i(k_i) & \ldots & x_m(k_i) \\
\vdots & \ddots & \vdots & \ddots & \vdots \\
x_1(k_n) & \ldots & x_i(k_n) & \ldots & x_m(k_n)
\end{bmatrix}
\]

(1)

where:

\[
\text{PI}_j = \begin{cases} 
1, & \text{Increasing} \\
0, & \text{Decreasing}
\end{cases}
\]

(2)
Afterwards, matrix D’ needed to be computed:

\[ D' = \begin{pmatrix} x_1(k_1)' & \ldots & x_i(k_i)' & \ldots & x_m(k_1)' \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_1(k_n)' & \ldots & x_i(k_i)' & \ldots & x_m(k_n)' \end{pmatrix} \]  

(3)

where:

\[ x_i(k_j)' = \frac{x_{i(k_j)}}{\max_{k\in J} \min_{j\in I} x_{(k_j)}} \]  

(4)

Then, a pre-reference sequence \( y_0 = \{y_{0(k_i)}: k=1, 2, \ldots, m\} \) was determined:

\[ y_0(k_j) = \begin{cases} \min_{i\in I} x_{i(k_j)} & \text{if } \text{PI}_j = 0 \\ \max_{i\in I} x_{i(k_j)} & \text{if } \text{PI}_j = 1 \end{cases} \]  

(5)

The reference sequence \( y' = \{y_{0(k_i)}': k=1, 2, \ldots, m\} \) was computed by turning all decreasing criteria into opposite direction:

\[ y_0(k_j)' = \begin{cases} 1 - y_{0(k_j)} & \text{if } \text{PI}_j = 0 \\ y_{0(k_j)} & \text{if } \text{PI}_j = 1 \end{cases} \]  

(6)

Finally, each sequence was compared with the reference sequence by calculating the grey relational coefficient:

\[ \gamma(y_0(k_j), x_i(k)) = \frac{\Delta_{\min} + \xi \Delta_{\max}}{\Delta_{\max}(k) + \xi \Delta_{\max}} \]  

\( \xi \) serves as the equation’s contrast control and the value of 0.5 is applied [12]. The mean of the grey relational coefficient was used as the grey relational grade:

\[ \gamma(y_0, x_i) = \frac{1}{m} \sum_{k=1}^{m} \gamma(y_0(k_j), x_i(k)) \]  

This made it possible to evaluate the user perspective towards CSFs for ERP system implementation and rank them in order of importance (Table 3).

4. Findings and analysis

The GRA values listed in Table 3 reveal that users from one case company (α) label two CSFs as ‘not important’ for ERP system implementation, including minimum customization and performance measurement. All other CSFs have a GRA value above 0.5, meaning they are regarded as ‘important’ by case company α, β, and γ. However, the GRA values also indicate that different emphasis was put on each CSF. Therefore, based on their GRA value, the CSFs can be ranked in order of importance and labelled as either ‘most important’, ‘important’, or ‘not important’.

The findings reveal that there is a level of consensus and discrepancy between the users from the three included case companies, as they all label the same four CSFs for ERP system implementation as the ‘most important’. The first CSF labelled as ‘most important’ is education and training (CSF12) which should therefore be prioritized by top management when implementing an ERP system according to users. This shows that users agree with Stedman [13], who stated that a well-prepared and educated user reduces the consultant hours needed, and increases the support of and commitment to the system. This also indicates that users also agree with Stedman’s [13] statement that adequate training and the education level of the ERP system’s users should be prioritized.

The second CSF labelled as ‘most important’ is strategic decision-making (CSF3), meaning that users from the three included case companies agree with Umble et al [14] that it is necessary to
constitute a clear understanding of strategic goals for ERP system implementation and that key people throughout the organization have to create a clear, compelling vision of how the company should operate.

Table 3. Ranking of the CSFs in order of importance.

| Rank | Case company α | Case company β | Case Company γ |
|------|----------------|----------------|----------------|
| 1    | CSF3 .827 MI   | CSF11 .844 MI  | CSF12 .882 MI  |
| 2    | CSF5 .807 MI   | CSF10 .802 MI  | CSF13 .832 MI  |
| 3    | CSF1 .783 MI   | CSF12 .784 MI  | CSF11 .764 MI  |
| 4    | CSF4 .727 MI   | CSF4 .742 MI   | CSF5 .680 MI   |
| 5    | CSF6 .727 MI   | CSF3 .690 MI   | CSF3 .667 MI   |
| 6    | CSF12 .695 MI  | CSF7 .690 MI   | CSF4 .620 MI   |
| 7    | CSF9 .609 MI   | CSF2 .667 MI   | CSF2 .614 MI   |
| 8    | CSF8 .555 I    | CSF13 .667 MI  | CSF8 .611 MI   |
| 9    | CSF2 .528 I    | CSF6 .667 MI   | CSF9 .606 MI   |
| 10   | CSF10 .514 I   | CSF9 .660 MI   | CSF7 .600 MI   |
| 11   | CSF13 .513 I   | CSF5 .637 I    | CSF1 .590 I    |
| 12   | CSF7 .442 NI   | CSF1 .575 I    | CSF10 .572 I   |
| 13   | CSF11 .431 NI  | CSF8 .562 I    | CSF6 .551 I    |

*MI=most important, I=important and NI=not important

Users also agree with Gargeya and Brady [15], who propose that planning should be closely identified with maintaining scope during an implementation, since excessive costs and developmental delays are costly, and sometimes-fatal results of ineffective planning.

The third CSF labelled as ‘most important’ is communication (CSF4), meaning that users agree with Davenport [16] that interdepartmental communication is necessary across functional boundaries in ERP context to integrate business functions. In addition, this validates the work of Wee [17], who stated that 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, this indicates that users agree with Rosario [18], who proposed that their input should be managed in acquiring their requirements, comments, reactions and approval.

The fourth and final CSF labelled as ‘most important’ by users is business process alignment (CSF9). This indicates that users agree with Akkermans and van Helden [19] who stress the necessity of interdepartmental cooperation. Users also agree with Gargeya and Brady [15] that the reengineering of the processes results in a changed corporate culture and that these actions have to be managed on the human and operational level. Lastly, users recognize the statement of Bingi et al [20] who mention that 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.

When comparing these findings with the study from Reitsma and Hilletoft [11], users from both studies label education and training as well as strategic decision-making as ‘most important’. However, this study also differs as users from the included case companies label two additional CSFs as ‘most important’ (communication and business process alignment) and do not label any of the CSFs as ‘not important’.

5. Concluding remarks

This study aimed to investigate the user perspective towards CSFs for ERP system implementation. A survey was distributed to three Pakistani companies to identify the user perspective towards the CSFs identified in a literature review. The findings revealed that users from only one case company (α) regard two CSFs as not important for ERP system implementation, including minimum customization and performance measurement. All other CSFs were labelled as important by case company α, β, and γ. However, the analysis also indicates that different emphasis was put on the different CSFs. Users from all three case companies label the following four CSFs as ‘most important’ for ERP system
implementation: (1) education and training, (2) strategic decision-making, (3) communication, and (4) business process alignment. Education and training and strategic decision-making, were also labelled as ‘most important’ CSFs by users from a previous study conducted by Reitsma and Hilletofth [11].

The CSFs that are labelled as ‘most important’ should according to users be prioritized when implementing an ERP system. This paper is a step closer towards identification of the user perspective, which ultimately promises to contribute to the design of more effective enterprise systems, its implementation, and management. Since this study utilised a survey strategy to highlight the perspective of users towards ERP system implementation, the underlying reason for the outcome is not explained. If further research provides similar findings, it would be interesting to conduct an exploratory study.

6. References

[1] Hilletofth P and Lättilä L 2012 Agent based decision support in the supply chain context Industrial Management & Data Systems 112 (8) pp 1217-1235
[2] Hilletofth P 2008 Differentiated supply chain strategy: response to a fragmented and complex market Licentiate thesis Chalmers University of Technology, Gothenburg, Sweden
[3] Hilletofth P, Hilmola O-P and Ujjvari S 2010 Teaching ERP in logistics curriculum: A case experience from Sweden Int. Journal of Business Information Systems 6 (3) pp 295-314
[4] Aloini D, Dulmin R and Mininno V 2007 Risk management in ERP project introduction: review of the literature Information Management 44 (6) pp 547-567
[5] Chang B, Kuo C, Wu C H and Tzeng G H 2014 Using fuzzy analytic network process to assess the risk in Enterprise Resource Planning system implementation Applied Soft Computing 28 pp 196-207
[6] Lech P 2016 Causes and remedies for the dominant risk factors in Enterprise System implementation projects: the consultants’ perspective’ Springer Plus 5 (238)
[7] Saade R G and Nijher H 2016 Critical success factors in enterprise resource planning implementation Journal of Enterprise Information Management 29 (1) pp 72-96
[8] Huang S M, Chang I C, Li S H and Lin M T 2004 Assessing risk in ERP projects: identify and prioritize the factors Industrial Management & Data Systems 104 (8) pp 681-688
[9] Davenport T 1998 Putting the enterprise into the Enterprise System Harvard Business Review 76 (4) pp121-132
[10] Young H K, Jane P, Boo Y C and Saumyendu G 2012 Understanding users’ acceptance of Enterprise Resource Planning (ERP) system in project-based sectors IEEE Transactions on Engineering Management 59 (2)
[11] Reitsma E and Hilletofth P 2016 Enterprise resource planning system implementation: an end user perspective 7th Int. Conf. on Operations & Supply Chain Management Phuket
[12] Deng J L 1986 The stability of the grey linear system Int. Journal of Control 43 (1) pp 313-320
[13] Stedman C 1999 Survey: ERP costs more than measurable ROI Computerworld 33 (6)
[14] Umble H, Haft R and Umble M 2003 Enterprise Resource Planning: implementations and critical success factors European Journal of Operational Research 146 pp 241-257
[15] Gargeya V B and Brady C 2005 Success and failure factors of adopting SAP in ERP system implementation Business Process Management Journal 11 (9)
[16] Davenport T 2000 Mission critical: realizing the promise of enterprise systems (Boston, Massachusetts: Harvard Business School Press)
[17] Wee S 2000 Juggling toward ERP success: keep key success factors high ERP News
[18] Rosario J G 2000 On the leading edge: critical success factors in ERP implementation projects Business World (Philippines) 27
[19] Akkermans H and van Helden K 2002 Vicious and virtuous cycles in ERP implementation: a base study of interrelations between critical success factors European Journal of Information Systems 11 pp 35-46
[20] Bingi P, Sharma M K and Godla J 1999 Critical issues affecting an ERP implementation
Information Systems Management 16 (2) pp 7-14