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A Primary Human Critical Success Factors Model for the ERP System Implementation

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Background and Purpose: Many researchers have investigated various Critical success factors (CSFs) and the different causes of ERP implementation project failures. Despite a detailed literature preview, we were unable to find an appropriate research with a comprehensive overview of the true causes behind CSFs, observed from a human factors perspective. The objective of this research was therefore to develop and evaluate the Primary human factors (PHFs) model and to confirm the significant impact of PHFs on traditional CSFs and on the project success.
Design/Methodology/Approach: The comprehensive PHFs research model was developed and examined in empirical quantitative research with the use of available literature and the application of the Root cause analysis. A survey was conducted in various Slovenian organisations in different branches that had previously implemented the ERP system SAP. The model was verified on a sample of 21 experts from 18 organisations.
Results: The results show that the PHFs have a significant positive impact on the ERP implementation project success, but only the Competence and Team composition factors are significant linear predictors in an adapted regression model and contribute significantly in predicting project success. These results therefore confirm both proposed hypotheses and the adapted regression model.
Conclusion: This study improves the understanding of PHFs and confirms that they have a significant impact on traditional CSFs and the ERP implementation project success. The proposed PHFs model offers project managers and other stakeholders an effective risk assessment of CSFs and is leading the way to human oriented model of ERP implementations.

Keywords: *ERP implementation project, Critical success factors, Primary human factors model*

1 Introduction

Over the last few decades, ERP systems have become an indispensable IT solution for all types of businesses and enterprises. ERP are business applications that integrate all the associated functional areas, business processes, and data within an organization. ERP solutions establish one central database, one integrated application, and one common graphical user interface that manages all its information and transactions. ERP allows different departments with diverse needs to communicate with each other by sharing the same information in a single system. ERP thus increases cooperation and interaction between all business units in an organization (Harrison, 2004).

Despite the many benefits the ERP systems provide if properly implemented, there are also many weaknesses, especially at the implementation process itself; this is why a successful implementation and use of the ERP is particularly important. Projects of ERP implementation are known for their complexity; they usually have a long implementation cycle and are consequently subjected to high risk. They use industry specific business processes, unite a variety of stakeholders and involve various participants

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with different knowledge, skills, and experience. Because of all these reasons, the success of an ERP implementation project is unpredictable. According to AMR (2015) and Standish Group (2013) and taking into account a standard triangle measure of project success, deadlines, budget and scope, only 39% of the projects are successfully finished, 43% are partly successful, and 18% are unsuccessful. The trend of successful projects has been positive in last years, but still insufficient as to what should be expected. Consequently, there has been a great interest in the ERP implementation area with numerous authors researching the causes and consequences of implementation failures from the early 1990's on. Such an interest is not surprising considering the growing importance of success in a company's most essential projects, with its high investment and organisational risks. Researchers in the past have introduced different CSFs and observed their interconnections, studied the causes and consequences, proposed actions, and used various risk management methods to improve people's perception and actions in order to increase the level of future implementations. In the last decade, the interest has focused mostly on the human group of CSFs and many researchers confirmed the strong impact of many human CSFs towards the implementation project success.

Interestingly, although the failure rate of the ERP implementations has been highly publicized, companies have not been distracted from investing large sums of money in new ERP systems as they have become something of a business standard and a must-have. What is alarming on the other hand is the fact that companies obviously still do not put much effort nor invest extra time and attention to change the course of the implementation by following the best practices and recommendations from referential case studies in available literature. In doing so, the results would be evident in improve success rates. One of the objective reasons is definitely a well-established business routine approach and a lack of an efficient model to access and address the truly important risk factors. The critical success factors are defined by Rockart (1979) as: Those few critical areas where things must go right for the business to flourish. The problem emerges when those few areas become "too many" and when we suddenly have more than 90 various CSFs, which are impossible to cope with. There are also many causal factors behind CSFs which these general factors are not addressing and yet they are critical and have the important influence on CSFs and achieving project success. Ram and Corkindale (2014) have come to the conclusion that merely identifying possible CSFs in not sufficient to help with ERP success. Williams and Ramaprasad (1996) also noted that, although CSFs are widely used by academic researchers and practitioners, it is important to distinguish between different levels of criticality. They suggested four types of criticality in a descending order of power: factors linked to success by a known causal mechanism, factors necessary and sufficient for success, factors necessary for success, and factors associated with success. A causal link between a factor and an outcome is therefore empirically and logically stronger than a mere association.

All the previously mentioned facts, especially the uncertain implementation results and the lack of a simple, yet comprehensive model to address the true causes behind CSFs were therefore the most important motivating factors for this research. The key research questions of this study were: Are the human factors truly the most important group of CSFs and if so, which primary human factors can be linked in a comprehensive research model to completely cover the causal influence on traditional CSFs? With the intention to answer these key research questions, the main objectives of research were: identification of the primary human factors, development of a comprehensive research model, and confirmation of the research model through an empirical analysis.

2 Methods

2.1 Methodology

The research was conducted in the following stages: In the first stage, we reviewed the relevant scientific literature and resources; in the second stage, we formed a research model with the analytical method of the Root cause analysis by exploring the true causes behind CSFs and taking into account the literature findings and recommendations. The model was developed to examine the influence of PHFs on CSFs and project success. In the third stage, the quantitative research approach was chosen, and a survey questionnaire was developed based on the proposed model. We submitted the online questionnaire to three participants to review it, in order to avoid any ambiguity in understanding and completing the survey. As the positive responses proved the questionnaire was adequate, the invitation was sent to other participants, selected from the company's database, considering their experience and position within the ERP implementation project. In the final stage, the available data was collected, statistically analysed, and the results were interpreted.

2.2 Literature review

Critical success factor (CSF) is a management term for an element that is necessary for an organization or project to achieve its mission. It is a critical factor or activity required for ensuring success (Rockart, 1979). The term was initially used in the world of data and business analysis by Ronald Daniel and refined into critical success factors by John F. Rockart.

Authors addressed a wide range of CSFs in the past few years, the factors were mostly reused with identical

names, sometimes with a different description but similar connotation and occasionally authors suggested some new ones. According to Shaul and Tauber (2013) who conducted a careful examination of the majority of the articles from the beginning of millennium, various authors suggested a total of 94 CSFs in ERP implementations. Tarhini et al. (2015) identified 51 CSFs and classified them according to a stakeholders group. The most listed and quoted CSFs in the past ten years according to several researchers, (Huang, 2010; Shaul and Tauber, 2013; Tarhini et al., 2015; Shirouyehzad et al.,2011; Ngai et al.,2008; Somers and Nelson, 2001) who made a comprehensive review of the CSFs used in the research articles are enclosed in Table 1.

Some authors (Gupta et al., 2014; Ziemba and Oblak, 2013; Nasir and Sahibuddin, 2011; Huang, 2010) classified CSFs into 3 main groups: human (people-related), organisational (process- and company-related), and technical (software technology- and IT system-related) factor groups.

Huang (2010) concluded that researchers pay more attention to human factors than to technical factors in an ERP implementation as more articles promote end-user training and involvement as a critical factor over technical skills or IT infrastructure. With the development of ERP software, it has become more mature and requires less attention to technical issues. Also, the communication among managers, end-users, ERP vendors, and project team members has become more important than before as it was found that an open and honest communication plays a vital role in ERP implementation. Many authors also emphasize the importance of knowledge and skills in a knowledge-intense project such as an ERP implementation.

Over 60 research articles addressing solely human critical success factors (HCSFs) were therefore carefully examined to get a deeper insight. The addressed HCSFs were: *Competence* (Charland et al., 2015; Massini and Wassenhove, 2009; Santos Rodriguez and Dorrego, 2008), *Knowledge transfer* (Goyette et al., 2014; Lech, 2011, Xu and Ma, 2008, Wang et al., 2007), *Tacit knowledge sharing* (Irick, 2007; Sun, 2007; Vandaie, 2008; Scorta, 2008), *Knowledge management and education* (O'Leary, 2002; Mohamed and McLaren, 2009), *Communication* (Aubert et al., 2013; Wang and Chen, 2006), *Motivation* (Walsh and Schneider, 2002; Yatsuzuka et al., 2009), *Team composition and transformation* (Yeh and Chou, 2005; Hamani et al., 2012; Lui and Chan, 2008), *Organizational and team learning cycle* (Akkermans and Helden, 2002; Bologa and Lupu, 2014; Akgun et al., 2014), *Team resilience* (Amaral et al., 2015), *Problem solving competence* (Lin et al., 2015, Li et al., 2010), *Conflict resolution* (Wang and Chen, 2006; Chou and Yeh, 2007), *Relationship bonding* (Hung et al., 2012), *Spiral continuous improvement* (McGinnis and Huang, 2007; Scorta, 2008), *Cognitive learning* (Cronan et al., 2012), Collective intelligence (Yuan et al., 2007), *Knowledge withholding intentions and social cognition* (Tsay et al., 2014), *Group cohesiveness and normative conformity* (Tsay et al., 2014), and *Personal interest in Agency theory* (Walsh and Schneider, 2002).

An overview analysis of the addressed topics revealed that beside individual human factors, researchers were mostly focused on team characteristics, which highlights the importance of an excellent team for achieving project success. Group development and Group dynamics address this field from a theoretical perspective and are supported a large number of theoretical models and different theories.

After the examination of many research articles, the number of CSFs and HCSFs rapidly increased, as it became evident that a large number of factors does not simplify their management and this is not a transparent and straightforward solution. Many researchers namely confirmed the influence of many factors on project success and addressed these factors in detail in order to successfully manage them and solve the possible issues. But actually, treating CSFs from a top level is only a part of solving the entire problem, as it is evident that this problem is more complex and multi-layered. We require a comprehensive solution to cover all the underlying causes in a much wider context. While searching for some existing or related procedures to address causal structure in the available literature, only a few authors (Akkermans and Helden, 2002; Gandhi, 2015) addressed the causal aspect of CSFs and were researching the interdependence (causes and consequences) between critical factors and sub-factors, but only for selected CSFs and with a limited perspective.

2.3 The development of the research model

In order to develop the research model, we used the following steps:

First, the CSFs were grouped into three main factor groups: Human, Organisational, and Technical. Since there was no available explanation to be found in the literature to suggest how to logically group different CSFs, we merged them according to their relation to the human activities and those related to the system, which represents a much wider concept. Every single system is in fact conceived by human ingenuity and activities which are already embedded in the system and therefore cannot be influenced by human factors during the implementation project. Using this logic, the system-related factors were sorted further in two groups. The first group representing a system is the organisation, the other is the technical or information technology platform. We evaluated the meaning and connection of every single CSF and estimated the possible interrelated impact of other groups. The grouping was also checked with the other authors quoted in the previous chapter.

In the second step, we analysed CSFs using the Root cause analysis. The purpose of this specific technique is

Table 1: The most listed and quoted CSFs in the past ten years

Primary human factors	**Authors**
COMPETENCE	Somers and Nelson (2001), Tarhini et al. (2015), Ngai et al. (2008), Shirouyehzad et al. (2011), Shaul and Tauber (2013), Candra (2012), Charland et al. (2015), Massini and Wassenhove (2009)
BEHAVIOUR	Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013), Walsh and Schneider (2002), Yatsuzuka et al. (2009)
COMMUNICATION	Tarhini et al. (2015), Ngai et al. (2008), Shirouyehzad et al. (2011), Shaul and Tauber (2013), Huang (2010), Wang (2006), Aubert et al. (2013)
TEAM COMPOSITION	Tarhini et al. (2015), Ngai et al. (2008), Shirouyehzad et al. (2011), Yeh and Chou (2005), Hamani et al. (2012), Lui and Chan (2008)
Human CSFs	
Project team capability and team work	Tarhini et al. (2015), Shirouyehzad et al. (2011), Ngai et al. (2008), Huang (2010)
Knowledge transfer/management	Ngai et al. (2008), Shaul and Tauber (2013), Goyette et al. (2014), Lech (2011), Xu and Ma (2008), Sun (2007), Vandaie (2008), Scorta (2008), O'Leary (2002)
Learning cycle (team and organisation)	Akkermans and Helden (2002), Bologa and Lupu (2014), Akgun et al. (2014)
Spiral continuous improvement	McGinnis and Huang (2007), Scorta (2008)
Top management support and commitment	Somers and Nelson (2001), Tarhini et al. (2015), Shirouyehzad et al. (2011), Huang (2010)
Clear goals and objectives	Somers and Nelson (2001), Tarhini et al. (2015), Shirouyehzad et al. (2011), Ngai et al. (2008), Huang (2010)
Interdepartmental cooperation/conflicts	Somers and Nelson (2001), Tarhini et al. (2015), Shirouyehzad et al. (2011), Ngai et al. (2008), Shaul and Tauber (2013)
Interdepartmental communication	Somers and Nelson (2001), Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013)
ERP implementation project management	Somers and Nelson (2001), Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013), Huang (2010)
Management of expectations	Somers and Nelson (2001), Tarhini et al. (2015), Shirouyehzad et al. (2011), Ngai et al. (2008), Shaul and Tauber (2013)
Adequate ERP package and consultant company selection	Somers and Nelson (2001), Tarhini et al. (2015), Shirouyehzad et al. (2011), Ngai et al. (2008), Shaul and Tauber (2013), Huang (2010)
Adequate project constraints planning	Tarhini et al. (2015), Shirouyehzad et al. (2011), Ngai et al. (2008), Shaul and Tauber (2013), Huang (2010)
End user involvement/support	Tarhini et al. (2015), Shirouyehzad et al. (2011), Ngai et al. (2008), Shaul and Tauber (2013)
Adequate end user training	Somers and Nelson (2001), Tarhini et al. (2015), Shirouyehzad et al. (2011), Ngai et al. (2008), Shaul and Tauber (2013), Huang (2010)
Adequate education on new business processes	Somers and Nelson (2001), Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013), Huang (2010)
ERP implementation quality management	Ngai et al. (2008), Shaul and Tauber (2013)
ERP implementation risk management	Shaul and Tauber (2013)
Adequate human resources	Tarhini et al. (2015), Shirouyehzad et al. (2011)
Recruit and retain human resources	Shirouyehzad et al. (2011), Ngai et al. (2008), Shaul and Tauber (2013)

Table 1: The most listed and quoted CSFs in the past ten years (continued)

Empowered decision makers	Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013)
Reducing the user's resistance	Tarhini et al. (2015)
Focus on user requirements	Tarhini et al. (2015), Shaul and Tauber (2013)
Unclear development requirements	Shirouyehzad et al. (2011)
Capable project manager	Tarhini et al. (2015)
Senior project champion	Somers and Nelson (2001), Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013), Huang (2010)
Professional steering committee	Somers and Nelson (2001), Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013)
Minimal customization decision	Somers and Nelson (2001), Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013)
Use of consultants decision	Somers and Nelson (2001), Tarhini et al. (2015), Shaul and Tauber (2013)
Political structure/conflicts	Shaul and Tauber (2013)
National culture	Ngai et al. (2008)
Organisational CSFs	
Organizational culture	Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013)
Team members availability	Somers and Nelson (2001), Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013)
Sufficient human resources	Shirouyehzad et al. (2011), Ngai et al. (2008)
Formalised /effective project methodology	Tarhini et al. (2015), Shirouyehzad et al. (2011)
Formalised project plan/schedule	Tarhini et al. (2015), Shaul and Tauber (2013)
Organisational fit for ERP system (structure and processes)	Tarhini et al. (2015), Shirouyehzad et al. (2011), Ngai et al. (2008), Shaul and Tauber (2013)
Alignment between business and IT strategies	Shaul and Tauber (2013)
Adequate process of change management/commitment	Somers and Nelson (2001), Tarhini et al. (2015), Shirouyehzad et al. (2011), Ngai et al. (2008), Shaul and Tauber (2013), Huang (2010)
Adequate business process redesign	Somers and Nelson (2001), Tarhini et al. (2015), Shirouyehzad et al. (2011), Ngai et al. (2008), Huang (2010)
Integration of business planning with ERP planning	Tarhini et al. (2015)
Vendor/Consultant/Customer partnership	Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013)
Vendor support	Somers and Nelson (2001), Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013)
Technical CSFs	
IT infrastructure/stability	Tarhini et al. (2015), Shirouyehzad et al. (2011)
ERP architecture and quality	Somers and Nelson (2001), Ngai et al. (2008), Shaul and Tauber (2013)
ERP advanced technology	Shirouyehzad et al. (2011), Shaul and Tauber (2013)
ERP implementation strategy	Ngai et al. (2008), Shaul and Tauber (2013)
Data analysis and conversion	Somers and Nelson (2001), Ngai et al. (2008), Shaul and Tauber (2013)
Data and information quality	Tarhini et al. (2015), Ngai et al. (2008), Shaul and Tauber (2013)
Suitable IT legacy systems	Tarhini et al. (2015)
Integration between enterprise wide-systems	Shirouyehzad et al. (2011)
Software management methodology	Shirouyehzad et al. (2011)
Use of vendor's tools	Somers and Nelson (2001), Ngai et al. (2008), Shaul and Tauber (2013)
Ease of system's use	Tarhini et al. (2015)

to identify a problem, discover the underlying causes that lead to it, and develop preventive action (PMI, 2013). This analysis can therefore be used to analyse CSFs and find the root cause factors that possibly influence the main factors. A root cause is the main source of a problem and if removed, it will prevent the primary effect from occurring. A contributory cause contributes to the severity of the primary effect, but if removed will not prevent the primary effect from occurring (Young, 2008). The behaviour of a complex system emerges from its causal structure. This can only be understood by modelling a problem's essential causal structure, which must include the root causes, whereas the problem is too complex to solve without first decomposing it into sub-problems.

We therefore decomposed the SCFs into sub-factors (causes) using a cause and effect diagram and then aggregated the identified causes into logical groups, which we named according to their content, to form the Primary human factors (PHFs). PHFs obviously have many sub-factors on a lower level, another set of independent variables that influence them. Therefore, four influential elements were identified as PHFs: Competence, Behaviour, Communication, and Team Composition. The first two factors can be primarily connected to a personal and the last two to a group (interpersonal) characteristic. The first two factors can secondarily also be connected to a group characteristic. PHFs represent soft factors that affect each other in a reinforcing manner and have an important influence on conventional hard factors (CSFs). We composed a two-level PHFs model with multiple variables obtained from the exploratory literature research. The model structure can be seen in Table 2.

Due to its complexity, we decided to leave it only as a proposition for a subsequent research, so the basic PHFs research model was chosen to represent the PHFs' interconnection and their influence on CSFs.

We can also conceptually check the proposed research model from one important aspect of the ERP implementation. It is known that the core process in ERP implementation that drives the project's progress is the ERP system software development process, which includes configuring and customizing the software package to the customers' needs and demands and is driven by the work groups of the key users, ERP consultants, and developers in the wider project team. It is clear that individuals have to cooperate within a group because of the projects' nature. The main parameters of a successful development process are an excellent individual competence of the participants and an effective and open communication between the participants that depends on good interpersonal relations, which again depends on a suitable team composition and behaviour of individuals. This illustration of the causal structure illustrates the long chain of dependent influences of PHFs that impact process effectiveness and ultimately its suc-

Table 2: The proposed two-levelled Primary human CSFs model

COMPETENCE	BEHAVIOUR	TEAM COMPOSITION	COMMUNICATION
Knowledge	Motivation	Interaction	Open and honest
Skills	Trust	Involvement	Efficient
Experience	Leadership	Cooperation	
Capability	Reliability	Efficiency	
Efficiency	Responsibility	Resilience	
	Perseverance	Conflict resolution	
	Initiative	Relationship bonding	
	Devotion	Collective intelligence	
	Empathy	Cohesiveness	
	Expectation	Group Conformity	
	Satisfaction		
	Normative conformity		
	Social cognition		
	Risk propensity		
	Conflict propensity		
	Partiality (bias)		
	Personal interest		
	Ability to establish relations		
	Willingness to work in a team		
	Knowledge concealing		

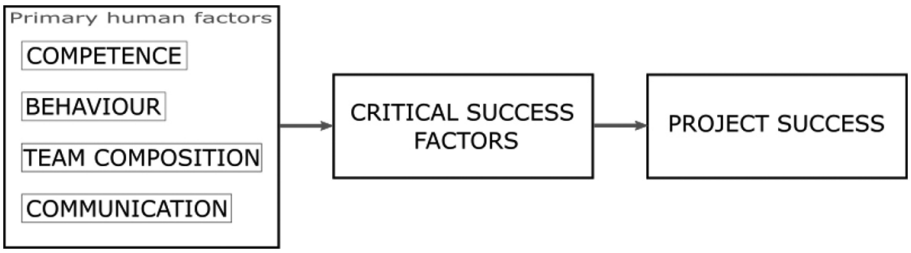

Figure 1: The primary human CSFs research model

cess. Akkermans and Helden (2002) also noted that ERP systems are meant to integrate different business functions and different organisational departments, so it is logical that communication and collaboration across the project team members from different departments are at the core of the implementation process. These two factors not only go hand in hand but they also seem to reinforce each other. As one goes up and the quality of collaboration increases, the other will increase as a result as well. People that work together more often communicate more often. Vice versa, better communication will lead to better collaboration. This is what system dynamics terms call a reinforcing loop. Left to its own, this loop will either continue to increase in an upward spiral of ever-higher performance, or become caught in a never-ending downward spiral of ever-lower performance.

All the previously mentioned characteristics are addressed in a concept named High-performance teams within organization development theory. A high-performance team can be defined as a group of people with specific roles and complementary talents and skills, aligned with and committed to a common purpose, who consistently show high levels of collaboration and innovation that produces superior results. The high-performance team is focused on their goal and have supportive processes that will enable any team member to surmount any barriers in achieving the team's goals. Therefore it outperforms all other similar teams and also expectations given to their composition (Bard, 2015).

Hereafter we reveal the characteristics of PHFs and the related sub-factors.

Competence

Competence is by definition the ability to do something successfully or efficiently (Oxford Dictionaries, 2016). It is a cluster of related abilities that enable an individual or an organisation to act effectively in a job or situation. Competence indicates a sufficiency of knowledge, skills, and experience that enable someone to act in a wide variety of situations (Business dictionary, 2016).

In the context of ERP implementation success, knowledge has been suggested as its critical factor by many authors (Sedera and Gable, 2010; Deng and Bian, 2007; Gable et al., 1998; Grant, 1996). Managing an ERP System is a knowledge intensive task that necessarily draws upon the experience and involvement of a wide range of stakeholders with diverse knowledge capabilities. Building on a resource-based view of the firm, the knowledge based theory of the firm considers knowledge as unique, the most strategically significant resource by focusing on knowledge (Grant, 1996). It has become a very important concept in the business world in the last decade. Knowledge is acquired with the process of theoretical learning and systematic study. Polanyi (1962) classifies knowledge into two categories: explicit and tacit knowledge. Explicit knowledge can be codified and shared in the form of hard data, manuals, codified procedures or universal principles, while tacit knowledge results from an individual's experience and is only revealed through its application. Spender (1996) proposes that knowledge can be held by individuals or collectively. Collective knowledge comes from knowledge integration: it is the combination of the coordinated efforts of several individuals who hold different but complementary skills (Grant, 1996). Knowledge capability is the systematic process of understanding, assimilating, and applying an organization to make the best use of knowledge to achieve a sustainable competitive advantage and high performance. Knowledge capability provides an opportunity for achieving substantial savings, significant improvements in human performance, and enhanced competitiveness. Knowledge capability is multidisciplinary by nature and integrates concepts used in strategic management, organization theory, and information systems management (Candra, 2012).

Experience is familiarity with a skill or field of knowledge acquired over months or years of actual practice and which, presumably, has resulted in a superior understanding or mastery (Business dictionary, 2016). Experience is acquired with the process of practical learning. A person with considerable experience in a specific field can gain a reputation as an expert. Learning, knowledge and experience are important on a personal and organisational level. Organisational learning is the process of creating, retaining, and transferring knowledge within an organisation, which improves over time as it gains experience and from

this experience it is able to create new knowledge. Knowledge is created at four different units, individual, group, organisational, and inter-organizational (Argote, 2013). To get a quick insight of the competence needed for different roles (Key users, Project manager, IT and general management personnel, External consultants, developers, system engineers), lists of knowledge and skills were drafted from the available literature. The lists show the complexity and wide array of the required expertise to successfully manage the knowledge intensive software development project of an ERP implementation.

Knowledge list: Strategic, Requirements, ERP evaluation and selection, Project management, Business processes knowledge, Change management, Crisis management, Time management, Knowledge management, Technology management, Risk management, Stress management, ERP technical knowledge, Solution designing knowledge, Evaluating knowledge, and Continuous improvement knowledge (Zhong et al., 2007).

Skill list: Personal, Team, System, Organizing, Decision making, Problem solving, Strategic planning, Analytical, Communication, Leadership, General, Information literacy, Conflict solving, Negotiation, Teaching, Training, Programming (Mahdavian and Mostejeran, 2013).

Behaviour

Behaviour is the way one acts or conducts oneself, especially towards others (Oxford Dictionaries, 2016). We distinguish between individual and group behaviour. The behaviour of one individual has a strong impact on the behaviour of other individuals inside a group or organisation. Organisational behaviour is a field of study that investigates the impact that individuals, groups, and a structure have on the behaviour within organisations and it studies many factors that have an impact on how individuals and groups respond to and act in organisations and how organisations manage their environments.

Under this name we therefore have an important group of psychological factors that influence other primary human factors. The main influence factors derived from the quoted HCSFs research articles and behaviour theory are: Motivation (personal and collective), Commitment, Responsibility, Trust, Empathy (understanding the needs of customers and interpersonal in a team), Expectation, Satisfaction (fulfilling personal needs and preferences), Satisficing (typical behaviour of decision makers), Propensity to take risk, Propensity to conflicts, Personal interest (principal-agent or agency theory), Knowledge withholding intentions, and Normal conformity.

Communication

Communication is the imparting or exchanging of information and it is the successful conveying or sharing of ideas and feelings (Oxford Dictionaries, 2016). It is a two-way process of reaching a mutual understanding in which participants not only exchange information, news, ideas, and feelings but also create and share meaning. (Business dictionary, 2016).

Communication is also a competence (skill), but in this context it means efficient exchanging of information to use individual competence at its maximum and to have an effective knowledge sharing, spiral continuous improvement, and a learning cycle. Therefore an open and honest communication and communication effectiveness plays a significant role in implementation projects (Wang and Chen, 2006). Aubert et al. (2013) notes that some research results also show that, for the dimensions of project success that are influenced by communication quality, the form of the communication efforts might be as important and will likely have as much impact as the content of the communication process. The results also specially emphasized the importance of openness in communication.

Team composition

Team composition refers to the overall mix of characteristics among people in a team, which is a unit of two or more individuals who interact interdependently to achieve a common objective (Hackman and Wageman, 2005). It is based on the attributes among the individuals that comprise a team in addition to their main objective. Team composition is usually either homogenous in which all members have similar personal qualities, or heterogeneous in which the team members contain significant differences. It has also been identified as a key factor that influences team performance (Senior and Swailes, 2004). The fashion in which a team is configured has a strong influence on team processes and the outcomes that the team achieves (Bell, 2007). It factors in the individual attributes of the team members (skills, experience, and ability) and how these contributors can potentially combine to dictate the overall performance outcomes for the team (Pieper et al., 2008)

Composing a successful cross-functional team is also an important skill but in this context it is a much wider and important factor so it is exposed individually. An appropriate team composition unites and upgrades the abilities that the individuals hold, so in that manner it has a strong potential influence on the team's performance. The abilities that a good team possesses are: Interaction and Cooperation between individuals, Group cohesiveness and conformity, Social cognition, Relationship bonding, Group resilience, and Conflict management. It influences Knowledge transfer, Spiral Continuous improvement, and Organizational learning cycle. The organizational factors influencing the team outcome are: Availability of team members and personal contact, Retention of experts, and a suitable Organizational culture (Al-Alawi et al., 2007).

Based on the research questions and reviewed literature, the two following hypothesis are eventually offered:

H1: Human critical success factors have the most influence on the implementation project success.

H2: Among the primary human factors, competence has the most influence on the project success.

2.4 Empirical research

To understand the impact of the Primary human factors and to measure their potential influence on success in a real environment and in actual ERP implementations, we conducted a post-implementation empirical research in various Slovenian companies. The research was limited to companies that previously implemented and currently run on an ERP system SAP.

A quantitative approach was chosen to conduct this empirical study as it enables a quick and uniform processing of the research information. A structured survey questionnaire was developed with mostly predefined closed questions. The questionnaire contained 30 questions divided into four groups; participant data, project success, critical success factors, and risk management.

The list of contacts was obtained from an internal company's database with a careful selection of participants, based on the project roles and their experience. The survey was published on a public internet survey portal and a request was emailed to 58 participants (project managers, key users, IT support, and general managers) from 35 large or medium-sized Slovenian organisations, operating in different branches from the public sector, utilities, to the production sector. To obtain a greater number and also more sincere responses, the survey was anonymous. It was successfully completed with 21 responses obtained from 18 different business entities with a 36% response rate. Most respondents were project managers (38%), followed by key users (33%), IT support managers (19%), and general management representatives (10%), in a representative sample, as 91% of participants were professionals with over ten years of experience with ERP systems and implementations. The collected data gave us a pragmatic insight view into ERP implementation projects.

2.5 Methodological tools

To obtain an overview of the linear dependence between the dependent variable—Project success and independent variables—CSFs and PHFs in our research model, the Pearson bivariate correlation coefficients were calculated. A multiple regression analysis was used to test the research hypothesis and research model, , an F-test to verify the statistical significance of the regression model, and a T-test to verify the statistical significances of the regression variables.

3 Results

In the first key measurement, the actual level of the ERP implementation project success was measured with a Likert scale from 1 – very unsuccessful to 5 – very successful with the research statement, "*Evaluate the actual level of success of the ERP implementation with the offered variables*". The objective was to measure different essential variables that define project success in order to observe the different aspects of success. The first three belong to the hard or business-oriented iron triangle, with project success regarding time (deadlines), funds (budget), and scope (functionality). We added some additional, soft or personal-oriented variables from numbers four to six: fulfilment of project goals, general user's expectations, and user's satisfaction. The seventh variable was intended for participants to evaluate the project success in total, by considering all the previously listed variables.

In the statistical analysis of the collected data, the variables were united into three evaluation groups to compare different aspects and verify the evaluation process. The first group represented the classical triangle project success evaluation, which contained the cumulated means of variables 1–3, the second group represented the expanded project success evaluation, which contained the cumulated means of variables 1–6, and the third group represented the participants' overall assessment of the project success,

Table 3: Project success evaluation factors

n=21	*Descriptive statistics*			
Project success	**Mean**	**Std. dev.**	**Min.**	**Max.**
Factor 1 _ V1-V3	3,22	0,745	2	5
Factor 2 _ V1-V6	3,24	0,751	2	5
Factor 3 _ V7	3,33	0,983	2	5

so it contained only variable 7. By comparing the summed mean values of these three factors presented in Table 3, we can see an insignificant difference. This shows the coherence of the participant's evaluation of the implementation project success. Factor 2 was selected for further calculation. In general, the results show a satisfactory implementation project success.

In the second key measurement, the participants were requested to *evaluate the actual level (quality) of the three CSFs groups: Human, Organisational, and Technical group in an ERP implementation project*, which were measured with a Likert scale from 1 – very inappropriate to 5 – very appropriate. The reliability test of the sample data showed that Crombach's Alpha is 0.792, by which the internal consistency was described as acceptable. We calculated the descriptive statistics and the Pearson correlation coefficients; the results are presented in Table 4. We can see that the Human CSFs group is in a strong positive correlation with Project success, followed by Technical and Organisational CSFs groups with a significant correlation. There is also a significant correlation between Human CSFs towards the Organisational and Technical CSFs group.

To test the CSFs group model and verify Hypothesis 1, we conducted a multiple regression analysis; the results are presented in Table 5. The value of the adjusted R coefficient of determination indicates that 54.3% of the variance of the Project success may be explained by three predictors in the model. The model is significant at a 5% significance level and a good fit is present between the model and the data, so we can confirm that the model describes the data well. All the regression coefficients are positive as expected, but only the Human CSFs group is statistically significant at a 5% significance level and therefore makes a significant contribution in this model in predicting Project success. Since the Human CSFs group is a significant linear predictor of Project success, Hypothesis 1 is confirmed.

In the third key measurement, the participants were requested to *evaluate the actual level (quality) of the 15 selected CSFs in an ERP implementation project*, for which we assume they play a vital role in the implementation success, regarding the facts mentioned in the literature preview chapter. We therefore selected the most important HCSFs, among them observed PHFs from our research model (factors 7–10 in Table 6) and some CSFs that are most likely influenced by PHFs. The factors were evaluated with the Likert 1–5 scale, 1 meaning very inappropriate and 5 very appropriate.

The reliability test of the sample data showed that Crombach's Alpha is 0.917, by which the internal consistency was described as excellent. We calculated the descriptive statistics and Pearson correlation coefficients; the results are shown in Table 6. We can see that all four PHFs are in a significant positive correlation with project success, especially Competence with a strong correlation, which suggests it has a high potential impact on project success. Other CSFs that are in a significant positive correlation with project success are Right selection of ERP system, Risk management activities, Business process reengineering, and Working conditions in organisation. Project management activities and Availability of team members have an insignificant correlation with project success. When observing interrelations of the PHFs, we can see the significant positive correlation between Composition

Table 4: Descriptive statistics and the Pearson correlation of the CSFs groups

	Descriptive statistics		*Pearson correlation coefficients*		
n=21	**Mean**	**Std. dev.**	*Project Success*	*Human CSF*	*Org. CSF*
Human CSFs	2,95	0,865	**0,7446**	1	
Org. CSFs	3,38	0,590	**0,4368**	**0,5278**	1
Tech. CSFs	3,85	0,727	**0,5434**	**0,4659**	0,1333

Correlation is significant at the 0.05 level (1-tailed)

Table 5: Multiple regression analysis of the CSFs groups

					95% Confidence Interval	
Relationship	**Coeff**	**Std. err.**	**t stat**	**p-value**	**lower**	**upper**
Human CSFs => PS	**0,533**	0,190	2,811	**0,012**	0,133	0,934
Org. CSFs => PS	**0,141**	0,249	0,567	0,578	-0,383	0,665
Tech. CSFs => PS	**0,297**	0,193	1,537	0,143	-0,111	0,705
Model	R_{squ} = 0,611, Adj. R_{squ} = 0,543, p-value = 0,0009 < 0,05					

and Competence, and Behaviour (motivation and trust) towards Competence and Communication. This indicates that individual PHFs are in a significant interconnection and most likely have a combined impact on CSFs and project success.

To test the adequacy of the PHFs research model and verify Hypothesis 2, we conducted a multiple regression analysis; the results are presented in Table 7. The value of the adjusted R coefficient of determination indicates that 63.3% of the variance of the Project success may be explained by four predictors in the model. The model is significant at a 5% significance level and a good fit is present between the model and the data, so we can confirm that model describes the data well. All the regression coefficients are positive as expected, but only the first independent variable (factor), Competence, is statistically significant at a 5% significance level when the other three variables are present in the model and therefore makes a significant contribution in predicting Project success. As the Competence factor is a significant linear predictor of Project success, Hypothesis 2 is confirmed.

Subsequently, we conducted a stepwise regression with a backward elimination of the independent variables (factors) with the lowest t-values while observing the remaining factors' statistical significance. This method eventually eliminated two initially statistically insignificant factors, leaving the last two factors, Competence and Team composition as significant linear predictors in the adapted regression model, which is also statistically significant at a 5% significance level. The results are seen in Table 8.

4 Discussion

In this research paper, we conducted two statistical analyses to observe the impact of CSFs and to test the two stated hypotheses. In the first analysis, we evaluated the influence of the previously grouped CSFs into a Human, Organisational, and Technical group, towards the implementation project success and verified Hypothesis 1, which claimed that human CSFs have the most influence on the implementation project success. With the second analysis, we evaluated the influence of the selected CSFs, including the four observed PHFs from the research model, towards the implementation project success and verified Hypothesis 2, which claimed that among the primary human factors, competence has the most influence on project success. With the use of statistical tools, we confirmed both hypotheses.

The four elements of the proposed research model: Competence, Behaviour, Team composition, and Communication referred to as the Primary human factors were specially observed in this study, beside other influenced CSFs. The Pearson correlation coefficients reveal that all PHFs are significantly positively correlated to project success, exposing Competence with a strong correlation, which has on average the most important impact on project success. The regression analysis reveals that all PHFs coefficients are positive as expected and the regression model is a significantly good fit, but only one primary human factor, Competence, is statistically significant and makes a significant contribution in the proposed research model in predicting project success. Other independent variables (factors) provide an insignificant direct contribution to the project success. We therefore used a stepwise regression analysis with backward elimination of the insignificant variables, which finally revealed a corrected model with only two remaining PHFs, Competence and Team composition. Both are statistically significant and make a significant contribution in the corrected research model in predicting project success.

One of the possible interpretations of such results is that participants were asked to evaluate many CSFs, of which some were classified as primary factors and others as secondary or related factors. We should have increased

Table 6: Pearson bivariate correlation between project success and CSFs

	N=21	Mean	Std. Dev.	Project success	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14
1	Clear goal and objectives	3,52	0,814	0,4353	1													
2	Right selection of ERP system	3,76	0,831	**0,6938**	**0,5635**	1												
3	Realistic project constraints planning	3,00	0,775	0,3967	0,3174	0,5438	1											
4	Top management support	3,57	0,746	0,4352	**0,6352**	**0,7140**	0,5189	1										
5	Project management activities	3,33	0,658	0,1556	0,3112	0,1523	0,4903	0,1018	1									
6	Risk management activities	2,29	0,717	**0,6121**	0,1592	**0,7072**	0,2700	0,4270	-0,1059	1								
7	Composition of project team	3,05	0,865	**0,6769**	0,2471	**0,7125**	0,4479	0,4206	-0,0293	0,5414	1							
8	Competence of project team	3,33	0,966	**0,8058**	0,4665	**0,6644**	0,5345	**0,5547**	0,2883	0,4330	**0,7582**	1						
9	Effective communication	3,14	0,727	**0,5555**	0,3744	**0,5557**	0,2664	0,2106	0,1045	**0,5891**	0,4659	0,4983	1					
10	Motivation and trust	3,48	0,814	**0,6978**	**0,5863**	0,4719	0,2380	0,3529	0,2490	0,2693	0,5348	**0,6786**	**0,6400**	1				
11	Knowledge transfer	3,29	0,644	**0,5865**	0,3683	0,5075	0,2006	0,2676	0,2360	0,4642	0,3337	0,4825	**0,6564**	**0,5865**	1			
12	Cooperation between team members	3,29	0,784	**0,6385**	0,3024	**0,6471**	0,2471	0,4762	0,1938	**0,5592**	**0,5692**	**0,5943**	**0,6268**	**0,5601**	**0,8212**	1		
13	Availability of team members	3,48	0,814	-0,1331	-0,0935	-0,1937	0,3174	0,1059	0,2490	-0,2449	0,0372	0,1060	-0,2053	0,0180	-0,1773	-0,0672	1	
14	Business process reengineering	3,14	0,854	**0,6171**	0,3189	**0,6143**	0,3781	0,4933	0,1780	0,5018	**0,6678**	**0,7276**	0,3683	0,4011	0,2860	0,5339	-0,2469	1
15	Working conditions in organisation	3,24	0,700	**0,7563**	**0,5599**	**0,7896**	0,3687	0,4919	0,1446	0,4551	**0,5583**	**0,6158**	0,5191	**0,5808**	**0,6180**	**0,6897**	-0,2089	**0,6094**

Correlation is significant at the 0.01 level (1-tailed)

Table 7: Multiple regression analysis of the research model

					95% Confidence Interval	
Relationship	**Coeff**	**Std. err.**	**t stat**	**p-value**	**lower**	**upper**
Competence => PS	**0,432**	0,202	2,144	**0,048**	0,005	0,859
Behavior => PS	**0,218**	0,210	1,039	0,314	-0,227	0,662
Communication => PS	**0,115**	0,201	0,573	0,575	-0,311	0,541
Composition => PS	**0,116**	0,198	0,587	0,566	-0,304	0,536
Model	R_{squ} = 0,706, Adj. R_{squ} = 0,633, p-value = 0,00037 < 0,05					

Table 8: Stepwise regression analysis of the adapted model

					95% Confidence Interval	
Relationship	**Coeff**	**Std. err.**	**t stat**	**p-value**	**lower**	**upper**
Competence => PS	**0,673**	0,135	4,976	**0,0001**	-0,326	1,330
Composition => PS	**0,238**	0,136	1,626	0,0344	-0,078	0,495
Model	R_{squ} = 0,772, Adj. R_{squ} = 0,747, p-value = 0,0000017 < 0,05					

the focus of the participants' evaluation only on the primary factors and subsequently evaluate the relations to other related CSFs. In that case, we believe we could obtain much more accurate results.

With this interpretation, we are able to answer our key research questions: Human CSFs are the most important group of CSFs as they have the strongest impact on project success. The adapted PHFs model consists of two verified primary human factors, Competence and Team composition with a significant statistical contribution to project success. We nevertheless suggest the use of the complete model with the other two unverified PHFs, Behaviour and Communication, included to cover the complete causal structure and to provide a comprehensive analysis of the primary human factors that are critical for project success.

The findings of this research are consistent with the research carried out by the following researchers. Ram and Corkindale (2014) have come to the conclusion that merely identifying possible CSFs is not sufficient in helping with the ERP success. Williams and Ramaprasad (1996) also noted that although CSFs are widely used by academic researchers and practitioners, it is important to distinguish between different levels of their criticality. Many researchers confirmed the strong impact of the human factors to the implementation project success (Al-Hadid et al., 2015; Huang, 2010; Lin et al., 2009; Vilpola et al., 2005; Wang et al., 2007). Many authors also confirmed a significant correlation between Competences and the ERP implementation project success (Charland et al., 2015; Massini and Wassenhove, 2009), especially knowledge has been suggested as the most important CSFs (Sedera and Gable, 2010; Deng and Bian, 2007; Gable et al., 1998; Grant, 1996). A few authors (Akkermans and Helden, 2002; Gandhi, 2015) researched the causal aspect of CSFs and their interdependence (causes and consequences), which suggests this was the right direction for our study. Due to the lack of an appropriate existing model or at least some additional in-depth literature addressing the true causes behind CSFs from a human factors perspective, we independently developed an interesting new model with a completely different approach.

A further research possibility would be to test the proposed two-levelled research model and measure the influence of the independent variables on PHFs and consequently on project success.

Another interesting task would be to study the individual cases of unsuccessful implementation projects and analyse them precisely with the Root cause analysis to identify the true causes of project failure and afterwards compare it with the proposed theoretical model to verify it.

5 Conclusion

The lack of a simple, yet comprehensive model to address the true causes behind CSFs from a human factors perspective therefore motivated us to identify the influencing primary human factors and develop the PHFs model as we believe it is a significant contribution to this important and widely researched topic. The proposed primary human factors model can be useful for project managers and HR specialists to assess the risk of PHFs when evaluating the human resources quality level in order to recognize their required potential needed in implementation projects. If appropriate PHFs are provided, individuals and teams can

increase their excellence and efficiency of the implementation and thus the possibility of project success. The PHFs model can therefore be used as a tool to help us understand the importance and influence of the primary human factors and to successfully predict any possible risks. If we are better in predicting potential risks, we are also better in preventing them. The proposed model suggests a new approach to address CSFs from a human factors perspective, for which we undoubtedly assert that they have an important influence on project success and are leading the way to human oriented ERP implementation approach.

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