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BUSINESS PROCESS MANAGEMENT AS AN IMPORTANT FACTOR FOR A SUCCESSFUL ERP SYSTEM IMPLEMENTATION

ABSTRACT

Enterprise resource planning (ERP) systems have become widely applied in all types of organizations today. Unfortunately, the success rate of ERP implementations is very low, which was cited in many researches and the majority of authors have reported up to 90% failure rate. Therefore, new studies are more than necessary to validate companies' contributions to the increase of the success rate of ERP implementation, which was the primary reason for our investigation. The main goal of this paper is to stress the impact of business process management and some other critical success factors on successful ERP implementations. Empirical investigation and a confirmatory approach using structural equation modeling (SEM) has been used. The research hypotheses that top management support, change management and business process management have a positive impact on successful ERP implementation were confirmed. These factors should be treated as very important in ERP systems implementation projects. The results also support the importance of top management perception: if they consider business process management as a basis of business change, this contributes to a strong and positive influence of successful ERP implementation.

JEL: M15

***Keywords**: enterprise resource planning, critical success factors, business process management, business process reengineering, structural equation modeling.*

1. Introduction

Globalization and increasing competition on the market endanger the existence of each company, however enterprise resource planning (ERP) implementations represent one of the more popular responses to those threats (Taube and Gargeya, 2005). ERP systems have become imperative for companies in order to gain competitive advantages, such as cost reduction, integration of operations and departments, business processes improvements, increasing their effectiveness and competitiveness (Vlachos, 2006). However, ERP implementations require many financial resources, the projects are complex, lengthy, difficult, and their success rate is very low. Another disadvantage is the threat of losing competitive

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advantage that can lie in flexibly customized business processes that can be better for an organization as the “best practice” (Indihar Štemberger and Kovačič, 2008).

The purpose of this paper is to expose and analyze the influence of business process management (BPM) and some other critical success factors (CSF) on a successful ERP implementation in companies. The paper is structured as follows: the following section reviews the relevant literature on critical success factors of ERP system implementation, organization culture and change management, top management support, business processes, and business process management. In section 3 the research model is conceptualized and research hypotheses are presented. Section 4 provides a research method and the results of data analysis. Section 5 concludes with a summary of the main findings, discusses them from both theoretical and practical standpoints, and outlines directions for future research together with the limitations of the study.

2. Literature review, research hypotheses and model conceptualization

Companies and other organizations use ERP systems more and more extensively. ERP software accounts for more than half of the software licenses and maintenance revenues in Western Europe, growing twice the rate of the overall application software market. Many firms have implemented ERP systems in the past few years and ERP market continues to grow at a compounded annual growth rate of 11% through 2011 (AMR Research, 2007). ERP continues to be one of the largest, fastest-growing, and most influential players in the application software industry in the next decade (Yen et al., 2002).

It is very interesting why companies, especially large ones, invest enormous financial resources in ERP systems. The main reason lies in ERP systems that enable the implementation of best business practices. Potential benefits of implementing ERP systems include drastic declines in inventory, breakthrough reductions in working capital, abundant information about customers' wishes and needs, along with the ability to view and manage the extended enterprise of suppliers, alliances and customers as an integrated whole (Indihar Štemberger and Kovačič, 2008). Among the most important attributes of ERP systems are their abilities to automate and integrate an organization’s business processes, share common data and practices across the entire enterprise and produce and access information in real-time environment (Nah et al., 2001). However, ERP solutions can help companies in business process reengineering, and from this point of view enable companies to become more competitive (Yen et al., 2002).

An enterprise resource planning system is a business management system that comprises integrated sets of comprehensive software that can be used, when successfully implemented, to manage and integrate all business processes and functions within an organization. They usually include a set of mature business applications and tools for financial and cost accounting, sales and distribution, management of materials, human resources, production planning and computer integrated manufacturing, supply chain, and customer information (Indihar Štemberger and Kovačič, 2008). Rao (2000) described an ERP system as a software solution to produce the right product on the right place, at the right time, and for the right price, containing the best industrial and management practice captured in those solutions, also agreed with Ekman and Revay (2004) and Kovačič and Bosilj-Vukšić (2005). Companies’ existence and efficiency rely upon successful implementation and use of ERP systems (Markus et al., 2000), thus unsuccessful implementation could even lead to bankruptcy (Markus and Tanis, 2000).

Over the last decade, many companies have invested enormous amounts of financial resources in ERP systems, however many of them were unsuccessful (Parr and Shanks, 2000; Magnusson et al., 2004; Mauldin and Richtermeyer, 2004; Ward et al., 2005; Wognum et al., 2004; Umble et al., 2003; Zhang et al., 2003). Unsuccessful implementation could be observed from two aspects, completely or partly. Completely unsuccessful projects are considered to be those, in which companies resigned from realization before taking-up implementation or failed so miserably, that the company suffered significant long-term

financial damage, while partly unsuccessful implementations often result in tenuous adjustment processes (Taube and Gargeya, 2005). Analysts usually consider it a non-success if timelines and implementation costs are overrun a few times (over 200%), if goals remain unaccomplished (less than 50%) or implementation may result in incomplete installations of system modules, and consequently, in lower benefits than hoped for (Al-Mashari, 2003). Even with significant investments in time and resources, there is no guarantee of a successful outcome (Mabert et al., 2003) and underestimating the complexity of such projects is one of the main reasons for unsuccessful projects (Al-Mashari, 2003).

Foreign and domestic literature indicates these projects as highly risky with a relatively low success rate (Kovačič in Bosilj-Vukšić, 2005; Zhang et al., 2005) namely, Magnusson et al. (2004) 90%, Kovačič and Bosilj-Vukšić (2005) 89%-91%, Martin (1998) 90%, Umble&Umble (2002) 50%-75%, Zhang et al. (2003) 67%-90%, Sarkis and Sundarraj (2003) two-third failure rate. At this point it is interesting to overview the critical success factors of ERP implementation, and to consider how to decrease the failure rate. Extensive literature on ERP implementations presents it as very topical, but as information indicated a 90% failure rate, new investigations in this area are more than necessary. There are still plenty of new opportunities for further investigations, which could lead to some new discoveries and hence a possibility to contribute to or indirectly reduce the failure rate. An extensive amount of literature on ERP implementation also lacks unsuccessful projects in practice, which is not surprising at all, since companies are usually reluctant to expose unsuccessful projects in public, which also leads to a need and importance for further investigations of factors, which influences the success and failures in ERP implementations (Zhang et al., 2003). A very important factor when talking about ERP implementation is top management's perception of business process management (BPM), which has shown to be one of the crucial elements in ERP implementation, yet, there is a lack of literature about it.

A special emphasis has to be given on business process modeling, because the key to a successful choice, implementation and usage of an ERP system is fit of planned processes in an organization with processes implemented in the solution. This paper will not discuss this topic, however, we propose further reading (Indihar Štemberger and Kovačič, 2008; Kovačič, 2004).

2.1. Critical Success Factors of ERP system implementation

A first step is to examine critical success factors discussed as a few objects or goals, which have to be successful if we want to assure successful ERP implementation (Kovačič and Bosilj-Vukšić, 2005). Different critical success factors and different classifications by importance are cited in literature. Despite differences, an overview of literature on ERP implementation shows the existence of some ascendant critical success factors, which are cited by authors most frequently. Table I indicates the following critical success factors shown by their impact or importance from the most to the least important, however other authors cited in the table do not necessarily classify them by the same scale of importance. This is only one of many classifications, nevertheless, many other authors cited the same or similar critical success factors, which results in a similar situation shown in Table I, only the factor change management is often cited on the top of importance. Hence, on the basis of literature overview (Gargeya and Brady, 2005; Molla and Loukis, 2005; Skok and Legge, 2002; Jarrar et al., 2000; Zhang et al., 2003 and others) we classify top management support and change management as the most important critical success factors in ERP implementation. From this point of view, this paper will be limited only to these two critical success factors. Although these factors are quite often presented in literature, new empirical studies are more than welcome and necessary to validate companies' contributions to increase the success rate of ERP implementation. Furthermore, extensive literature presents business process reengineering (BPR) as one of the most important factors (Table 1). Jarrar et al. (2000) stressed out that BPR presents a critical factor in ERP implementation, however there

is still room for a detailed empirical analysis and therefore we also include it in our study, in a wider and newest notion, as business process management (BPM).

Table 1

Critical success factors in ERP implementation. Source: Adjusted and updated upon Sternad et al., 2007.

Top management support.	Al-Mashari et al., 2003; Al-Sehali, 2000; Akkermans and Van Helden, 2002; Esteves-Souza and Pastor-Collado, 2000; Gargeya and Brady, 2005; Gattiker, 2002; Gupta, 2000; Harrison, 2004; Holland and Light, 1999; Jarrar et al., 2000; Mabert et al., 2003; Magnusson et al., 2004; Parr and Shanks, 2000; Skok and Legge, 2002; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007; Umble et al., 2003; Yen et al., 2002; Zhang et al., 2003.
Clear goals and objectives.	Al-Mashari et al., 2003; Al-Sehali, 2000; Akkermans and Van Helden, 2002; Gargeya and Brady, 2005; Holland and Light, 1999; Mabert et al., 2003; Magnusson et al., 2004; Parr and Shanks, 2000; Reif, 2001; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007; Umble et al., 2003.
Project team organization and competence.	Akkermans and Van Helden, 2002; Esteves-Souza and Pastor-Collado, 2000; Gargeya and Brady, 2005; Jarrar et al., 2000; Mabert et al., 2003; Magnusson et al., 2004; Parr and Shanks, 2000; Reif, 2001; Skok and Legge, 2002; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007; Umble et al., 2003.
User training and education.	Al-Mashari et al., 2003; Al-Sehali, 2000; Akkermans and Van Helden, 2002; Gupta, 2000; Jarrar et al., 2000; Mabert et al., 2003; Magnusson et al., 2004; Skok and Legge, 2002; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007; Umble et al., 2003; Zhang et al., 2003.
Business Process Reengineering.	Al-Mashari et al., 2003; Akkermans and Van Helden, 2002; Esteves-Souza and Pastor-Collado, 2000; Gargeya and Brady, 2005; Gattiker, 2002; Harrison, 2004; Jarrar et al., 2000; Magnusson et al., 2004; Skok and Legge, 2002; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007; Zhang et al., 2003.
Change Management.	Aladwani, 2001; Al-Mashari et al., 2003; Al-Sehali, 2000; Akkermans and Van Helden, 2002; Esteves-Souza and Pastor-Collado, 2000; Gargeya and Brady, 2005; Holland and Light, 1999; Jarrar et al., 2000; Magnusson et al., 2004; Parr and Shanks, 2000; Skok and Legge, 2002; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007; Umble et al., 2003; Yen et al., 2002.
Communication.	Aladwani, 2001; Al-Mashari et al., 2003; Al-Sehali, 2000; Akkermans and Van Helden, 2002; Esteves-Souza and Pastor-Collado, 2000; Gargeya and Brady, 2005; Holland and Light, 1999; Mabert et al., 2003; Magnusson et al., 2004; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007; Yen et al., 2002.
User involvement and participation.	Aladwani, 2001; Al-Sehali, 2000; Esteves-Souza and Pastor-Collado, 2000; Gattiker, 2002; Magnusson et al., 2004; Skok and Legge, 2002; Somers and Nelson, 2004; Sternad et al., 2007; Yen et al., 2002; Zhang et al., 2003.
Legacy system management.	Al-Sehali, 2000; Akkermans and Van Helden, 2002; Gattiker, 2002; Reif, 2001; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007; Umble et al., 2003; Zhang et al., 2003.
Consulting services.	Al-Mashari et al., 2003; Al-Sehali, 2000; Akkermans and Van Helden, 2002; Harrison, 2004; Magnusson et al., 2004; Skok and Legge, 2002; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007.
Project Management.	Al-Mashari et al., 2003; Al-Sehali, 2000; Akkermans and Van Helden, 2002; Esteves-Souza and Pastor-Collado, 2000; Magnusson et al., 2004; Reif, 2001; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007; Umble et al., 2003; Yen et al., 2002; Zhang et al., 2003.
Sponsorship.	Akkermans and Van Helden, 2002; Esteves-Souza and Pastor-Collado, 2000; Parr and Shanks, 2000; Skok and Legge, 2002; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007.
System, technological.	Al-Sehali, 2000; Akkermans and Van Helden, 2002; Gargeya and Brady, 2005; Gattiker, 2002; Jarrar et al., 2000; Parr and Shanks, 2000; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007; Zhang et al., 2003.
Minimal customization	Esteves-Souza and Pastor-Collado, 2000; Gargeya and Brady, 2005; Mabert et al., 2003; Somers and Nelson, 2004; Somers and Nelson, 2001; Sternad et al., 2007.

2.2. Organization culture and change management

ERP implementation has a significant impact on company's culture and its organizational structure (Bosilj-Vukšić and Spremić, 2004). Successful implementation requires that people, processes, departments, and organizations change (Umble & Umble, 2002). We have already mentioned change management as one of the most important factors having influence on a successful ERP implementation as stressed out by many authors (Table I). Change management comprises human resource management as well as social changes, needed by top management when introducing new processes and structures in order to prepare people to accept changes and decrease their reluctance to change. Effective communication is an important factor when talking about changes and it is required through the whole business process and on all levels, although employees are not directly connected with business process management (Harmon, 2007). Business process reengineering also means power transmission to lower company levels resulting in adequate organizational culture and climate, where employees will feel more responsible and important. BPR also results in structure changes which reflect in new tasks and responsibilities; therefore it is vital to have a formal and clear description of all tasks and responsibilities driven by a new process (La Rock, 2003). From this standpoint, it is obvious that employees have an ability to complete all new tasks and hence to be flexible in order to have an ability to adapt to new changes in companies, and be prepared to learn, nevertheless teaching employees in companies is often underestimated, which is also agreed by Hammer and Champy (2003).

Change management in human resources includes activities such as training of employees affected by the business process change, developing new skills needed by the new processes, and establishing management systems to cultivate the required values. If these critical factors are not established within the project itself, its success could be jeopardized (Grover et al., 1995). Consequently, employees are less sensitive to possible destructive impacts from the environment, they develop a culture to become more resistant in a highly competitive business environment, however everybody on all levels needs to be educated (Bashein and Markus, 1994; Umble & Umble, 2002). Even if companies manage to form a favorable environment, including top management support, readiness to change and required technological competence, the project would certainly lead to a failure if the vital employees lack eligible skills and knowledge about the new process, or if they are not educated properly and on time (Grover et al., 1995). However, this is still not a guarantee for success, because employees also have to be motivated, cooperative, prepared to educate, be aware of the roles and responsibilities within a BPR project, as well as be flexible and capable of performing different tasks. Similar conclusions were presented by Harmon (2007); are the performers physically, mentally and emotionally able to perform tasks, because in some cases an employee is not able to perform a specific task and therefore another employee who is capable needs to do it. Searching for the right employees with required skills and knowledge needed for business process reengineering is one of the main problems (Grover et al., 1995), which is also stated by Kovačič and Bosilj-Vukšić (2005), La Rock (2003).

Intellectual capital represents the most important factor of a business process (Milost, 2004). In the period of intellectual capital, the vital role of knowledge and the ability of employees will be a key to success, and the essential competitive advantage will be an organization’s ability to learn more quickly than their competitors, as only an organization oriented towards learning can sustain more and more pressure as a consequence of rapid and unpredictable environmental changes. The features of human capital that are so crucial to an organization's performance are flexibility and creativity of individuals, their ability to develop skills over time and to respond to different contexts in a motivated way (Armstrong, 2006). However, abundant literature defines human capital as part of intellectual capital, indicates ability and flexibility as important excellence in a competitive environment, contemplates flexibility from different aspects, also as organization’s abilities to respond to various demands from dynamic competitive environments (Schuler and Jackson, 1999).

On these bases and on the bases of examined literature we propose the first hypothesis (h1):

h1: If change management in a company comprises employees' learning ability and employees' flexibility, this makes a positive impact on successful enterprise resource planning.

2.3. Top management support

Top management support presents the crucial critical success factor in ERP implementation cited by many authors (see Table I). Successful ERP implementation completely depends upon strong and persistent top management involvement, because top management support has to be included in each step and in all company levels. Some companies hand over its ERP implementation responsibility to technical departments and therefore make a vital mistake resulting in an unsuccessful project (Harrison, 2004). It is therefore wrong and inadequate to think that the whole ERP implementation project should be driven by the IT department or its management, which was also stated by Guha et al. (1997).

Essentially, all IT literature stressed the importance of top management executives in the implementation, use, and success of IT in organizations and it should include both, involvement and participation (Byrd and Davidson, 2003). Lok et al. (2005) also emphasized top management incentives as an essential ingredient for a successful process change. Umble&Umble (2002) have come to the same conclusion, because IT department managers identified three main critical success factors causing a failure of all IT projects in companies, and one of them is the lack of top management support. From this standpoint we can conclude that only the involvement of an IT department in ERP implementation is not enough, yet the main initiative has to be taken from top management, because insufficient top management support leads to a failure of all IT projects and hence also to ERP implementation failure. In other words, information specialists and top management need to cooperate and establish a partnership, which is also agreed by Indihar-Štemberger and Kovačič (2006). A gap between information specialists and top management is still present in many companies. Nevertheless, the perception of the top management is imperative for a successful IS implementation and position of IT professionals. In the research presented by Weill and Ross (2005) only one third of all top managers are well acquainted with the activities of the IS department, while this percent reaches 60%-80% in successful companies.

Information projects are successful when the planned content, time, and cost parameters increase business performance. However, this is not achieved only by IS implementation but by radically rethinking the strategic orientation and organization's moves concerning management, human resources, knowledge, structure, and business processes. Unfortunately, the existing - in many cases uncontrolled and inadequate business processes - are implemented in practice. Instead, an opportunity for radical business renovation in terms of increasing effectiveness should be taken into consideration, which causes top management to neglect the business value of IT and therefore consider it as an expense. Managers, as the only proper contracting authority are usually not familiar with the impact of information technology on business performance, and they realize neither the possibilities nor opportunities driven by modern information technology (Indihar Štemberger and Kovačič, 2006). Managers' perception and activities within the information management area are mainly cost oriented, as they expect moves mostly in the way to gain efficiency and transparency in business process implementation. However, top management's course of thinking about the moves toward increasing business effectiveness is difficult or even unattainable. To assure business effectiveness it is necessary to shift management's perception of information management from information support in the business department or function to a strategic impact on business performance (Kovačič in Bosilj-Vukšić, 2005).

On these bases and on the bases of the examined literature we propose the second hypothesis (h2):

h2: If top management has sufficient knowledge of information management, and if it supports initiatives of information specialists, this is a clear indicator that the top management perceives business process management in a company, which yields a positive impact on successful implementation of enterprise resource planning.

2.4. Business processes

In order to survive in a highly competitive business environment companies are subject to continuous change of their business processes (Bosilj-Vukšić and Spremić, 2004). This section is divided in two parts, the first describing process owners, and the second one dealing with process identification and documentation.

2.4.1. Process owners

Companies do not reengineer processes - people do. An initiative to change a business process should come from the top, i.e. from the top management, so the transition of process ownership is very important and necessary. The employees, who work with new processes have to own them otherwise the project will tend to fail (Caron et al., 1994). Most companies lack process owners or they are defined to a minor extent, which is a consequence of a traditional organization of people and their thinking, which is not process oriented (Hammer and Champy, 2003).

Process owners have to be defined; organizations need to give them adequate power and include them in the project from the very beginning. A process owner is an individual with ultimate authority and responsibility over process operations, however, this person needs to be well acquainted with the process and occupy a relatively high position in the company, because this person presents the process throughout the company (Boyle, 1995). The task of a process owner is not to do business reengineering but to make it happen (Hammer in Champy, 2003). It is therefore not surprising that process owners should be the persons of trust and confidence with quite high reputation, respect, toleration and readiness to change. Al-Mashari and Zairi (1999) cited undetermined process owners as one of the factors leading to a failure of business process reengineering, while Grover et al. (1995) and Jackson (1997) emphasized the lack of process owners as a barrier in business process reengineering. Overcoming employee's resistance can be a critical factor for a successful ERP project, and top management has to provide leadership for all changes (Bosilj-Vukšić and Spremić, 2004). Furey (1993) exposes the involvement of process owners and their remuneration among other suggestions that managers should consider in BPR. Process owners are the ones who are the most threatened by a change, however, their input is invaluable and their incorporation in the company helps them contemplate the change from a positive point of view instead of thinking about their job positions being endangered. However, managers have to motivate them by rewards thus influencing their success.

Every employee can do his part of the job with excellence. If there is no person to supervise and manage the integrity of all activities, the excellence of this individual could quickly turn into a failure. A critical part of business process reengineering is to assign someone to own each critical business process (Harrington, 1991). Quite a few researches show that companies are aware of the importance to define process owners, because the companies, in which process owners have not been defined yet, intend to do it in the future (e.g. Zairi in Sinclair, 1995).

2.4.2. Process identification and documentation

Responsibilities of individual business processes are spread among the boundaries in the organization, therefore identification of the core business processes is a necessary step before reengineering. Just as companies have organization charts, they can have a process map with defined business processes to facilitate the understanding and sharing of the workflow in companies (Hammer and Champy, 2003). Efficient and effective process performance is primarily subject to understanding its structure and the process flow as a whole. However it is reasonable to identify only those activities as processes, which directly or indirectly contribute to end products as added value (Kovačič in Bosilj-Vukšić, 2005).

Processes have to be defined and understood. Each employee in the company, regardless of whether he is involved in production or provides a particular service uses a particular process that transforms a set of inputs into a specified set of outputs. Nevertheless, these processes are quite often invisible, because they have never been documented. Sometimes these processes are formally and completely documented, yet the processes are constantly refined and amended, hence the changes have to be documented as well. Some organizations have documented the procedures and processes in, while some of them mainly rely on employees' experience. Although this was sufficient in the past, it is not sufficient today as the understanding of the processes of today mostly requires a graphic presentation - a flowchart (Tenner in DeToro, 1997). Process maps graphically represent process activities, discipline our thinking, and they are a key element in business process improvement (Harmon, 2007).

Non-existent or inadequate documentation can be a reason for problems during business process reengineering, so one of the first tasks is to identify the existing business processes and see to it they are documented (Harrison, 2004). Guha and Kettinger (1993) paid attention to the importance to clearly understand the existing business processes before business process reengineering; therefore processes need to be documented first, which is also agreed by Donovan (2002) and Tenner, DeToro (1997). Likewise, it has been shown in practice that companies define their core and sub-processes before business process reengineering (e.g. Zairi in Sinclair, 1995). Inappropriately defined business processes can also be a reason for a failure of business process reengineering (Grover et al., 1995). Even too broad or too narrowly defined processes can lead to a failure of a business process reengineering project (Hall et al., 1993). Lok et al. 2005 stressed that reengineering causes legacy information system to be overhauled. Quite often business process reengineering incorporates legacy systems, however, due to continuous evolution companies are forced to migrate the existing legacy systems to a new environment in order to ensure new hardware and software, thus reducing the costs of software maintenance, enabling new features etc. From this standpoint, missing or incomplete documentation can jeopardize business process reengineering (Tilley, 1995). Since the goal is not to improve the existing business processes, but to redefine the processes anew, there is no need to analyze and document the existing processes in details. However, they should be defined to the extent that the processes are well understood, which represents a basis for a definition of completely new processes (Hammer in Champy, 2003).

On these bases and on the bases of the examined literature we propose the third hypothesis (h3):

h3: If business process management incorporates defined business processes, business process documentation, and defined business process owners, this is an indicator of the existence of management's perception of business process management in a company, which yields a positive impact on successful implementation of enterprise resource planning.

2.5. Business process management

The role and impact of business process management on successful ERP implementation has a crucial role. Jarrar et al. (2000) present a link between ERP and BPM based on a research in six companies. All six companies have agreed that business process reengineering presents a critical factor in ERP implementation. An ERP implementation project is not only an information technology project and is more than just a change in the way companies work. For a successful implementation of ERP, organizations must treat it like a change management project and focus on an integrated approach to business process management (BPM). On these bases and on the bases of the examined literature we propose the fourth hypothesis (h4):

h4: If top management treats business process management as a basis of a business change, this indicates the existence of management's perception of business process management in a company, which yields a strong and positive influence on successful implementation of an enterprise resource planning system.

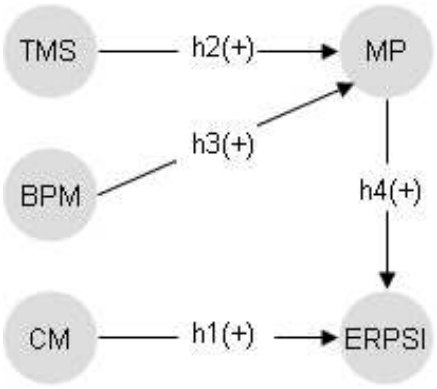
Considering top management support, change management and business process management as exceedingly wide topics, this paper will cover only a part of realization, captured in our conceptual model (Figure 2).

2.6. Model conceptualization

The main purpose of this paper is to test the four hypotheses based on literature overview presented in the previous subsections. In Figure 1 the conceptualized model along with the hypothesized relationships is shown. Construct notations are described in Table II.

Figure 1

Conceptual model and direction of impact between constructs



3. Research methods and data analysis

3.1. Research instrument

To test the hypothesized relationships, we employed the approach proposed by Diamantopoulos and Siguaw (2000) and tested the relationships between constructs by using structural equation modeling. We used LISREL 8.72 software.

3.1.1. Data collection and sample characteristics

Data were collected during December 2005 and February 2006. We invited a representative sample of 600 randomly selected Slovenian companies from different industries with more than 50 employees to take part in the research. In the case of a positive response a CIO answered a questionnaire that consisted of several areas in an interview. All companies that took part in the research could compare their state with an average state of all participants and an average state in their industry. In this way, 152 completed questionnaires ware gathered, which represents a 25.3% response rate. The sample is an adequate representation of the population of Slovenian companies with more than 50 employees.

3.1.2. Operationalization of constructs

None of the constructs is easily observed since all of them are latent variables, so measuring is accomplished by measurable indicators known as manifest variables shown in Table 2.

Table 2

Item measures for constructs (five-point scale anchored by »strongly agree« and »strongly disagree«)

Item	Item measures for change management (CM)
ELA	Employees learning ability
EADT	Employees adaptability on different task
Item measures for top management support (TMS)	
MSITI	Management support information technology initiatives
MITK	Management information technology knowledge
Item measures for business process management (BPM)	
DeBPO	Defined business process owners
DeBP	Defined business processes
DoBP	Documented business processes
Item measure for management perception (MP)	
BPMBBC	Business process management as a basis of business change
Item measures for enterprise resources planning successful implementation (ERPSI)	
ERPPBP	ERP implementation has a positive influence on business performance
ERPER	ERP implementation in line with expected results

3.1.3. Confirmatory analysis using structural equation modeling

The first step is identification of the model, which means the information provided by the empirical data is sufficient to allow for a unique solution to be derived for model parameters. The following formula determines if the model meets the minimum requirement for identification:

$t \leq s/2$, where t is the number of parameters to be estimated and s is the number of variances and covariances amongst the manifested (observed) variables, calculated as: $(p^1+q^2)*(p+q+1)$.

For our model we have $t=24$, $p=7$ and $q=3$. Thus $s/2 = [(7+3)\cdot(7+3+1)]/2=55$.

Because the number of variances and covariances available exceeds the number of parameters to be estimated ($t=24$), this model is over identified, which we aim to.

The next step was the assessment of the model fit. This refers to the extent to which a hypothesized model is consistent with the data and involves three stages: the assessment of the model's 'global' (overall fit), the assessment of the measurement part of the model, and the assessment of the structural part of the model.

3.1.4. Overall fit assessment

The purpose of assessing a model's overall fit is to determine the degree, to which the model as a whole is consistent with the available empirical data. A wide range of goodness-of-fit indices have been developed that can be used as summary measures of a model's overall fit. Different authors tend to favor different indices, often leading to direct conflicts when recommending which indices should (or should not) be relied upon. Research evidence supports the need to use more than one index (Škrinjar et. al., 2008). Table 3 shows Diamantopoulos and Siguaw (2000) goodness-of-fit measures, their reference values, the values derived from our model and the overall fit of the model.

[1] p = the number of y-variables

[2] q = the number of x-variables

Table 3

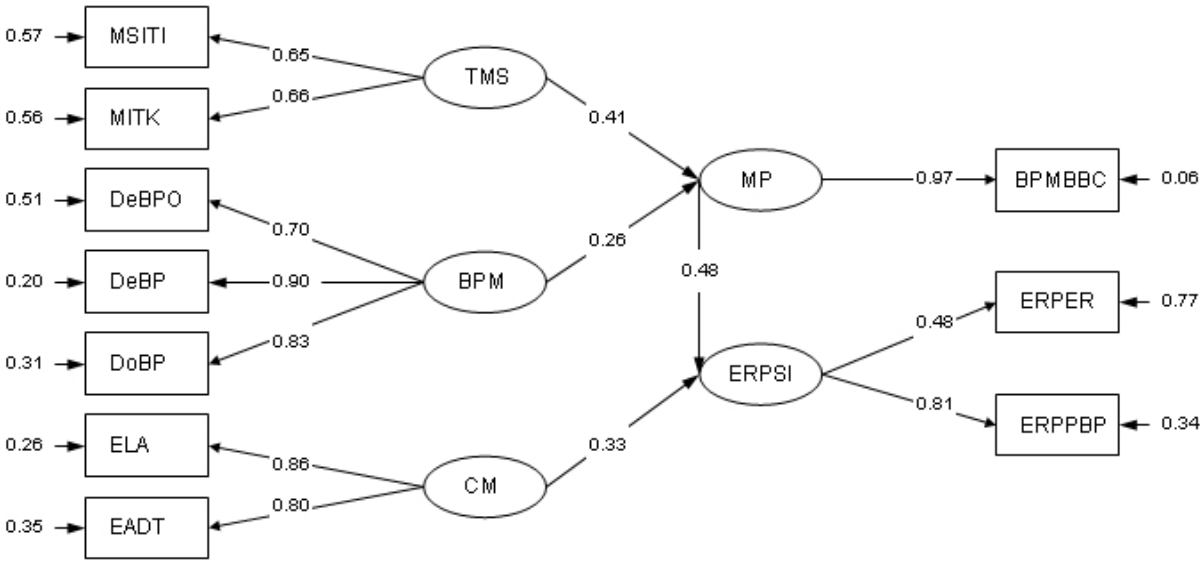
Fit indices

Fit indices	Model value	Reference value	Global model fit?
χ^2 (p value)	41,77 (0,046)	p≥0,05	Yes (Acceptable)
RMSEA	0,054	< 0,100	Yes
ECVI	0,65	<ECVI saturated model	Yes
		<ECVI independence model	Yes
AIC	93,91	<AIC saturated model	Yes
		<AIC independence model	Yes
CAIC	201,28	<CAIC saturated model	Yes
		<CAIC independence model	Yes
Standardized RMR	0,039	<0,05	Yes
GFI	0,95	≥0,90	Yes
AGFI	0,90	≥0,90	Yes
PGFI	0,48	≥0,50	Yes (Acceptable)
NFI	0,95	≥0,90	Yes
NNFI	0,97	≥0,90	Yes
CFI	0,98	≥0,90	Yes

Comparative fit index (CFI – should exceed value of 0.90) and non-normed fit index (NNFI – should exceed value of 0.90) are used most often to assess model fit (Koufteros, 1999). Incremental fit indices (normed fit index – NFI, non-normed fit index – NNFI and comparative fit index – CFI) compare the χ^2 statistics of the researcher's model and a base model that assumes that all variables are uncorrelated (Škerlavaj et. al., 2007). NFI, NNFI are also called The Tucker and Lewis' index – TLI. In addition, we also used the following indices. The chi-square (χ^2) statistics is the traditional measure for the evaluation of the overall model fit and small χ^2-values indicate a good fit. Root means square error of approximation (RMSEA) is the most wide spread measure of global fit and in our case represents a good model-fit. The expected cross-validation index (ECVI) focuses on overall error, discrepancy between population covariance matrix and the model fitted to the sample. Akaike's information criterion (AIC) and consistent version of AIC (CAIC) are known as information criteria used for a comparison of models. Smaller values represent a better fit of the hypothesized model. Standardized root mean square residual (Standardized RMR) is fit index calculated from standardized residuals (differences between elements of sample and implied covariance matrix). Goodness-of-fit index (GFI), adjusted goodness-of-fit (AGFI) and parsimony goodness-of-fit index (PGFI) are absolute fit indices. The first two directly assess, how well covariances based on parameter estimates reproduce sample covariances, while the latter take model complexity into account.

Figure 2

Path diagram of conceptualized model



An overall fit index does simply not exist. More than sufficient tests to reach an informed decision concerning the model's overall fit Diamantopoulos and Siguaw (2000) suggest the results of the chi-square test used in conjunction with the RMSEA, ECVI, standardized RMR, GFI and CFI indices. All indices described above lead to a conclusion of model's overall fit. In Figure 2 the path diagram of our model is presented.

3.1.5. Assessment of the measurement model

In this step we focus on the relationships between the latent variables and their indicators (observed variables). The aim is to determine the validity and reliability of the measure used to represent the construct of interest. Validity reflects the extent to which an indicator actually measures what it is supposed to measure. All indicator loadings should be significant (t-values should exceed 1.96 in absolute terms), which provides that construct validity is achieved. All t-values from Table 4 are larger than 1.96, meaning that the construct validity is achieved.

Table 4

Completely standardized loading estimates and t-values

Latent variable	Observed variable	Completely standardized factor loading	t-value
	LAMBDA-X		
MP	BPMBBC	0.969	- [a]
ERPSI	ERPER	0,479	- [a]
	ERPPBP	0,812	3.880
	LAMBDA-Y		
TMS	MSITI	0.654	7,505
	MITK	0.661	7,590
BPM	DeBPO	0.698	9,122
	DeBP	0.896	12,780
	DoBP	0.832	11,509
CM	ELA	0.858	10,172
	EADT	0.803	9,535

[a] Indicates a fixed parameter in the original solution

When reliability is an issue, we need to address it in two steps: reliability of individual indicators and construct (composite) reliability. The former is measured by using R^2 for every single individual indicator and presents a part of variance in an indicator explained by its latent variable (Dimovski et. al., 2006). In our case the least reliable is ERPER with the value 0.229, all other indicators are very reliable ranging from 0.428 to 0.940 shown in Table 5.

Table 5

Indicators with R^2 values

Indicator	BPMBBC	ERPER	ERPPBP	MSITI	MITK	DeBPO	DeBP	DoBP	ELA	EADT
R^2	0.940	0.229	0.659	0.428	0.437	0.488	0.803	0.692	0.736	0.646

In addition to assessing the reliability for every single construct composite reliability can be calculated by using the following formula:

$$\rho_c = \frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + \sum \theta_i}$$

where λ is indicator loadings and θ variances of indicator errors (whether δ or ε) obtained from the completely standardized solution. The values greater than 0.6 are desirable by Diamantopoulos and Siguaw (2000). We can conclude that composite reliabilities shown in table 6 are adequate.

Table 6

Composite reliability

Latent variable	TMS	BPM	CM	MP	ERPSI
ρ_c	0.604	0.853	0.817	0.940	0.600

3.4.3. Assessments of the structural model

Evaluating the structural part of the model consists of three steps. First, we test the signs of the parameters representing the paths between the latent variables indicating whether the direction of the hypothesized relationships is as hypothesized. In our case, all four relationships are positive, which confirms that latent variables TMS and BPM have a positive influence on the latent variable MP, as the latent variable CM has a positive influence on the latent variable ERPSI, and as the latent variable MP has a positive influence on the latent variable ERPSI, as we hypothesized. In the second step we are interested in the magnitudes of the estimated parameters, which provide important information on the strength of the hypothesized relationships. At the very least, these parameters should be significant (as indicated by t-values in excess of $|1.96|$), (Diamantopoulos and Siguaw, 2000). In our case all four parameters are statistically significant. Third, we examine the squared multiple correlations (R^2) for the structural equations, which indicate the amount of variance in each endogenous latent variable that we manage to explain by the independent latent variables. For the hypotheses h2 and h3, R^2 is high (0.371) and for the hypotheses h1 and h4, R^2 is even higher (0.439) indicating a strong relationship.
Considering all these aspects, a confirmatory analysis has supported all four hypotheses.

4. Discussion and implications

The research has confirmed the impact of all three critical success factors included, the impact of top management support, change management and business process management on a successful ERP implementation. These factors that have been found as some of the most important CSFs in the previous research have a positive impact on a successful ERP implementation and should be treated as very important in ERP systems implementation projects. The results also support the importance of top management's perception, namely if they consider business process management as a basis of business change, this yields a strong and positive influence on a successful ERP implementation.

The results of our study also have practical implications. Companies should treat BPM as a basis for a business change and therefore increase its usage, which yields a strong and positive influence on a successful ERP implementation. They need to take all of success factors examined in this study into consideration, they should be aware of them instead of omitting them, which also yields a positive influence on a successful ERP implementation. Organizations should not resign from an ERP implementation project too soon, because the results are usually shown after some time. If ERP projects do not meet the predefined time,

budget, and specification, they can still be successful, thus defining the project success, yet only time, budget, and specification are not appropriate (Zhang et al., 2005). Once again, even if ERP implementation per se is not the most efficient, its effectiveness on business performance can be greater. Companies usually start to believe that projects are good when a project shows results, therefore they increase activity and investment in this kind of projects (Lok et al., 2005).

However, this study also has some limitations. The research was based on the sample of 152 completed questionnaires, which represents a 25.3% response rate. Better validity and reliability could be obtained by a larger sample, which is the next step in this research. Although validity and reliability checks were performed on the measures, there is still room for improvement. Though, we have measured the management perception (MP) construct with one manifest variable (BPMBBC), and although this indicator was well defined, we suggest including more indicators, which represents the next challenge in this research. The next limitation is the sample taken only from one country, which is a common question in most studies, namely what results might be obtained from a "global sample". Likewise, the CIO's' aspect is worth paying attention to, because other managers could answer the same questionnaire differently. To assure stronger evidence a longitudinal analysis should be performed.

Successful ERP implementation, represented with the ERPSI construct in SEM model, is measured by two measurable indicators. If we analyze them in more detail, we can conclude that the manifest variable (ERPER) measures ERP implementation efficiency, because we measured conformity results with the expected results, costs, and time schedule. The significance of this factor is nearly 0.5, which is not so high; however, from our standpoint, it is relatively high, because we have to consider that some of the companies quite often overvalue their results. The second manifest variable (ERPPBP) measures how successful the ERP implementation impact on effective business performance is, and the significance of this factor is high (0.8). From this point of view we can conclude that even the ERP implementation per se is not the most efficient (factor 0.5), its effectiveness on business performance can be greater (factor 0.8). However, positive results of ERP implementations are usually not seen immediately, but only after some time, of which the companies should have been aware before the ERP implementation was started.

Furthermore, this study is limited to a few critical success factors covered by the conceptual SEM model. Successful ERP implementations should include a number of other critical success factors, which are not included in this study and should not be omitted.

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MENADŽMENT POSLOVNIH PROCESA KAO VAŽAN FAKTOR USPJEŠNE PRIMJENE ERP SUSTAVA

SAŽETAK

ERP sustavi koriste se danas u svim vrstama organizacija. Na žalost, uspješnost provedbe ERP projekata vrlo je niska. Prema rezultatima nekih istraživanja čak 90% projekata završava neuspjehom. Zbog toga je potrebno provesti dodatna istraživanja kako bi se utvrdilo na koji način organizacija može utjecati na uspjeh implementacije ERP sustava, a to je i glavni razlog ovog istraživanja. Cilj članka je proučiti utjecaj menadžmenta poslovnih procesa i drugih kritičnih čimbenika uspjeha na uspješnost implementacije ERP sustava. Za dokazivanje utjecaja korišteno je empirijsko istraživanje i metoda modeliranja strukturnim linearnim jednadžbama (SEM). Rezultatima istraživanja potvrđene su hipoteze da potpora top-menadžmenta, menadžment promjena i menadžment poslovnih procesa imaju pozitivan utjecaj na uspješnu implementaciju ERP sustava.. Ovime je potvrđena važnost tih čimbenika u provedbi ERP projekata. Rezultati potvrđuju i važnost percepcije top-menadžmenta: spoznaja o važnosti menadžmenta poslovnih procesa za provedbu promjena snažno i pozitivno utječe na uspješnost implementacije ERP sustava.

JEL: M15

***Ključne riječi**: ERP sustav, ključni faktori uspjeha, menadžment poslovnih procesa, potpora vrhovnog menadžmenta, metoda modeliranja strukturnim linearnim jednadžbama (SEM).*