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OANA VELCU

DRIVERS OF ERP SYSTEMS' BUSINESS VALUE

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## Drivers of ERP systems' business value

Key words: ERP implementations; ERP business value; IT investments; IT business value; economic benefits

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Helsinki, April 2<sup>nd</sup>, 2008

Oana Velcu

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## LIST OF PAPERS

1. Velcu Oana (2005) “Impact of the Quality of ERP Implementations on Business Value”, Published in *Electronic Journal of Information Systems Evaluation*, Vol. 8, No. 3, pp. 229–238.
2. Velcu Oana (2007) “Exploring the effects of ERP systems on organizational performance – Evidence from Finnish companies”, Published in *Journal of Industrial Management and Data Systems*, Vol. 107, No. 9, pp. 1316-1334.
3. Velcu Oana (2007) “A model of organizational and implementation factors that enable the benefits of ERP systems”, In press.

# 1 INTRODUCTION

## 1.1. Description of the problem area

In order to reach profit growth, companies need to operate with augmented agility nowadays. To achieve this, they depend more and more on information technology (IT) infrastructures to support their business processes. Information and knowledge gain ground against conventional assets, like property or financial capital, and computers become the tools for better leveraging the information and knowledge assets. Since firms become more information intensive, business becomes more dependent on IT (Kearns and Lederer, 2004). Within certain business fields, expenditure on IT, and the complementary activities enabled by it, can increase up to the second highest costs in the cost hierarchy, right after staff costs.

There are different views on what IT represents, but a common definition of IT consists of a range of hardware, software and networks used to process, transmit and retrieve information for users (Melville, Kraemer & Gurbaxani, 2004). In this thesis, IT is viewed as a tool applied to generate value measured in cost reduction, productivity enhancement or attainment of competitive advantage. In the information systems (IS) literature, there is a subtle difference between the IT and IS concepts. In a nutshell, IS builds on IT, which represents the actual technology (Editorial, 2006). An IS refers to particular business applications which support different organizational functions, decision-making and control within organizations (e.g. CRM software).

The management of IT requires a strategic vision that strikes the balance between the IT opportunities and IT business requirements. In general, IT strategy refers to the acquisition and development schedules for hardware, software, and application systems (Gelinias, Sutton & Hunton, 2005). In this thesis, IT strategy refers to specific investments in IT under the form of different types of systems, such as SCM software or ERP systems. An IS strategy refers to the identification and monitoring of how each information system within the organization will support the organizational goals (Levy, Powell & Galliers, 1999).

The focus of this thesis is on ERP systems, which relate to the management of IT and IS. Since the mid 1990's, ERP systems have been widely implemented and have become the backbone of IT infrastructure in organizations. ERP systems "*may in fact be the most important development in the corporate use of information technology in the 1990s*" (Davenport, 1998, p.122). They are acknowledged as having "*fundamentally re-shaped the way business event data is collected, stored, disseminated and used*" (Sutton, 2006, p.1) ERP systems are a specific IT strategy that combine the business processes and IT technologies of the implementing organizations into an integrated system. The management is thus provided with real-time operating information.

From the design point of view, ERP systems are built on an IT architecture that has the following components: IT capacity, network infrastructure, server platform and operating system, client platform and operating system, a common relational database, data ownership, and Web enablement (Al-Mashari, 2003). The relational database collects information from and inputs the information into the modular applications that

support the business processes (accounting, manufacturing, logistics, and human resources) across business units and across subsidiaries (Poston and Grabski, 2001).

This increased involvement of IT in organizational practices raises several issues regarding the economic benefits of IT, in general and ERP systems, in particular:

- 1) To identify the value delivered by different strategies of IT investments at the firm level.
- 2) To analyze the ERP systems contribution to productivity and firm profitability.
- 3) To assess the effects of ERP systems on the underlying business processes, and how these intermediate effects are reflected at high-level business performance.
- 4) To identify the organizational and contextual factors with leveraging effect on the relationship between ERP systems and organizational performance.

Based on the resource-based model of competitive advantage, also known as the resource-based model of superior returns, ERP systems may enable companies to reach competitive advantage when these systems are valuable for the company, heterogeneously distributed, leveraged, and costly to copy within industry. Provided ERP systems fulfill these four criteria within the companies that exploit them, they may enable companies to reach higher profits.

The analysis of the economic benefits of ERP systems fits within the research of the economic benefits of IT, which is a broader field with a longer tradition. The “business value of IT” is the main concept on which researchers focus when they investigate issues regarding the economic benefits of IT. Melville, Kraemer & Gurbaxani (2004) define the business value of IT as:

*“... the organizational performance impacts of information technology at both the intermediate process level and the organizational-wide level, and comprising both efficiency impacts and competitive impacts”.* (Melville et al., 2004, p. 287)

Therefore, the business value of IT refers to the impacts of IT on business performance at intermediate process and financial profitability levels. There are four approaches to the measurement of IT impacts on business performance. First, some researchers apply productivity measures, as gross marginal product (Brynjolfsson, 1993; Brynjolfsson and Hitt, 1998; Brynjolfsson and Hitt, 2003). Second, other researchers use profitability measures, such as accounting performance measures (e.g. ROA or ROI), or capital market measures (e.g. abnormal stock returns, Tobin’s q) (Dehning and Richardson, 2002). A third category of studies uses process-level measures, such as capacity utilization, relative price and relative quality (Barua et al., 1995; Chan, 2000). Fourth, recent research analyzes the business value of IT from the four perspectives of the balanced-scorecard (BSC): financial, customer, internal processes and learning and growth (Chand, Hachey, Hunton, Owosho, & Vasudevan, 2005). The four BSC dimensions intertwine, in the sense that the financial measures are a function of the three non-financial measures. This is indicated by Fang and Lin (2006) who show that

customer retention (customer perspective), the emergency response time in order processing (internal process perspective), and the productivity per employee (learning and growth perspective) have an explanatory power on ROI (financial perspective).

Early 1990's studies pointed out that some companies invested large amounts in IT without obtaining any benefits, while others made similar investments, which turned out highly productive. In order to determine the business value of IT, some researchers studied the relationship between IT investments and business performance on broader datasets that contained hundreds of firms over several years (Brynjolfsson and Hitt, 1998). The underlying idea was that successful or less successful experiences with IT investments would average out and would convey a clearer picture on this relationship. On average, IT investments are consistently found to have positive impacts on productivity in late 1990's studies (Brynjolfsson and Hitt, 1995; Brynjolfsson and Hitt, 1996). However, this fact alone does not show how managers can make good investments. Technology expenses are only one aspect of IT investments. In general, process redesign, training and other organizational changes are constituents of IT investments. The careful management of these intertwining aspects of IT investments may provide sources of competitive advantage compared to other companies that may neglect or mismanage some of the constituents of their IT investments.

The organizational changes (e.g. new strategies, strategic alignment, process reengineering) which are coupled with IT take considerable time and are incrementally applied. Thus, the IT impact on business performance should be analyzed for longer time periods (Brynjolfsson and Hitt, 1996; Dewan and Min, 1997; Stratopoulos and Dehning, 2000; Dedrick, Gurbaxani & Kraemer, 2003; Nicolaou, 2004). Every dollar invested in IT is followed by several dollars of investment in organizational changes, and when combined, these investments are expected to have positive impacts on business performance in the long-term (Brynjolfsson and Hitt, 1998; Brynjolfsson and Hitt, 2000; Byrd, Lewis & Bryan, 2006). For example, Dell offers tours to investors, customers and researchers around its manufacturing operations unit to provide insight into the various organizational changes complementing IT in the company and into the resulting profit-making potential (Brynjolfsson, Hitt & Yang, 2002). Therefore the implementation of the IT enabled changes faster and better than the competing companies within industry may represent a source of competitive advantage for the firms investing in IT. In addition, the understanding of IT business value can be enriched by looking at the broader system of organizational changes, in which IT is an essential component.

Most of the literature of the early 1990's concentrated on estimating the overall contribution of IT. The next step was to go beyond the "average" effects of IT. In accordance with this, Dehning and Richardson (2002) observe that a different way to analyze IT investments is to look at different IT strategies implemented at company level. The focus of some studies was on determining the successful and unsuccessful IT strategies of individual companies and their impact on firm performance (Hitt and Brynjolfsson, 1996; Stratopoulos and Dehning, 2000). The findings suggest that it is not enough to simply complete the IT projects on time, within budget and with the required specification. In order for IT investments to contribute to business performance, IT should be successfully integrated into business processes.

ERP systems have been implemented as an IT strategy in different industries, ranging from banking and insurance companies, manufacturing and utility companies, retail and hotels, health care companies to universities and government agencies. Regarding the success rate of ERP implementation projects, in 2007, a statistics report on ERP systems states that 60% of the ERP projects still fail in terms of time and money (Harvard, 2007).

The reasons behind ERP implementations are to improve the organizational efficiency, effectiveness, and eventually profitability (Arnold, 2006; Mandal and Gunasekaran, 2003). However, the studies investigating whether companies can use ERPs to reach higher profits contain mixed findings. In addition, managers from six Danish companies disagree with the claimed gain in competitive advantage as a result of implementing an ERP system (Rikhardsson and Kraemmergaard, 2006). Rather, they consider ERP systems as “entrance tickets” to a particular market, without which companies cannot compete. Differently stated, ERP systems are seen as enablers of operational efficiency, which keeps companies on the competitive edge in global markets. Yet, Kalling (2003) considers that it is still unclear whether ERP systems can actually contribute to sustained competitive advantage, mainly due to the fact they impose a common set of applications supporting business operations.

Using the resource-based perspective, Beard and Sumner (2004) examine whether firms are able to use ERP systems to earn higher profits than would have been earned otherwise, despite the common set of applications adopted by competing companies within the same industry to support similar business processes. They conclude that ERP systems may not directly provide firms with a competitive advantage as a result of lower costs or higher revenues of the firm compared to the case where the ERP systems were not implemented. However, the value of the systems appears to come from improved information, better decision-making and more efficient customer service. In addition, ERP systems have high degrees of penetration within industries, which implies that the cost of implementing ERP is merely the cost of doing business and the system creates a new environment where the competition takes place. The companies that start their ERP implementations later can benefit from the experiences acquired by individuals and consulting firms and can have faster and more cost-effective implementation projects. Thus, the temporary competitive advantage enabled by ERP will last for a shorter period of time. Summing up, Beard and Sumner (2004) concur that ERP systems may not provide sustained competitive advantage based upon the premises of system value, distribution and imitability.

*“Instead, the source of competitive advantage may lie in the careful planning and successful management of ERP projects, refinement of the reengineering of the organization, and the post-implementation alignment of the ERP system with the organization’s strategic direction”.* (Beard and Sumner, 2004, p.129)

In other words, the competitive advantage may come from implementing ERP better than competing companies, by finding the balance between the logic imposed by the system on strategy, organization and culture, and the logic of the existing business strategies and work practices. Indeed, ERP systems are viewed as organizational actors that influence the culture and behavior of management and employees in organizations.

The ERP literature goes through a shift in focus from ERP implementation issues to benefits of ERP, utilization and upgrading (Rikhardsson and Kraemmergaard, 2006). However, extant research on ERP business value has not investigated the links between the management of ERP projects and the organizational changes, and their profit implications. The underlying assumption is that the impact of ERP systems on business performance depends on how companies manage the ERP resource. Therefore, in this thesis, the focus will be on the management of ERP implementations as a potential source of competitive advantage.

## **1.2. Scientific aim of the thesis**

This thesis explores key drivers of successful ERP implementations and their contribution to business performance. Using a triangulation method (survey and multiple case studies) and taking a multiple stage approach to ERP implementations, the thesis examines the potential of strategic alignment and successful management of ERP projects to increase the ability of ERP systems to affect business performance. The objective of the first paper is to analyze the extent to which ERP systems having the required system functionality are associated with the development of business performance when the system goes live compared to the pre-implementation period. The second paper explores the business process changes associated with quicker and more economical ERP projects and the effects of these changes on firm performance. The third paper evaluates the role of alignment between business and ERP strategies for realizing benefits of ERP at the post-implementation stage.

The contribution of this thesis consists of providing a conceptual model showing how ERP systems may add value in the first years of system use in mid-sized organizations. The developed model points to the relevance of coordinating organizational and implementation project factors and business process changes for an efficient use of ERP systems in the long run.

## **1.3. Structure of the thesis**

The thesis is made up of two parts: part 1 contains the theoretical framework and contribution of the thesis, and part 2 presents in detail the three research papers. Part 1 continues with section 2, which describes the relevant research streams in the area: first, the literature on the contribution of IT to business performance, and second, the research on ERP business value. Both streams are presented based on the same framework: first, the papers that investigated the direct relationship between the IT/ERP investments and business performance. Second, the papers that discussed the intermediate effects of IT/ERP investments and third, the papers that identified organizational and contextual factors with leveraging effect on the IT/ERP business performance. Section 3 briefly discusses each of the three research papers of this thesis, with an emphasis on their individual contributions. The overall contribution is discussed in section 4. Part 1 ends with a conclusion on the overall contribution of this thesis to the research field.

## 2 RESEARCH ON THE BUSINESS VALUE OF ERP SYSTEMS

### 2.1. Literature review framework

In the review of archive-based research studies that investigate the IT impacts on business performance, Dehning and Richardson (2002) suggest three ways in which IT investments are measured: (1) as differences in IT spending, (2) as IT strategy examining IT deployments under the form of types of system (e.g., EDI, ERP, electronic commerce), (3) as differences in the management of IT implementations. The business performance is usually quantified in productivity measures or profitability measures such as accounting measures (ROE, ROA, PM, etc.), and capital market measures (Tobin's  $q$ , market share).

The theoretical underpinning of the relationship between the productivity and profitability measures of IT business value is the concept of "value". According to economics, organizations obtain value in two ways: (1) by creating and capturing it, and (2) by transferring it from customers or suppliers (Hitt and Brynjolfsson, 1996). IT productivity is associated with the process of value creation and measures the marginal benefits of IT. Firm profitability shows whether the value created by IT can be captured by the companies investing in IT. Alternatively, firms can increase their profits with IT by receiving the value created by IT up or down the supply chain, but not captured there (e.g., by using information to drive down prices paid to suppliers). This is the case of value redistribution, when business profitability is distinct from productivity in the sense that productive IT can enable higher business profitability but is neither necessary nor sufficient. This theoretical explanation shows that the processes of value creation and value redistribution can be studied separately despite the fact that they are usually linked.

The value of a company on the capital market is estimated by financial analysts by using different methods. The return on equity (ROE) methods represents a type of valuation methods, which express the company value as a function of accounting numbers. In a nutshell, ROE methods compare the company's ROE with its cost of equity capital. If in the long run a company's ROE exceeds its cost of equity capital, then its market value should exceed its book value, and the company generates supernormal profitability. However, in time, ROE is driven by competitive forces towards the level of the cost of equity capital.

ROE is the starting point of the analysis of the profitability and growth of a company (Palepu, Healy & Bernard, 2004; Kim, 2004). The profitability and growth analysis entails the measurement of business performance at four levels of management: operating, investment, financing strategy and dividend policies. The objective of the field of IT business value is to assess the performance of a company that invests in IT in the context of its operational and investment strategies.

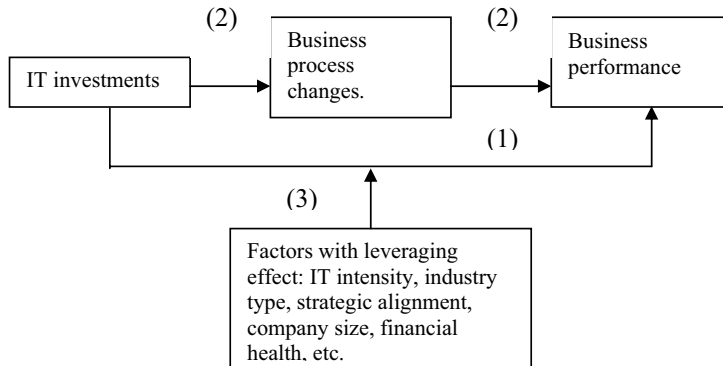
The return on assets (ROA), profit margin (PM) and assets turnover (ATO) are the main drivers of a company's ROE. In the literature on ERP implementations, the expected benefits of ERP systems include increased efficiency and profitability. Therefore, ROA is the most used ERP impact measure, which shows how profitable is the company



implementing ERP in using its operating assets to generate operating profits (Brakeley, 1999, Hunton et al., 2003). The combined effects of profitability and efficiency expressed by ROA are further separated into PM and ATO, where PM shows the profitability of the operating activities within a company, and ATO shows the effectiveness of a company's asset management. The return on investment (ROI) is another key performance measure used in the literature on ERP business value to check the robustness of the results using ROA.

ROE has another main driver, the financial leverage, which reflects the company capital management. However, ERP systems are not expected to impact the financing and dividend policies of the company implementing the systems. In the literature on ERP business value, researchers do not consider the impact of ERP systems on the short-term liquidity ratios, debt policy ratios or coverage ratios. Therefore, it is admissible to assume that if ERP implementation leads to changes in ROA, PM, ATO or ROI – *ceteris paribus* -, it shows the potential of ERP systems to influence the company value.

Figure 1 illustrates the three ways in which the relationship between IT investments and business performance has been investigated in archived studies of IT business value: (1) as a direct link between IT and business performance, (2) as a link intermediated by the business process changes, and (3) as a link dependent on factors with leveraging effect on business performance.



**Figure 1 Framework for literature review regarding the assessment of IT business value (adapted from Dehning and Richardson, 2002)**

Dehning and Richardson (2002) observe that the research on IT business value is dominated by the input-output approach (Link (1)), which examines the correlations between IT and business performance. However, little is known about the impact of IT at process level and if there are any benefits, how they tie to the bottom line. They encourage further examination “inside the black-box” of the relationship IT - business

performance (Link (2)). Future research into this path provides insight into the different mechanisms by which IT creates value in organizations.

Link (3) is developed as a result of recognition that there are additional factors that influence the companies' ability to gain business value from their IT investments. The different studies use slightly ambiguous terms by referring to these factors with leveraging effects, either as "contextual" or "organizational" factors. For example, company size is interpreted in some studies as a contextual factor, whereas in others, as an organizational factor. In addition, in Byrd et al. (2006), strategic alignment is referred to either as a contextual factor, or as an organizational factor, implying that both "contextual" and "organizational" have the same meaning. However, in this thesis the two terms are seen as different aspects of IT investments. The contextual factors are considered to be the defining characteristics of the industry before the first companies implement a new IT strategy (e.g. market uncertainty, IT intensity, industry type). The organizational factors are defined as the organizational changes the companies go through when they invest in IT (e.g. strategic alignment, organizational restructure). However, considering that both contextual and organizational factors are investigated for their leveraging effects on IT business value, they are discussed in the same section of ERP research strands (Link (3)).

The research on ERP systems value is a more specialized literature stream that belongs to the broader research strand on IT business value. This specialized literature stream measures IT investments as IT strategies under the form of ERP systems implementations. In this thesis, the literature review on both IT business value and ERP business value is presented according to the three links displayed in Figure 1. The findings discussed in this section extend beyond the archived studies.

## **2.2. IT Business Value**

### ***2.2.1. Direct relationship between IT and business performance***

The late 1980's and early 1990's studies show negative correlation between IT investments and productivity. According to the resource-based model, this negative correlation would point out that IT is not a valuable resource to the company. These findings are referred to in the literature as the "IT productivity paradox". Although this paradox was initially defined at economy level and some studies carried out the analysis at national and industrial level, most of the researchers focused on the examination of the IT productivity at firm level (Chan, 2000).

Brynjolfsson (1993) starts the discussion on IT productivity by commenting on the source of disappointment with IT:

*"The relationship between information technology (IT) and productivity is widely discussed but little understood. Delivered computing power in the U.S. economy has increased by more than two orders of magnitude since 1970 yet productivity, especially in the service sector, seems to have stagnated."* (p.67)

Therefore, productivity, the fundamental economic measure of IT contribution, is the central dimension of the paradox. Brynjolfsson (1993) suggests four non-exclusive explanations for this productivity paradox:

- The measurement error of inputs and outputs seems to be at the core of this issue. In essence, the inputs measurement refers to how to measure with accuracy the IT stock, labor and other complementary inputs (e.g. software, training). The outputs measurement refers to the difficulty of obtaining the real prices for goods and services for comparing two output levels. This difficulty comes from the necessity to remove both the inflation effects and adjusting the quality improvements.
- The lags caused by extensive learning and adjustment that management and employees need in order to get acquainted with new technologies.
- The mismanagement of information technology is caused by decision makers who do not act in the best interests of the company and build inefficient systems. The result is an increase in the organizational slack, and not the output or the profit.
- Redistribution and dissipation of profits refer to the fact that companies investing in IT benefit privately at the expense of other companies, therefore the net IT benefits are not obvious at industry level. This explanation is for studies on IT business value at industry or country level.

The mismeasurement and lags explanations are considered research, not practice, flaws. The “traditional” measures of the relationship between inputs and outputs do not include “nontraditional sources of value” such as improved quality, variety, customer service, speed and responsiveness (Brynjolfsson, 1993, p.73). Hence, the author suggests a change in the traditional measurements of productivity. Indeed, as discussed in the introduction, in order to be successful, IT implementations should be complemented by business process changes, enabling the companies to run their new processes in new ways, rather than produce more of the same thing. Therefore, it may be that the benefits of the IT use are not reflected entirely in the increase in productivity measures, but for example in the improvement in customer service. Then, due to the lags between learning and fully exploiting IT, lags between costs and benefits may exist in the immediate post IT implementation period, before results on the bottom line are obtained. Brynjolfsson (1993) concludes that “*Researchers must not overlook that fact that our tools are still ‘blunt’... so must researchers be prepared to look beyond conventional productivity measurement techniques.*” (p.76). Nevertheless, the productivity paradox is due to a combination of factors.

The mismanagement of IT shows that IT investments can be imperfectly mobile resources. Thus, according to the resource-based model, this third explanation of IT productivity paradox indicates that there are companies that can be at a competitive disadvantage when using IT compared to other companies that successfully manage their IT resources. Still, this does not explain why the early 1990’s studies do not find any positive link between average IT investments and business performance. Hence,

further research on the business value of IT may need to jointly analyze the productivity paradox explanations.

Hitt and Brynjolfsson (1996) classify the IT effects on business value in three dimensions: the effect of IT on productivity, the effect of IT on business profitability, and the effect of IT on consumer surplus. They find evidence that IT may contribute to increased productivity and consumer surplus, but the effect on firm profitability is slightly negative. These findings may indicate that IT investments can create value in organizations but that value is not captured by the companies which make the investment. A second implication of this paper regards the possibility of gaining competitive advantage based on the investment in IT. The negative impact on profitability may show that, on average, companies invest in IT to keep themselves at the competitive parity. On the other hand, the positive impact on productivity points to the potential to gain competitive advantage in an industry where the cost is the main strategic issue, as long as the competitors cannot imitate the cost reduction strategies. Yet, in companies where the strategic priorities are product position, quality or customer service, focusing on productivity is not enough. Managers need to find innovative ways to use IT in their organization to produce and deliver products and services so that competition cannot duplicate. Thus, the IT spending itself is not the key to the success of IT investments. Instead, business strategy needs to be considered in the IT use so IT can be a source of competitive advantage.

From the vantage point of research, the results obtained by Hitt and Brynjolfsson (1996) point to the need for new econometric models and data. By using a more recent and larger database and several econometric models of neoclassical production theory, Brynjolfsson and Hitt (1996) test the contribution of inputs such as computer capital and information systems labor to output measured in inflation-adjusted firm level revenues. They obtain a significant positive impact of information systems on firm productivity. The gross marginal product for the IT capital averaged 81% for the companies in the sample and was as high as the marginal product for other types of capital investments. The authors conclude that at least in their sample of companies the productivity paradox disappeared by 1991. However, further research on the factors which differentiate between high and low IT performers would increase the understanding of IT business value. For example, identifying the strategies which led to higher IT productivity would be the next step in the research of productivity paradox.

Dehning, Dow & Stratopoulos (2004) investigate whether the productivity paradox claimed until 1991 is explained by organizational slack, resulting from the mismanagement of IT. *“Successful IT implementation processes must not simply overlay new technology on old processes”* (Brynjolfsson, 1993, p.75). Using slack measures previously used in other studies (accounts receivables as a percentage of sales, inventory as a percentage of sales, selling, general and administrative costs as a percentage of sales), the univariate t tests and the analysis of covariance (ANCOVA) confirm the hypothesis that before 1991, IT investments were followed by an increase in the organizational slack, but not after 1991. One explanation is that in the pre-1991 period, IT investments were followed by increased slack to reduce the perceived risks inherent in IT projects. Another explanation is that after 1991, IT became a lever in business process reengineering, streamlining business processes rather than simply supporting the existing ones.

According to Schrage (1997) managers acted irresponsibly in spending “*over half of every dollar*” (p.178) in IT investments and relying on technology to solve the fundamental business problems. Stratopoulos and Dehning (2000) consider the likelihood that part of the productivity paradox is due to the mismanagement of IT investments. Based on a sample of Computerworld Premier100 companies evaluated according to how well their information systems serve their business needs, Stratopoulos and Dehning (2000) use the Wilcoxon signed-rank test to find whether successful users of IT enjoy higher profitability and efficiency relative to less successful users of IT. They find that the companies that utilized IT successfully had higher gross profit margin, operating profit margin, net profit margin, ROA, ROE, ROI and total assets turnover. Yet, the superior financial performance is gained in the first three or four years, after which the competitors develop the ability to imitate the successful stories of IT projects. This study validated Brynjolfsson’s (1993) proposition that mismanagement is another viable explanation for the productivity paradox. Another implication consists of pointing to the potential of IT implementations aligned with the business strategy to reach temporary competitive advantage compared to the IT implementations which are misaligned with the strategy.

Summing up, the mismeasurement of inputs and outputs and the mismanagement of IT investments are tested and validated as explanations for the IT productivity paradox. Stratopoulos and Dehning (2000) change the approach to the measurement of IT investments. Instead of measuring the investment in IT as IT capital expenditure and information systems labor, they focus on how companies manage the IT implementations, i.e. if companies invest in IT to support the business strategies. Other differences in the management of IT implementations come from whether the companies investing in IT accommodate organizational changes (e.g. the decrease of the firm size, new business processes, new skills, etc). For example, the companies included in the sample used by Brynjolfsson and Hitt (1996) performed restructuring and cost-cutting that are believed to explain the realization of the benefits of IT within that sample of companies. Similar studies theorize that a combination of IT expenditure and IT enabled changes, usually referred to as “intangible assets” contribute to the productivity growth and market value (Brynjolfsson, Malone, Gurbaxani & Kambil, 1994; Brynjolfsson and Hitt, 2000).

In conclusion, IT investments are found to contribute to productivity growth. On the other hand, IT investments are not always positively correlated with firm profitability, and when they do, the higher profits last for only a short period of time. Thus, the evidence shows that IT has the capability to create value in organizations, but the value is only temporarily retained within the company. Based on the existing evidence, companies invest in IT to keep themselves on the competitive edge. However, managing IT investments requires mastering organizational, technical and political factors that are needed to facilitate changes in organizational structures and business processes and that may create the sources of competitive advantage.

### 2.2.2. *Relationships between IT and business performance intermediated by business process changes*

The papers mentioned in the previous section examined the direct link between IT and business performance, using firm level output measures of productivity and profitability. However one of the main conclusions was that the capability of companies to fully exploit the IT potential relies partly on reengineering the existing business processes. Thus, in order to increase the understanding of the ways in which IT business value is created, a different research strand takes a process-based approach to assessing how IT implementations create value in organizations (Barua, Kriebel & Mukhopadhyay, 1995; Mooney et al., 1996; Tallon, Kraemer & Gurbaxani, 2000; Beretta, 2002; Byrd and Davidson, 2006).

Barua et al. (1995) is one of the few studies that investigate empirically the intermediate contributions of IT at process level. In addition, using the microeconomics production function, they trace the impact of the lower levels variables to high-level performance measures such as ROA and market share. They show that IT related factors had a significant positive effect at lower levels, where IT investments are implemented (e.g. capacity utilization, inventory turnover, inferior quality, relative price). Thus, this study shows why certain impacts of IT on business performance occur.

Mooney et al.'s (1996) framework is motivated by the scarcity of studies like Barua et al. (1995). The framework is based on the premise that IT impacts both operational and management processes. Here, it is believed that IT creates value in the organization through three complementary effects that IT has on these two types of processes: automational, informational and transformational effects. The automational effects emerge from the role of IT as a capital asset substituted for labor and the resulting impacts consist of productivity improvements, labor reductions, and cost reductions. The informational effects are mainly driven from the IT impact on management processes, and refer to the IT capability to collect, store, process and distribute information. The transformational effects are generated from the combined IT impact on both operation and management processes, and refer to the IT ability to enable process innovation and transformation. This type of effects result in improved cycle times, responsiveness, new products and services. Table 1 contains a set of measures successfully used in a previous multi-firm study of IT business value. Some of these measures represent intangible benefits of IT, which the productivity measurement techniques of traditional IT business value studies do not capture in the economic output brought about by IT (e.g. reliability, quality, innovation, responsiveness, competitiveness).

**Table 1 Framework for understanding potential IT impacts on business value**

	Dimensions of IT Business Value		
Business Processes	Automational	Informational	Transformational
Operational	Labour costs Reliability Throughput Inventory costs Efficiency	Utilization Wastage Operational flexibility Responsiveness Quality	Product and service innovation Cycle times Customer relationships
Management	Administrative	Effectiveness	Competitive flexibility

Business Processes	Dimensions of IT Business Value		
	Automational	Informational	Transformational
	expense Control Reporting Routinization	Decision quality Resource usage Empowerment Creativity	Competitive capability Organizational form

(Mooney et al., 1996, p.78)

In addition, the Mooney et al. (1996) framework is not explicit about how one could measure the actual business value of a specific IT effect on a specific process (e.g. the informational effect on sales processes). This can be done based on the objectives for which IT is implemented within a firm. Instead, the framework specifies the object of measurement, providing a clearer picture of the link between the level at which IT is deployed, the level at which the IT impact takes place, and the level at which the impact is measured. In other words, this process-oriented framework points to the sources of IT business value within organizations.

Overall, the process-oriented approach underlines the importance of successfully using IT applications at operational level before developing insights into how to use IT for the strategic goals of the company (Barua et al., 1995; Beretta, 2002; Byrd and Davidson, 2006).

### ***2.2.3. Factors with leveraging effects on the business performance of IT***

There is no longer the question whether IT investments impact the business performance. More research is needed to know why, when, where and how much IT investments provide business value (Chan, 2000; Tillquist and Rodgers, 2005).

Studies of the direct relationship between IT and business performance concluded that higher levels of IT do not necessarily yield better business performance than lower levels of IT investments. Dehning and Richardsson (2002) identify contextual factors (e.g. strategic alignment, size, IT intensity, financial health, and industry) that when included in the analysis of the link between the IT invested amounts and business performance, higher positive correlations are expected.

The most investigated leveraging factor of the impact of IT on business performance is the strategic alignment construct (Chan, Huff, Barclay & Copeland, 1997; Palmer and Markus, 2000; Sabherwal and Chan, 2001). The purpose is to assess whether the strategic use of IT delivers enhanced business performance. Chan et al. (1997) analyze strategic alignment from the perspective of the realized IT and business strategies. The realized IT and business strategies are evident in the IT implementations in companies. The authors did not consider the verbalized or documented strategies, due to the reason that these strategies may not be actually carried out. Innovation, return measures and market growth are the different measures of business performance. The findings show a strong association between strategic alignment and innovation (e.g. developments in processes, products and service), and a weak link to ROA, PM and market growth. Overall, these findings support the proposal that strategic alignment is positively linked to business performance.

Palmer and Markus (2000) test the realized strategic alignment as the correlation between the business strategy and the IT strategy of a firm. However, strategic alignment is not found to be significantly associated with business performance measured as net income/sales, sales growth, and sales per employee. This leads to the conclusion that researchers need to refine their theories about what makes IT investments pay off. Sabherwal and Chan (2001) show that the link between IT strategic alignment and firm performance depends on the types of business strategy. The study uses the same perceptual measures of business performance as Chan et al. (1997), involving dimensions of innovation, profitability, market growth and business reputation. Using Miles and Snow's classification of business strategies as Defender, Analyzer, and Prospector, Sabherwal and Chan (2001) find that for the sample as a whole, and especially for Prospectors and Analyzers, there is a significant correlation between strategic alignment and business performance. However, this association is not observed for Defenders. Further research is needed to investigate the lack of support for the relationship between IT strategic alignment and business performance in the case of companies that have a Defenders business strategy. Another explanation for the results may reside in the developing stage of the literature on IT strategic alignment. Hence clearer results may be reached if more investigation is carried out related to the processes by which alignment is accomplished.

Byrd et al. (2006) examine the strategic alignment from four perspectives: on one hand, two perspectives on the alignment of the planning process of the business and IT strategy (coordination and integration), and on the other hand, two perspectives on the realized alignment of business and IT strategy (matching and moderating). They test whether the combined impact of strategic alignment and IT investment on financial performance is stronger or weaker than the individual impact of either strategic alignment or IT investment on financial performance. The findings suggest that the coordination of the planning process, and the matching and the moderating factors of the realized strategic alignment have a leveraging effect on the IT business value. However, the integration of the planning process of the strategic alignment does not show any leveraging effect on the relationship between IT investment (measured as IT expenditure per employee) and business performance (measured as profit per employee). These findings have three implications: (1) that the integration factor of the strategic alignment process does not yield positive results; (2) that firms with coordination views on strategic alignment can make further IT investments that can have substantial leveraging effects and (3) that firms with matching and moderating views on alignment can increase their revenues without further investments in IT. In essence, in the small and medium size manufacturing firms, strategic alignment is proved to be an important element for the success of IT management, as a moderator between IT investments and firm performance.

Other studies attempt to explain the difference in the performance of IT investments on account of contextual factors surrounding the IT investments (e.g. market conditions, environmental uncertainty, information intensity, cultural factors, legal environment). Kearns and Lederer (2004) show that both environmental uncertainty and information intensity are positively associated with the business dependence on IT, with the alignment of the IT plan with the business plan, and with the use of IT for competitive advantage. Companies, with high information content in value-chain activities and



under market pressure for product diversity, rely more on IT to support the core activities and improve the business level performance. These findings underpin the importance of IT focus in organizations operating in industries with high information intensity and uncertain environment.

Kettinger, Grover, Guha and Segars (1994) examine the influence of environmental factors and internal infrastructure factors on the company's ability to generate performance gains from IT investments. The established technological base and the substantial capital available to the company investing in IT are found to lead to IT enabled competitive advantage. The implication for practitioners is that when they assess the availability of emerging IT in developing the strategic IT plans, they must consider the competitors' resources in addition to the existing firm resources. In other words, the industry competitiveness becomes an environment factor with leveraging effect on IT business value.

Chatterjee, Pacini and Sambamurthy (2002) analyze a particular internal infrastructure factor, the IT infrastructure, which refers to the IT platform that supports the development of different business applications. The potential of investments in IT infrastructure to contribute to the company value is examined through the reaction of market investors to the announcements of investments in IT infrastructure. Stock market investors provide a complementary perspective on the value-creation potential of IT investments through their reactions to specific IT investments made by companies. The findings show significant abnormal stock return and volume trading associated with announcements of IT infrastructure investments. From a resource-based view of the company, this implies that IT infrastructure meets all the characteristics to become a source of competitive advantage.

The leveraging effect of company size was studied by Hayes, Hunton & Reck (2000) in the context of the impact of IT outsourcing announcements on the market-value of the contract-granting companies. The findings show significant market value gains for smaller and service companies compared to bigger and non-service companies. Hayes et al.'s. (2000) findings are confirmed by Im, Dow and Grover (2001) who indicate that the IT investments of smaller companies increased the market value of those companies. The fact that investors react differently to IT investment announcements coming from small or large companies may show the existence of information asymmetry in the capital market for smaller companies and service companies. The predisclosure information in large companies may decrease the impact of the formal announcement. According to Brynjolfsson (1994), an alternative explanation for the fact that IT investments are more beneficial for smaller companies may be that they provide better incentives for exploiting IT compared to larger companies. Im et al. (2001) find that both size and industry effects become stronger over time. This implies that for smaller companies and financial services companies, the IT productivity paradox is alleviated. The use of stock market valuation as an alternative measure of the business performance provides a richer understanding of IT impacts on organizational performance.

Summing up the results of this section, the IT impact on business performance appears to be contingent on various organizational and contextual factors. Therefore, the identification of factors that determine the success of IT investments could represent fruitful areas of inquiry that would reveal enablers of IT business value in different

competitive environments (Brynjolfsson and Hitt, 1998; Dehning and Richardson, 2002).

### **2.3. ERP systems business value**

#### ***2.3.1. ERP implementations and business performance***

The focus of this thesis is on the business value of Enterprise Resource Planning systems (ERP), which is a more specialized literature on IT business value. This research strand fits within the Dehning and Richardson (2002) framework due to two reasons (see Figure 1, p. 7): first, the way of measuring IT investment fits in with one of the three ways mentioned in the framework (IT strategies under the form of ERP implementations); second, the methodology of analyzing the relationship between ERP systems and business performance is similar to the one used to analyze the relationship between IT investments and business performance. In the literature on ERP business value, the contribution of ERP implementations to firm profitability is reflected in positive, negative or nonexistent relationships (Poston and Grabski, 2001; Hunton, Lippincott & Recj, 2003; Nicolaou, 2004; Nicolaou and Bhattacharya, 2006). As the research field develops, it becomes clear that the business value of ERP should be analyzed taking into consideration the different stages of ERP implementation.

Among one of the first studies, Poston and Grabski (2001) use a sample of 50 companies that implemented SAP, Oracle, PeopleSoft or Baan from 1993 to 1997, and observe a significant decrease in the cost of goods sold as a percentage of revenue in the third year after implementation, whereas during the first two post-implementation years, there is no significant decrease in the financial ratio. There are no significant changes in the ratio of selling, general, and administrative costs to revenues or residual income. However, the number of employees as a percentage of revenue significantly decreased all three years after ERP implementation. These results confirm that ERP implementations are complex, and even when the system goes live there may be additional implementation costs with fine-tuning the installations, consulting and system staff to maintain the ERP system. All these would actually increase the proportion of costs to revenue in the first post-implementation years. Then, another explanation for these findings may reside in Brynjolfsson's (1993) lag explanation of IT productivity paradox. It may be that after implementation, the performance gains created by the ERP system are shadowed by the inefficiencies caused by employees when learning the new technology.

The mixed results obtained by Poston and Grabski (2001) stress the need for larger data samples and more developed business performance measurements and models. Using the data sample of 1117 companies implementing ERP, Hitt, Wu & Zhou (2002) analyze if SAP implementations impact the business performance by looking at the performance development before, during and after implementation. Productivity, stock market valuation and profitability are the three business performance measures used in their study. They find that the companies implementing ERP have higher financial performance than non-implementers in terms of sales, profit margins, ROA, inventory turnover, asset utilization and accounts receivable turnover. This shows that companies

implementing ERP are better at generating income per unit of input and manage the inventories and customer payments more efficiently.

Most of the performance gains occur during the implementation period, but in the immediate period after implementation, the productivity and the profitability decrease. This may indicate that many ERP modules are already implemented, operational and efficient before management considers the project to be completed. However, performance reverts to pre-implementation levels, which may be due to the fact that the gains in performance are scattered by the long-term maintenance costs. This explanation is supported by the fact that performance ratios (e.g. accounts receivable turnover), which are not affected by costs, continue to rise. Alternative theoretical explanations for the temporary dip in performance are the inadequate training of the end-users to help them understand the new business processes (Nicolaou, 2004) and ineffective change management (Motwani, Mirchandani, Madan & Gunasekaran, 2002).

The third measure of business performance in Hitt et al. (2002) is Tobin's  $q$ . The financial markets seem to reward the ERP implementers with higher market valuations, both during and after implementation, which reinforces the assumption of both short-term and long-term benefits of ERP implementations. In addition, the analysis of the impact of the implementation scale on business performance finds an optimal level of functional integration in ERP systems. The financial benefits decrease beyond this optimal level. This suggests that full-scale ERP implementations engender diseconomies of scale. All in all, Hitt et al. (2002) show that on average, ERP implementations are productive investments, which provide benefits at different stages in an ERP project. They also show that the benefits of ERP may be influenced by the synergies between different modules of the entire system, which entails that part of the business value of ERP systems resides in the scale of implementation.

Hitt et al. (2002) imply that ERP implementations have the potential to lead to both short-term and long-term benefits. Based on a sample of 63 firms implementing ERP matched to 63 peer firms that did not implement ERP, Hunton et al. (2003) show that in the third year after implementation, the ROA, ROI and ATO are significantly better for the companies implementing ERP compared to non-implementers. The findings in Hunton et al. (2003) are consistent with Poston and Grabski's (2001) statement that the realized benefits of ERP become visible when the post-implementation frame is extended to a time horizon of 4 or 5 years. Yet, in Hitt et al. (2002) the improvements in ROA and ATO are significant during the implementation stage. Additional findings in Hunton et al. (2003) reveal that the profitability of non-implementers declines in time, whereas the profitability of implementers remains at an approximately constant level during the first three years after implementation. The findings suggest that ERP implementations help companies stay on the competitive edge in the first years of post-implementation. This confirms that investments in ERP represent that cost of doing business. For clarification of the long-term ERP benefits, the profitability of ERP implementers and non-implementers should be compared during longer post-implementation time.

Nicolaou (2004) extended the analysis frame of ERP impact on business performance to four years and tested for differential profitability across matched pairs of ERP and non-ERP implementers. The differential profitability measures the long-term performance of

companies implementing ERP relative to non-implementers. The companies implementing ERP turned out to have a higher ROI two years after the system goes live in comparison with ROI level before implementation. ROA was significantly higher in the fourth post-implementation year. However, both ROI and ROA were lower in the first year of go-live stage. These findings are in line with the Hitt et al. (2002) results where the profitability of the companies implementing ERP sinks in the first year after implementation. Yet, some of the findings contradict Hunton et al. (2003), which show a constant level of financial performance in the three post-implementation years for the companies implementing ERP.

In conclusion, the studies of the direct relationship between ERP systems and business performance agree on the fact that ERP implementations enable companies to improve their productivity and profitability. There are mixed results related to the time frame when the improvements in business performance become visible (e.g., be it during the implementation project, or in the 2nd or 3rd year of go live stage) (Hitt et al., 2002; Hunton et al., 2003; Nicolaou, 2004). These studies are confronted with the problem of determining the ERP business value due to the existence of time lags caused by the learning and adjustment that employees need to get acquainted with the new ERP system. This is why future research of the long-term productivity effects would increase the understanding of the time lags between costs incurred and benefits received.

### ***2.3.2. Intermediate benefits of ERP systems***

The findings presented in the previous section do not show why ERP systems enable companies to improve their efficiency and profitability ratios. ERP systems provide the business infrastructure and implementing an ERP system is not an issue of changing software, but an issue of transforming business processes. Hence the examination of how ERP systems affect the organization at intermediate process levels brings insight into the matter. To this end, Chand et al. (2005) suggest a balanced-scorecard based framework to assess the organizational benefits of ERP systems. The benefits of ERP are evaluated not only in financial terms (e.g., higher revenues and lower costs), but also in terms of process level performance (e.g., improved cycle times), customer value (e.g., improved customer service), and organizational learning value (e.g., better understanding of business, creativity). In addition, the benefits of ERP are analyzed contingent on the three effects that ERP systems have at firm level: automate, informate or transformate effects. Thus, a twelve cells framework results. Each cell contains a set of financial and non-financial success measures of ERP systems. The combination of non-financial measures (e.g. customer satisfaction, internal processes, ability to innovate and learn) with financial measures offers a deeper analysis of the sources of benefits of ERP systems and the future impact on the bottom line.

In Chand et al.'s (2005) view, companies usually start ERP implementation with the intention to automate the business processes. At this level, operational benefits of ERP are identified based on specific goals within each of the four balanced scorecard perspectives: to improve process efficiency, meet current needs of customers more efficiently, reduce costs and increase productivity (see Table 2, p.19-20). When the ERP system is in operational use, companies realize that it can be used to provide information to all the parties across the value-chain. At this informate level, tactical

benefits of ERP may be evaluated contingent on the specific goals of each of the four dimensions of the balanced scorecard: to improve tactical decision-making, identify and fulfill customer needs proactively, increase revenues, and workers becoming more effective decision makers. In order to keep up with the highly competitive markets, companies need to reengineer and transform themselves. At this transformate level, strategic benefits of ERP may be assessed depending on the goals within each of the balanced scorecard dimensions: to adapt to radical environment changes, meet new customer needs or new needs of customers, and improve market value.

**Table 2 ERP scorecard**

ERP benefits	Process	Customer	Finance	Innovation
Automate (Operational benefits )	Goal: Improve process efficiency  Success measures: error reductions, faster processing, consistent data, increase in throughput.	Goal: Meet current needs of customers more efficiently  Success measures: improved response time, reduced customer complaints, reduced errors.	Goal: Reduce costs  Success measures: reduced inventory- carrying cost, lower labor cost.	Goal: Increase productivity  Success measures: power user involvement in user training for operational tasks.
Informate (Tactical benefits)	Goal: Improve tactical decision making  Success measures: improved work scheduling, improved work assignment, improved access to information, improved quality management, improved control.	Goal: Identify and meet customer needs proactively  Success measure: better customer expectation setting, improved customer satisfaction, improved scheduling and delivery.	Goal: Increase Revenue  Success measures: better forecasting, increase market share.	Goal: Make workers more effective decision makers  Success measures: training for decision making skills, worker empowerment for taking actions.
Transformate (Strategic benefits)	Goal: Adapt to radical environment	Goal: Meet new customer	Goal: Improve market value	Goal: Absorb radical changes  Success measures: change

ERP benefits	Process	Customer	Finance	Innovation
	changes  Success measures: technology changes, competition changes.	needs or new needs of customers  Success measures: increased customer base, partnership with customer.	Success measures: growth capitalization, new markets.	management processes, breath and broader horizon.

(Chand et al., 2005, p.568)

An important conclusion is that the goals for implementing the enterprise systems must be considered in the assessment of the impact of ERP systems on business performance. The operational, tactical and strategic benefits of ERP impact the bottom line performance in different ways. Chand et al.'s (2005) framework captures these different ways of impact using the balanced-scorecard lens. However, this framework does not highlight the links between the benefits of ERP that would show how ERP systems create value within organizations. Therefore, using Chand's et al. (2005) framework as a lens for the identification of the benefits of ERP systems, the second paper in this thesis puts forward a set of interrelationships between motivations for implementing ERP systems, the ERP project management and the different types of benefits of ERP generated at the process level, customer level, financial level and learning and growth level (Velcu, 2007a). The third paper in this thesis explores the importance of a new factor (alignment of business and ERP strategies) for the above-mentioned interrelationships. The result of the exploration is a conceptual model, which shows how ERP systems can create value within organizations (Velcu, 2007b).

### ***2.3.3. Factors with leveraging effects on the business performance of ERPs***

The mixed results regarding the direct link between ERP systems and business performance should be interpreted with consideration to the fact that all these results report average performance measures across a spread range of companies implementing ERP (Link (1), Figure 1, p.7). The studies of this direct link do not consider the various experiences companies have with their ERP projects and the organizational and contextual factors that may affect both the cost of implementation and the benefits obtained. A distinct research strand discusses differences in the characteristics of the ERP systems selection process, implementation methods, implementation effort, and critical success factors of implementation (Bingi, Sharma & Godla, 1999; Bernroider and Koch, 2001; Baki and Cakar, 2005; Ehie and Madsen, 2005; Motwani, Subramanian & Gopalakrishna, 2005). However, there is a dearth of papers that empirically analyze the influence of the characteristics of ERP projects on business performance. This type of investigation would add to the understanding of additional factors that influence the ability of companies to use ERP systems to obtain productivity gains and turn them into profit.

Hunton et al. (2003) examine the combined effect of two organizational factors - firm size and financial health - on the business performance of companies implementing ERP. Large and unhealthy implementers are found to have higher ROI than large and healthy adopters. The large and unhealthy companies may have more room for potential efficiency and profit gains. The results also show that small and healthy companies implementing ERP show better performance in terms of ROA, ROI and ROS than small and unhealthy ERP implementers. The small and healthy firms have the possibility to obtain the resources necessary for the full completion of the implementation, whereas small and unhealthy firms may have limited resources that force them into partial implementations. In conclusion, this study shows that the organizational conditions at the outset of the ERP implementation project should be controlled for when studying the relationship between ERP investments and profitability.

Nicolaou (2004) examines the influence of ERP implementation characteristics on the firm's ability to use ERP to improve the business performance two years after continued use of ERP. The selection of an ERP package coming from a larger vendor, having a technological-led objective, and the implementation of specific modules enable higher financial returns from ERP implementations relative to the firms that follow a different implementation strategy. Thus, the consideration of implementation factors can help explain a company's ability to improve its operational performance in the long run. The study does not exhaust the list of implementation factors and the possible relationships among the investigated factors.

ERP systems have their own lifecycle in organizations. As most of the companies have an ERP system in place, the focus moves from the implementation project issues to the utilization and development of the implemented system (Rikhardsson and Kraemmergaard, 2006). Accordingly, researchers of ERP business value turn the attention towards the effects of the continuous improvements to ERP systems on the benefits realized from ERP use.

Nicolaou and Bhattacharya (2006) empirically examine the impact of ERP revisions (e.g. enhancements, upgrades, abandons and switches) on business performance. Enhancements to the system are the modular additions to the system or upgrades. The system abandons are the switches to another ERP vendor or complete abandon of the ERP project. Additionally, the study examines the effect of the timing of system revisions on the differential performance of the companies implementing ERP. The sample companies are divided into two groups:

- companies implementing ERP that make early changes to the system, in the first year after the completion of the implementation project;
- companies implementing ERP that make later changes to the system, at an interval of 2 years or more after the completion of the implementation project.

In general, the changes to the ERP system made in the post-implementation period are found to significantly improve the financial performance of the companies. Furthermore, in the fourth post-implementation year, the companies that embark on an

early enhancement have higher differential performance results than their non-ERP matching companies. Late enhancements and early and late abandons are shown to deteriorate the differential performance of ERP implementers.

Summing up, ERP implementations may increase the firm's ability to generate long-term superior business performance contingent on factors such as: the organizational conditions at the outset of the ERP implementation project (Hunton et al., 2003), the characteristics of ERP projects (Nicolaou, 2004), the continuous management of the ERP post-implementation process (Rikhardsson and Kraemmergaard, 2006), and the changes to the system in the post-implementation stage (Nicolaou and Bhattacharya, 2006). However, the extant research on ERP business value did not examine the leveraging effect of the success of ERP projects on business performance. The first paper in this thesis researches this question (Velcu, 2005). This examination would help understanding if companies that manage their ERP projects successfully obtain at least temporary competitive advantage compared to companies which have less successful implementation projects.

ERP systems become an organizational actor in the implementing companies. Hence, future research on the business value of ERP systems should include in the analysis the complementary effects on the bottom line of organizational changes facilitated by ERP implementations at different stages (e.g. the ability of the ERP system to integrate the organizational activities across the entire value chain and the use of the ERP system in combination with latest internet technologies) (Davenport and Brooks, 2004; Davenport, Harris & Cantrell, 2004; Rikhardsson and Kraemmergaard, 2006). The potential of ERP systems to enable companies to reach competitive advantage may reside in the unique combination of the different dimensions of the management of ERP implementations throughout their lifecycle.



### **3 SUMMARY OF THE THREE RESEARCH PAPERS**

#### **3.1. Research paper 1: Impact of the Quality of ERP Implementations on Business Value**

The body of research which developed and tested models of the relation between IT investments and business profitability showed positive, negative or non-existent relationships between the input and output variables (Dehning and Richardsson, 2002; Dedrick et al., 2003.). This research paper is built upon the research stream that strives to understand the factors with leveraging effect on the financial returns of IT investments. One of these potential factors, the successful management of IT projects, is investigated by Stratopoulos and Dehning (2000) as a key to the IT productivity paradox issue of the early 1990's studies. The success of implementation was not examined in the research on ERP business value then, though it would be worthy of investigation today.

Unlike other types of IT investments that are focused on functional IT infrastructure, the design of ERP systems takes the process-based view. ERP systems are built to solve the fragmentation of information in organizations. When implemented, they have integration and streamlining effects on business processes. Overall, ERP systems enable the introduction of best business practices that meet the companies' needs and are expected to lead to enhanced productivity (Chung and Snyder, 2000; Al-Mashari, 2003). However, before implementing an ERP system, managers need to understand the business implications of the system and make sure that the logic of the system does not impose its own logic on the company's strategy and culture (Davenport, 1998). If there are contradictions between the system logic and the business logic, either the ERP implementation fails or the ERP system destroys the sources of competitive advantage.

ERP projects are complex and costly (Markus, Axline, Petrie & Tanis, 2000; Mabert, Soni & Venkataramanan, 2001; Umble, Haft & Umble, 2003). Companies have technological difficulties in integrating the ERP software with the hardware, operating systems, and database management systems. Then, additional complexity comes from the substantial organizational changes that result from the system implementation. These changes require additional expenses with consultant fees, training of system users, and accommodation of structural changes. Hence, companies that manage their implementation projects with lower costs and less time and consideration for the business implications of the system, may have a potential source of competitive advantage in the ERP software, compared to the companies with more troubled ERP projects.

The main objective of this paper is to investigate whether the successful management of ERP implementations is correlated with the way the business performance of the company develops after the completion of the implementation project. To this end, based on a sample of 43 companies implementing ERP between 1997 and 2001, the financial performance trend of successful and less successful companies implementing ERP is compared over the first three years following the implementation.

The success of ERP implementations is discussed from two perspectives: (1) the project perspective, which measures the success of an ERP implementation in terms of time and costs committed to the endeavor, and (2) the operational perspective which measures the success in terms of perceived system functionality. Additional tests show a positive correlation between the measures of project perspective and the measures of operational perspective (Velcu, 2004). However, the system functionality is the measure further used in this paper because it is considered a longer term measure of success, which reflects whether the system meets the business needs. It refers to three aspects of the system use: the functionality of each implemented module, the ease of use of the system by end users, and the attainment of the business case. The timeliness of the project is considered a more elusive measure of success, since there may be other reasons why an ERP project is implemented faster (e.g. managers may try to keep pace with the competitors that have already implemented an ERP system, managers may struggle with the previous incompatible IS and they may view the fast ERP implementation as a wise business move).

Considering the small sample size, the non-parametric Mann-Whitney U test is applied to check the differences in the mean difference between the performance in the post-implementation period and the performance in the pre-implementation period of successful and less successful companies implementing ERP. The findings indicate no significant difference in the change in ROA and ROI of the two groups of companies. However, further disaggregating ROA and ROI, successful ERP adopters prove to have significantly better efficiency benefits in terms of asset turnover and capital turnover than the less successful ERP adopters in the first two years after implementation. The profit margin does not differ significantly between the two groups of companies.

The second aim of the study is to examine the relationship between ERP implementation effort and ERP implementation success measured from the system functionality perspective. The paper redefines the concept of ERP implementation effort. The number of modules implemented and the actual implementation expenses scaled to total assets are proxies for implementation effort. One assumption is that the actual implementation expenses include the time component of the implementation as well. The other underlying assumption is that when companies commit more money to their ERP projects, the project manager disposes of more resources to work on the technical requirements of the modules, to train the people in its use, and to follow up the business implications of the system. However, the findings show no significant contribution of implementation effort to the success of ERP implementation.

The main contribution of this paper consists of showing that the immediate benefits of companies successfully implementing ERP systems are operational. In the first two years of post-implementation, the successful companies can increase the sales by better managing their assets compared to the less successful companies implementing ERP. However, by the third year, these efficiency benefits are lost, which may point to the fact that the less successful companies manage to recover from a more demanding implementation and they learn how to efficiently use the system. These findings imply that the less successful ERP implementations may bring competitive disadvantage for a short period of time (two years), after which the companies reach the competitive parity due to enhancements in ERP system use.

For the sample as a whole, there is an observed general trend of decreased post-implementation performance. However, the t-tests of the change in performance in the first three post-implementation years show no significant worsening of performance. Therefore, since this decreasing trend is not statistically supported, no conclusive interpretation can be made regarding whether companies implementing ERP show worse performance in the first three post-implementation years than before implementation. The findings of this paper may also be applied to large companies that have partial ERP implementations, since the statistical tests performed for the two hypotheses of this paper took into consideration the company size factor.

### **3.2. Research paper 2: Exploring the effects of ERP systems on organizational performance – Evidence from Finnish companies**

Research paper 1 shows that successful ERP implementations lead to efficiency benefits during the first two years of post-implementation stage compared to less successful implementations. However, it does not provide an answer to why these efficiency benefits are obtained. According to Dehning and Richardson's (2002) framework, the changes in business processes, which complement the new IT investments in companies, may provide the answers to the reasons behind the IT impact on business performance. In addition, Arnold (2006) suggests the triangulation method that combines case studies research, surveys and cross sectional studies in order to understand what other benefits result from the internal process changes enabled by new IT investments at inter-organizational level.

ERP systems are viewed as a driving technology of changes in business process within organizations (Al-Mashari, 2003). This thesis adopts the interacting feedback loops perspective on business processes, which is proposed in Melao and Pidd's (2000) conceptual framework. According to this view, a business process constitutes a set of interactions between policies and sub-systems - people, tasks, organizational structure, and technology - with the goal to meet certain business objectives (Laguna and Marklund, 2005). The feedback loop view is considered a more comprehensive view as it takes into consideration the human action on business processes. In addition, this way of describing business processes is suited for cases when it is difficult to quantify the process of re-engineering.

ERP systems are designed based on best practices, which mean that the companies implementing the system need to accommodate changes in their business processes and IT infrastructure. However, the major challenge with ERP implementations is to keep the balance between the ERP-enabled standardization and the flexibility of doing business. This balance should be considered at the ERP package selection stage, based on the motivations for implementing the system. Depending on whether the companies view the ERP project as just a technological initiative or as an opportunity to rethink the company's strategy and organization, the benefits resulting from implementing the system may differ.

The aim of research paper 2 is to explore the business process changes that occur in companies implementing ERP, and the influence of these internal changes on business performance. The changes in business processes refer to ERP-enabled changes in how a

task flows through the process, in what activities are performed on it, and in what people are involved in, at two levels: operational level and management level, according to Davenport's (1993) typology of business processes. Therefore, the paper aims at observing changes in processes associated with primary business operations and processes associated with information handling, coordination and control required to ensure the efficiency and effectiveness of primary operations. Fourteen semi-structured interviews were held in mid-sized Finnish companies at different stages of their ERP lifecycle: project phase, shakedown phase, or onward and upward phase (Markus et al., 2000). Chand et al's. (2005) ERP scorecard framework was applied to assess the benefits of ERP in the shakedown and onward and upward phases.

The findings of this qualitative study point to similarities and differences in the perceived benefits of ERP depending on whether the companies had a business-led or a technologically-led motivation for implementation. The researcher acknowledges the various organizational and political factors that determine the implementation project stakeholder's approval of the ERP implementation plan. However, in this paper, the interviewees were members with key roles in implementation (e.g. project managers and super users) and their perception on the initial motivation which pushed the project forward was accepted as being the motivation for the entire company.

Both companies having business-led and technologically-led motivation reported business process changes in terms of "reassignment of financial management of business cases". Then, companies having business-led motivation perceived "economies of scale" as an internal efficiency benefit, and "lower headcount costs" and "lower selling, general and administrative costs" as financial benefits. This may imply that these companies focus on observing any decreases in the average costs of each increase in input unit. On the other hand, companies having technologically-led motivation perceived "improved service time in accounting tasks" as an internal efficiency benefit, "faster response to business change" as customer benefit, and "other improved efficiencies" as financial benefits. This finding may imply that companies with technologically-led motivation focus more on benefits coming from the fit of the system with the organizational processes.

Most of the interviewees reported learning and growth benefits in terms of integration effects: "... *we have the system that helps you see what the business processes are and how they link to each other.*" (key user, Company 4). However, no links were perceived to other types of benefits. One reason for this may be that the respondents did not assign importance to the learning and growth aspect of ERP systems, their focus being on meeting the process, financial and customer needs of the company.

In conclusion, this paper shows that the ERP scorecard offers a systematic perspective on the analysis of the ERP effects on business performance. In addition, the use of a multiple case study provides a new insight into the interrelationships between the motivations for ERP implementations and the perceived benefits of ERP at organizational level. This new insight is a reminder of the importance of continued monitoring of ERP systems throughout their lifecycle in order to leverage the benefits obtained from using the systems.

### **3.3. Research paper 3: A model of organizational and implementation factors that enable the benefits of ERP systems**

Researchers on IT business value show that IT investments pay off. But, in order to understand why some companies investing in IT are better performers than others, researchers turned their attention towards various organizational factors that may have a leveraging effect on the relationship between IT and business performance: IT strategy (Brynjolfsson and Hitt, 1996), strategic alignment of business and IT strategy (Byrd et al. 2006), and management of implementation projects - motivations for implementation, organizational adaptation, package adaptation (Stratopoulos and Dehning, 2000; Somers and Nelson, 2003).

ERP systems are the most developed form of IT corporate use and their main characteristic is the integration of business processes and IT technologies into one system. The companies that exploit ERP may gain competitive advantage by successfully aligning their ERP to the business strategies and successfully managing the ERP at the implementation and utilization stages (Beard and Sumner, 2004). However, extant research does not empirically test the role of strategic alignment for the successful management of ERP systems. This paper investigates this issue and further explores the links between ERP projects management, the underlying process changes, and their impact on business performance.

Based on a sample of 88 Nordic companies implementing ERP, the data analysis shows that there is a positive association between strategic alignment and the successful management of ERP projects, measured in time and money committed to the project. This suggests that in order to make an accurate estimate of the time and expenses involved in the project, the project management needs to be aware of the business needs that the new ERP system will support.

Furthermore, the data analysis points to a significant positive relation between the success of ERP projects, the real-time and easy follow-up of the business, and internal efficiency benefits (e.g. automation of cost control of operations, improvement of accuracy of sales data and accounts receivables management). This implies that successful ERP projects lead to changes in processes, which increase the internal efficiency when the system starts to be used.

Last but not least, there is a significant interrelationship between the benefits of ERP obtained from the automation of business processes and the use of the system to improve the decision-making in organizations. The internal efficiency benefits are significantly positively associated with the customer benefits (e.g. more accurate customer invoices, focus on customer value-added activities) and the financial benefits (e.g. lower selling, general and administrative costs, lower headcount costs).

This paper contributes to the field of ERP business value by pointing out a pattern that illustrates the way ERP systems may create value in organizations. In essence, strategic alignment and business process changes prove to be significant factors enabling the realization of benefits of ERP. In addition, these two key variables need to be coordinated with the management of the ERP projects. Thus, this paper reinforces the findings in Law and Ngai (2007), which show that the strategic intent to use ERP is

closely related to the success of ERP (measured by user satisfaction), the business process improvement and business performance (measured by profitability, sales growth, expansion of market share, and customer satisfaction). Considering the integrative role of ERP systems in organizations and rapid changes in business, the ERP business value would be considerably enriched by further investigating the value implications of the dynamics between ERP systems operations and business strategy changes.

## 4 CONTRIBUTION

The focus of this thesis is on ERP systems implementations. The aim is to identify a mechanism that shows how ERP system implementations can create value in organizations. The impact of ERP implementations on business performance represents a challenging research field due to the difficulties in applying quantifiable measures for some types of benefits resulting from the system implementation (e.g., informational benefits such as improved work assignment, improved access to information, improved quality management, better forecasting, and more effective decision-making).

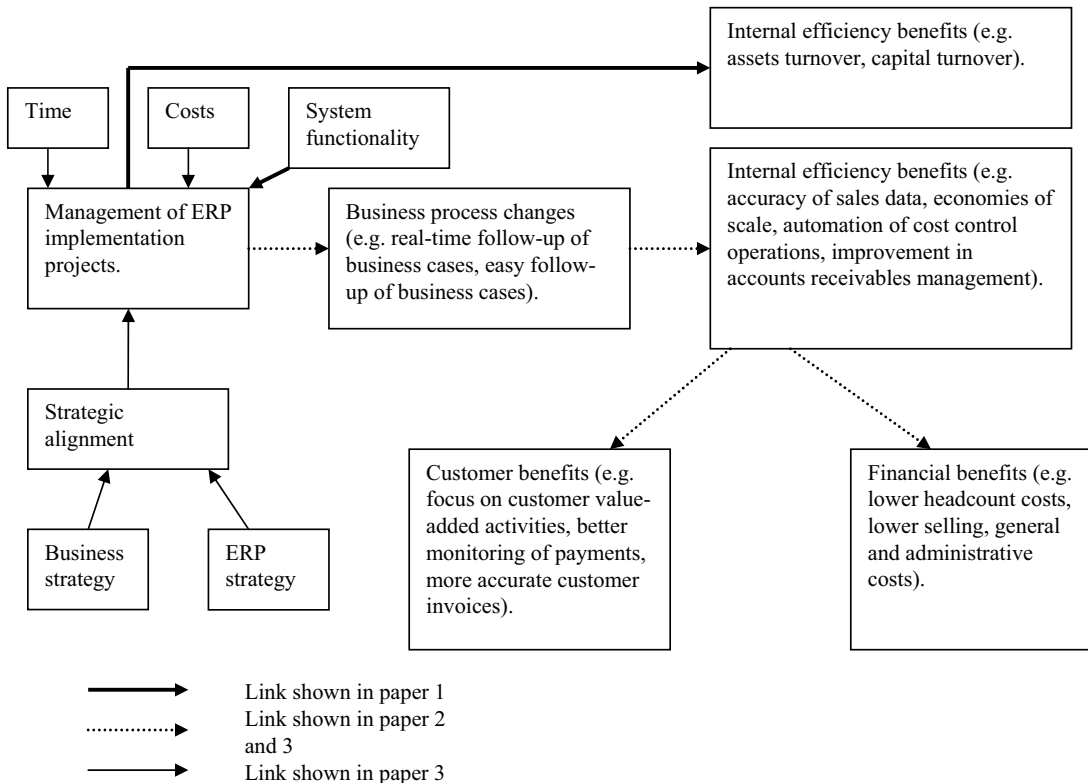
This thesis expands on Dehning and Richardson's (2002) framework that summarizes the different paths that researchers have used to study the relationship between IT investments, in general, and business performance (see Figure 1, p.7). The main observation resulting from this general framework is that the direct study of the link between IT investments and business performance ignores the network of business processes where IT is actually deployed and the contextual and organizational factors that enable the IT deployment. Therefore, this thesis extends the framework by analyzing the impact that business process changes enabled by one specific IT strategy, ERP systems, have on business performance.

Mooney et al. (1996) develop a process-oriented framework that underpins the sources of IT business value at the operational and management levels of business processes. In essence, the framework proposes that IT can have automational, informational and transformational effects on business processes and provides the constructs that measure the three types of effects at each of the two process levels. This is a useful framework for identifying the process-level sources of IT business value. It assesses the link between the level at which IT is deployed and the level at which IT impact takes place. However, it does not describe how the non-financial measures about processes, customer impact and growth can be combined with financial measures to assure future financial results. In addition, the framework applies to IT investments in general. Different types of IT strategies, like ERP systems, have distinguished characteristics which lead to specific effects on business processes, the organization as a whole, and the organization's interactions within the supply chain. Hence, specific IT investments deserve separate assessment of how they influence the financial results of the implementing companies.

Chand et al. (2005) suggest an ERP balanced scorecard framework of success measures that shows how ERP implementations and operations align with business strategies to maximize the value-added contribution of the ERP system to an organization. The ERP balanced framework has the great benefit that it shows the ERP organizational effects within the four dimensions of the balanced scorecard. Hence, the framework emphasizes the different perspective from which ERP systems contribute to business strategy. However, it does not provide a pattern of how specific ERP success measures at all the dimensions of the balanced scorecard interrelate to impact the financial results of the company.

The empirical work carried out in the three papers comprising this thesis leads to findings that show a pattern of how ERP implementations align with business strategy,

and enable business process changes and internal efficiency benefits that improve the customer service and reduce the organizational costs. The contributions from the three research papers are summed up in the conceptual model displayed in Figure 2. The model is not meant to be an exhaustive, but an illustrative model of interrelated factors that contribute to the ERP impact on business performance.



**Figure 2 Conceptual model regarding ERP contribution to business performance**

In essence, the model in Figure 2 represents an operationalization and improvement of Dehning and Richardson's (2002) framework. First, if in the case of the latter the constructs are operationalized using quantitative measures. In the case of the former, the constructs are operationalized using both quantitative and qualitative measures. The quantitative measures are the accounting measures of business performance (e.g. ROA, PM, ATO, CTO). The qualitative measures are perceptions of the persons involved in ERP implementations on the different constructs in the model (e.g. perceptions on internal process benefits, customer benefits and financial benefits). For example, as can be seen in Figure 2, in this thesis it was shown that ERP systems lead to improved ATO



and CTO – quantitative measures of internal efficiency benefits -, and to economies of scale and improved accounts receivable management – qualitative measures of internal efficiency benefits.

Second, in this thesis, the construct “Management of ERP implementation projects” combines two of the three ways of analyzing IT investments mentioned in Dehning and Richardson’s (2002) framework. It measures ERP system implementations, one type of IT strategy, and the degree of success with which companies implement and use the system. The management of ERP implementation projects is assessed in terms of implementation time, money committed to the project and system functionality.

Third, the alignment between ERP and business strategies proves to be an organizational factor that contributes to the success of ERP implementation projects. This finding expands Dehning and Richardson’s (2002) framework by adding strategic alignment to the list of factors that enable the companies to manage their ERP system so that they can gain business value from the system use.

Fourth, the model in Figure 2 captures both a direct link and a processes intermediated link between the management of ERP implementations and business performance. The direct link shows a positive relationship between successful ERP projects and efficiency measures. The process approach identifies what changes in business processes may take place when companies implement ERP systems. The empirical evidence points at significant informational ERP effects at the managerial level of processes. The business information is stored and controlled more easily and in real-time in the ERP environment compared to the previous system.

Fifth, in the last two research papers, the business performance is analyzed from the balanced scorecard perspective, which enables a multidimensional analysis of the ERP impact on performance, combining the financial and non-financial ERP effects. The process dimension of the balanced scorecard provides insight into the relationship between the business process changes enabled by ERP and the resulting internal efficiency benefits. In addition, the model in Figure 2 underlines the links between types of internal efficiency and customer benefits, and between types of internal efficiency benefits and costs reductions. However, the learning and growth perspective is not captured in the model due to the lack of observations regarding the interrelations between this perspective and the other three perspectives. This may be due to the fact that the sample companies were in the first two stages of ERP implementation; the automate and informate stages. When the companies step into the transformate stage, the management may start realizing the value of the learning and growth aspect of ERP systems. This limitation leaves room for future research on the connection between benefits of ERP at all dimensions of the balanced scorecard, with special focus on the learning and growth dimension.

Sixth, in this thesis the resource-based model of competitive advantage represents the theoretical foundation of the study of ERP implementation effects on business performance. This implies that the focus is mainly on how companies manage internally their ERP projects and how these internal implementation characteristics have effect on the company performance. This is why the model in Figure 2 does not take into

consideration any contextual factor that may have leveraging effects on the ERP business value.

In conclusion, this thesis shows that successfully managed ERP projects, whose strategy is aligned with the organizational strategy, lead to automate and informate changes in processes. Furthermore, these process changes are shown to benefit the customers, improve the internal efficiency and reduce the companies' costs. Considering that ERP systems are implemented by competing companies throughout industries, the ERP systems are capabilities that companies need to acquire and develop to keep themselves at the competitive parity within industry.

## 5 CONCLUSIONS

This thesis investigates the drivers of ERP business value in organizations. Companies implementing ERP make significant investments in time, organizational resources and capital, ranging from a few million dollars to several hundred million dollars. The implementation results in significant organizational changes, i.e. the underlying business process changes, as a compromise for the fit between the organizational structure and the new system (Mabert et al., 2001). Due to these simultaneous organizational changes that accompany ERP implementations and other exceptional changes in business (e.g. mergers and acquisitions, other enhancements in legacy systems) it is hard to attribute the effects on performance solely to ERP systems.

ERP system implementations are the most criticized strategy of IT investments concerning the impact on business value (Vemuri and Palvia, 2006). For example, immediately after the go-live of the ERP system implemented at Hershey Food Corp., the company lost \$60.4 million due to problems in customer service, warehousing, order processing, and due shipments to retailers. The bankruptcy at FoxMeyer Drugs, one of the American leaders of pharmaceutical distributing companies in the early 1990's, is attributed to the deficient management of the ERP implementation. The warehouse employees had low morale problems and damaged inventory resulting in a \$34 million loss. Orders were not filled as the new system could process only 10000 customer orders per night compared to 420000 orders under the previous system. Considering that FoxMeyer was competing on price, it would have needed a high volume of transactions to gain profit. However, for other companies implementing ERP the business dysfunctions are only temporary, until the organization cleans up its data and processes and adjusts to the ERP system environment (Ross and Vitale, 2000).

Previous research provides mixed results regarding the impact of ERP implementations on profitability measured as ROA, ROI or PM (Poston and Grabski, 2001; Hitt et al., 2002; Hunton et al. 2003). However they agree on the fact that the benefits of ERP systems may become visible in a longer time horizon, of about 4 or 5 post-implementation years. Further, observing whether the financial performance of companies implementing ERP is superior to the financial performance of companies not implementing ERP is a necessary but not a sufficient investigation for understanding how the business value of ERP is created. The ERP implementation characteristics (e.g. the ERP package selection, the motivation for implementation, the number of modules implemented) and the system changes in the post-implementation stage are proved to increase the company's ability to gain financial performance (Nicolaou, 2006; Nicolaou and Battacharya, 2006). Based on these findings, ERP systems may be a source of competitive advantage in the long-run depending on the management of the implementation.

Based on the resource-based view, Beard and Sumner (2004) conclude that ERP systems do not provide sustained competitive advantage. In addition, they theorize that the source of competitive advantage may come from the successful management of ERP projects, from the reengineering of the business processes and from the use of ERP systems to support the business strategies. This thesis contributes to the field by developing a model of the interrelationships between these factors and business

performance. Alignment between ERP and business strategies, successful management of ERP projects, and business process changes brought about by these implementations, are found to be enabling factors of benefits of ERP. However, the benefits in terms of increased efficiency, improved customer service and reduced costs only help companies implementing ERP to stay on the competitive edge within the industry.

ERP systems are implemented by competing companies in most of the industries. Hence, ERP systems are no longer heterogeneously distributed as they were in the mid 1990's. The different software vendors offer ERP packages that meet the needs of both large and middle size firms. This thesis shows that the mid-sized companies implementing ERP can run their business at lower costs if they align the ERP and business strategies, manage the projects more economically and in a shorter period of time, and make adequate process changes. However, the management of ERP may still be a potential source of competitive advantage provided companies find a unique way to combine other internal characteristics like changes in their organizational culture, operating procedures and routines with the management of their ERP systems throughout their lifecycle.

Companies exist within a network of relationships with their customers, suppliers and other organizations. Future research would benefit from investigating if companies can use the benefits gained from ERP systems to improve their relationships within the supply chain, and differentiate themselves from the competition.

## REFERENCES

- Arnold V. (2006) "Behavioral research opportunities: Understanding the impact of enterprise systems", *International Journal of Accounting Information Systems*, Vol. 7, Issue 1, pp.7-17.
- Al-Mashari M. (2003) "Enterprise resource planning (ERP) systems: a research agenda", *Industrial Management and Data Systems*, Vol. 103, No. 1, pp.22-27.
- Baki B., Cakar K., (2005) "Determining the ERP-package selecting criteria: the case of Turkish manufacturing companies", *Business Process Management Journal*, Vol. 11, No. 1, pp-75-86.
- Barua A., Kriebel C.H., Mukhopadhyay T., (1995) "Information Technologies and Business Value: An Analytic and Empirical Investigation", *Information Systems Research*, Vol. 6, No. 1, pp.3-23.
- Beard J.W., Sumner M., (2004) "Seeking strategic advantage in the post-net era: viewing ERP systems from the resource-based perspective", *Journal of Strategic Information Systems*, Vol. 13, pp.129-150.
- Bernroider E., Koch S., (2001) "ERP selection process in midsize and large organizations", *Business Process Management Journal*, Vol. 7, No.3, pp. 251-257.
- Beretta S., (2002) "Unleashing the integration potential of ERP systems: The role of process-based performance measurement systems", *Business Process Management Journal*, Vol. 8, No. 3, pp.254-277.
- Bingi P., Sharma M.K., Godla J.K., (1999) "Critical Issues Affecting an ERP Implementation", *Information Systems Management*, Summer99, Vol. 16, No. 3, pp. 7-15.
- Brakeley H. (1999) "What makes ERP effective", *Manufacturing Systems*, Vol. 17, No. 3, pp.120.
- Brynjolfsson E., (1993) "The Productivity Paradox of Information Technology", *Communications of the ACM*, Vol. 36, No. 12, pp.67-77.
- Brynjolfsson E., Malone T.W., Gurbaxani V., Kambil A., (1994) "Does Information Technology Lead to Smaller Firms?", *Management Science*, Vol. 40, No. 12, 1628-1644.
- Brynjolfsson E. (1994) "Information Assets, Technology and Organization", *Management Science*, Vol. 40, No. 12, pp.1645-1662.

- Brynjolfsson E., Hitt L.M., (1995) "Computers as a factor of production: The role of differences among firms", *Economics of Innovation and New Technology*, Vol. 3, No. 3-4, pp.183-199.
- Brynjolfsson E., Hitt L.M., (1996) "Paradox lost? Firm-level evidence on the returns to information systems spending", *Management Science*, Vol. 42, No. 4, pp.541-560.
- Brynjolfsson E., Hitt L.M., (1998) "Beyond the Productivity Paradox", *Communications of the ACM*, Vol. 41, No. 8, pp.49-55.
- Brynjolfsson E., Hitt L.M., (2000) "Beyond Computation: Information Technology, Organizational Transformation and Business Performance", *Journal of Economic Perspectives*, Vol. 14, No. 4, pp.23-48.
- Brynjolfsson E., Hitt L.M., Yang S., (2002) "Intangible Assets: Computers and Organizational Capital", *Brookings Papers on Economic Activity*, Vol. 2002, No.1, pp. 137-181.
- Brynjolfsson E., Hitt L.M., (2003) "Computing Productivity: Firm-Level Evidence", *The Review of Economics and Statistics*, Vol. 85, No. 4, pp.793-808.
- Byrd T.A., Davidson N. W., (2006) "An empirical examination of a process-oriented IT business success model", *Information Technology Management*, Vol. 7, pp. 55-69.
- Byrd T.A., Lewis B.R., Bryan R. W. (2006) "The leveraging influence of strategic alignment on IT investment: An empirical examination", *Information & Management*, Vol. 43, pp.308-321.
- Chan Y., Huff S.L., Barclay D.W., Copeland DG., (1997) "Business Strategy Orientation, Information Systems Strategic Orientation and Strategic Alignment", *Information Systems Research*, Vol. 8, No. 2, pp.125-150.
- Chan Y. (2000) "IT Value: The Great Divide between Qualitative and Quantitative and Individual and Organizational Measures", *Journal of Management Information Systems*, Vol. 16, No. 4, pp.225-261.
- Chand, D., Hachey, G., Hunton, J., Owhoso, V. and Vasudevan, S. (2005), "A balanced scorecard based framework for assessing the strategic impacts of ERP systems", *Computers in Industry*, Vol. 56, pp.558-572.
- Chatterjee D., Pacini C., Sambamurthy V., (2002) "The Shareholder-Wealth and Trading-Volume Effects of Information-Technology Infrastructure Investments", *Journal of Management Information Systems*, Vol. 19, No. 2, pp.7-42.

- Chung S., Snyder C. (2000), "ERP adoption: a technological evolution approach", *International Journal of Agile Management Systems*, Vol. 2, No. 1, pp.24-32.
- Davenport T.H. (1993): *Process innovation: reengineering work through information technology*. Boston, MA: Harvard Business School Press.
- Davenport T.H., (1998) "Putting the enterprise into the enterprise system", *Harvard Business Review*, Vol. 74, No. 4, pp.121-131.
- Davenport T.H., Brooks J.D., (2004) "Enterprise systems and the supply chain", *Journal of Enterprise Information Management*, Vol. 17. No. 1, pp.8-19.
- Davenport T.H., Harris J.G., Cantrell Susan, (2004) "Enterprise systems and ongoing process change", *Business Process Management Journal*, Vol. 10, No. 1, pp.16-26.
- Dedrick J., Gurbaxani V., Kraemer K.L., (2003) "Information Technology and Economic Performance: A Critical Review of the Empirical Evidence", *ACM Computing Surveys*, Vol. 35, No. 1, pp.1-28.
- Dehning B., Richardson V.J., (2002) "Returns on Investments in Information Technology: A Research Synthesis", *Journal of Information Systems*, Vol. 16, No.1, pp.7-30.
- Dehning B., Dow K.E., Stratopoulos T., (2004) "Information technology and organizational slack", *International Journal of Accounting Information Systems*, Vol. 5, pp.51-63.
- Dewan S., Min C., (1997) "The substitution of information technology for other factors of production: A firm level analysis", *Management Science*, Vol. 43, Issue 12, pp.1660-1675.
- Editorial (1996) "An economic view of information systems", *Decision Support Systems*, Vol. 41, pp.683-687.
- Ehie I.C., Madsen M., (2005) "Identifying critical issues in enterprise resource planning (ERP) implementation", *Computers in Industry*, Vol. 56, pp.545-557.
- Fang M.-Y., Lin F., (2006) "Measuring the Performance of ERP System – from the Balanced Scorecard Perspectives", *Journal of American Academy of Business*, Vol. 10, No. 1, pp.256-263.
- Gelinas Jr U.J., Sutton S.G., Hunton J.E., (2005): *Accounting Information Systems*, 6th edition, Thomson South-Western 2005.

- Harvard N., (2007) “Statistics/Research on ERPs”  
(<http://erp.ittoolbox.com/groups/strategy-planning/erp-projectmanagement>)  
Accessed on 31.08.2007.
- Hayes D.C., Hunton J.E., Reck J. L., (2000) “Information Systems Outsourcing Announcements: Investigating the Impact on the Market Value of Contract-Granting Firms”, *Journal of Information Systems*, Vol. 14, No. 2, pp.109-125.
- Hayes D.C., Hunton J.E., Reck J.L., (2001) “Market reaction to ERP implementation announcements”, *Journal of Information Systems*, Vol. 15, Issue 1, pp.3-18.
- Hitt L.M., Brynjolfsson E., (1996) “Productivity, Business Profitability, and Consumer Surplus: Three Different Measures of Information Technology Value”, *MIS Quarterly*, Vol. 20, No, 2, pp. 121-142.
- Hitt L.M., Wu D.J., Zhou X., (2002) “Investment in Enterprise Resource Planning: Business Impact and Productivity Measures”, *Journal of Management Information Systems*, Vol. 19, No. 1, pp. 71-98.
- Hunton J.E., Lippincott B., Reck J.L., (2003) “Enterprise Resource Planning Systems: Comparing Firm Performance of Adopters and Nonadopters”, *International Journal of Accounting Information Systems*, Vol. 4, pp.165-184.
- Im K.S., Dow K.E, Grover V., (2001) “Research Report: A Reexamination of IT Investment and the Market Value of the Firm – An Event Study Methodology”, *Information Systems Research*, Vol. 12, No. 1, pp.103-118.
- Kalling T., (2003) “ERP systems and the strategic management processes that lead to competitive advantage”, *Information Resources Management Journal*, Vol. 16, No. 4, pp.46-67.
- Kearns G.S., Lederer A.L., (2004) “The impact of industry contextual factors on IT focus and the use of IT for competitive advantage”, *Information & Management*, Vol. 41, pp.899-919.
- Kettinger W.J., Grover V., Guha S., Segars A.H., (1994) “Strategic Information Systems Revisited: A Study in Sustainability and Performance”, *MIS Quarterly*, pp.31-58.
- Kim K.S., (2004) “Strategic planning for value-based management”, *Management Decision*, Vol. 42, No. 8, pp.938-948.
- Laguna M., Marklund J. (2005): *Business Process Modelling, Simulation and Design*, Pearson Education Inc., Upper Saddle River, New Jersey.



- Law C.C.H., Ngai E.W.T., (2007) "ERP systems adoption: An exploratory study of the organizational factors and impacts of ERP success", *Information & Management*, Vol. 44, pp. 418-432.
- Levy M., Powell P., Galliers R., (1999) "Assessing information systems strategy development frameworks in SMEs", *Information & Management*, Vol. 36, No. 4, pp. 247-261.
- Mabert A.V., Soni A., Venkataramanan M.A., (2001) "Enterprise Resource Planning: Measuring Value", *Production and Inventory Management Journal*, Vol. 42, No. 3/4, pp. 46-52.
- Mandal P., Gunasekaran A. (2003) "Issues in implementing ERP: A case study", *European Journal of Operational Research*, Vol. 146, pp.274-283.
- Markus, M.L., Axline, S., Petrie, D. and Tanis, C. (2000), "Learning from adopters" experiences with ERP: problems encountered and success achieved", *Journal of Information Technology*, Vol. 15 No. 4, pp.245-266.
- Melao N., Pidd M. (2000) "A conceptual framework for understanding business processes and business process modelling", *Information Systems Journal*, Vol. 10, pp. 105-129.
- Melville N., Kraemer K., Gurbaxani V., (2004) "Review: Information Technology and Organizational Performance: An Integrative Model of IT Business Value", *MIS Quarterly*, Vol. 28, No. 2, pp. 283-322.
- Mooney J.G., Gurbaxani V., Kraemer K.L., (1996) "A Process Oriented Framework for Assessing the Business Value of Information Technology", *The DATA BASE for Advances in Information Technology*, Vol. 27, No. 2, pp. 68-81.
- Motwani J., Mirchandani D., Madan M., Gunasekaran A., (2002) "Successful implementation of ERP projects: Evidence from two case studies", *International Journal of Production Economics*, Vol. 75, pp.83-96.
- Motwani J., Subramanian R., Gopalakrishna P., (2005) "Critical factors for successful ERP implementation: Exploratory findings from four case studies", *Computers in Industry*, Vol. 56, pp.529-544.
- Nicolaou A.I., (2004) "Firm Performance Effects in Relation to the Implementation and Use of Enterprise Resource Planning Systems", *Journal of Information Systems*, Vol. 18, No.2, pp.79-105.

- Nicolaou A.I, Battacharya S., (2006) “Organizational performance effects of ERP systems usage: The impact of post-implementation changes”, *International Journal of Accounting Information Systems*, Vol. 7, No.1, pp.18-35.
- Palepu K.G., Healy P.M., Bernard V.L. (2004): *Business Analysis and Valuation Using Financial Statements*. Thomson South-Western.
- Palmer J.W., Markus M.L., (2000) “The Performance Impacts of Quick Response and Strategic Alignment in Speciality Retailing”, *Information Systems Research*, Vol. 11, No. 3, pp.241-259.
- Parr A., Shanks G., (2000) “A model of ERP project implementation”, *Journal of Information Technology*, Vol. 15, pp.289-303.
- Poston R., Grabski S., (2001) “Financial impacts of enterprise resource planning implementations”, *International Journal of Accounting Information Systems*, Vol.2, pp.271-294.
- Rickardsson P., Kraemmergaard P. (2006) ”Identifying the impacts of enterprise system implementation and use: Examples from Denmark”, *International Journal of Accounting Information Systems*, Vol. 7, Issue 1, pp.36-49
- Ross J.W., Vitale M. R., (2000) “The ERP Revolution: Surviving vs. Thriving”, *Information Systems Frontiers*, Vol. 2, No. 2, pp. 233-241.
- Sabherwal R., Chan Y.E., (2001) “Alignment between Business and IS Strategies: A Study of Prospectors, Analyzers and Defenders”, *Information Systems Research*, Vol. 12, No. 1, pp 11-33.
- Schrage M., (1997) “The Real Problem with Computer”, *Harvard Business Review*, Vol. 75, No.5, pp.178-188.
- Somers T.M., Nelson K.G., (2003) “The impact of strategy and integration mechanisms on enterprise system value: Empirical evidence from manufacturing firms”, *European Journal of Operational Research*, Vol. 146, pp.315-338.
- Sutton, S.G. (2006) “Enterprise systems and the re-shaping of accounting systems: A call for research”, *International Journal of Accounting Information Systems*, Vol. 7, Issue 1, pp.1-6.
- Stratopoulos T., Dehning B., (2000) “Does successful investment in information technology solve the productivity paradox?”, *Information & Management*, Vol. 38, No. 2, pp.103-117.

- Tallon P.P., Kraemer K.L., Gurbaxani V., (2000) "Executives" perceptions of the business value of information technology: A process-oriented approach", *Journal of Management Information Systems*, Vol. 16, No.4, pp.145-173.
- Tillquist J., Rodgers W., (2005) "Using Asset Specificity and Asset Scope to Measure the Value of IT", *Communications of the ACM*, Vol. 48, No. 1, 75-81.
- Umble E. J., Haft R.R., Umble M.M., (2003) "Enterprise Resource Planning: Implementation Procedures and Critical Success Factors", *European Journal of Operational Research*, Vol. 146, No. 2, pp. 241-257.
- Velcu O., (2004) "An Investigation of ERP Implementation Experiences in Finland", *The Romanian Economic Journal*, Vol. 7, No. 14, pp. 97-112.
- Velcu O., (2005) "Impact of the Quality of ERP Implementations on Business Value", *Electronic Journal of Information Systems Evaluation*, Vol. 8, No. 3, pp.229-238, available online at [www.ejise.com](http://www.ejise.com).
- Velcu O., (2007a) "Exploring the effects of ERP systems on organizational performance – Evidence from Finnish companies", *Journal of Industrial Management and Data Systems*, Vol. 107, No. 9, pp. 1316-1334.
- Velcu O., (2007b) "A model of organizational and implementation factors that enable the benefits of ERP systems", In press.
- Vemuri V.K., Palvia S.C., (2006) "Improvement in Operational Efficiency Due to ERP systems Implementation: Truth or Myth?", *Information Resources Management Journal*, Vol. 19, No. 2, pp. 18-36.



## PART II: RESEARCH PAPERS



## **6 RESEARCH PAPER 1 “IMPACT OF THE QUALITY OF ERP IMPLEMENTATIONS ON BUSINESS VALUE”**

### **6.1. Introduction**

The degree of success of investments in IT as an explanation for the “productivity paradox” has recently attracted the attention of researchers of business value of information technology investments (Stratopoulos and Dehning 2000). This dimension of the success or quality of the investment appears to be worth investigating in the context of investments in Enterprise Resource Planning Systems. An investigation of the quality aspect is important considering the fact that ERP investments are expensive, and the implementation process is intensive and takes a long time.

Previous research has focused primarily on the relationship between the ERP implementations and the firm profitability. To my knowledge, no research has been done related to the relationship between the quality of ERP implementations and firm profitability.

### **6.2. Research objective**

The aim of this paper is to investigate if the quality of ERP implementations is correlated with how the business performance of the company develops after the implementation. In addition, the relationship between the ERP implementation effort and the success of the implementation is investigated.

### **6.3. Literature review**

#### **6.3.1. *The Productivity Paradox***

The exploration of the impact of IT investments on organizational performance has progressed ever since the 1980s. Some results show a significant contribution of IT to productivity, and business performance, some fail in showing any positive impact whatsoever (Dehning and Richardson, 2002).

At the outset, studies showed negative correlation between IT investments and productivity. These results were summed up by Robert Solow, who stated that “we see computers everywhere except in the productivity statistics”. This so-called “productivity paradox” seemed to be the conclusion of the 1980’s and early 1990’s studies in the area. Brynjolfsson (1993) suggests four explanations for these early findings: the mismeasurement of inputs and outputs, the time lags, the redistribution and dissipation of profits, and the mismanagement of information technology. He further recommends a change in the traditional measurements of productivity.

Brynjolfsson et al. (1994) extend the analysis to the organizational changes that are correlated with IT investments. Their results point to the decrease of the average size of the firm as the most important organizational change. Additionally, the findings indicate that this occurs especially after the first three years from the IT investment.

Hitt and Brynjolfsson's (1996) study is one of the first studies that reveals a positive net return to IT investment by finding a gross marginal product of IT on productivity of approximately 95%. They also investigate the IT effect on firm profitability and the statistical results indicate a slightly negative correlation. Brynjolfsson and Hitt (1996) analyse different econometric models previously employed in research. Using a larger and more recent database, they reveal a significant positive impact of information systems on firm productivity.

The nebulous results led researchers to broaden their outlook on the relationship between IT and business performance. Brynjolfsson and Hitt (2000) and Stratopoulos and Dehning (2000) agreed that the key aspect of the relationship IT investment-business value does not consist of how much the organization invests in IT, but in how the company is capable of managing the IT asset and the organizational changes that accompany the IT investment.

Continuing the research path started in 1994 about the organizational transformations engendered by IT investments, Brynjolfsson and Hitt (2000) indicated that there is a correlation between IT investments and the changes in the organizational context engendered by these investments that positively contributes to productivity growth and market value.

Researchers also started analysing the impact on business performance of the organizational changes that complement IT investments. Osei-Bryson and Ko (2004) explored the relation between IT investments and organizational productivity using multivariate adaptive regression splines (MARS). The main result was the discovery of a statistically significant positive impact of the IT asset on productivity only when the value of the investment surpasses a certain threshold value. Dehning et al. (2004) investigated whether the "productivity paradox" claimed until 1991 is explained by organizational slack. The findings were that before 1991, IT investment was followed by an increase in the organizational slack, a situation that was not valid after 1991.

By the late 1990's, the research concerning the IT impact on financial performance broadened with a new research path that focused on the business value of Enterprise Resource Planning (ERP) systems. Once adopted within and across organizations, ERP systems achieve the integration of such business functions as accounting, sales and marketing, operations and logistics, and human resources. ERP systems are built on a single database that enables modules to share data, thus speeding up the information flow within organizations.



### **6.3.2. ERP project success**

How to measure the success of ERP projects has been extensively discussed. Wang and Chen (2004) conclude that the success of an ERP project may be analysed from three perspectives that depend on the different stages in the system lifecycle:

1. The operational perspective, which means that the system should have the expected functionality.
2. The financial perspective, which means that the analysis focuses on establishing whether the ERP system realizes the key performance indicators.
3. The project implementation perspective, according to which the success of an ERP project is achieved if the software is installed on time and on budget.

In their study of critical managerial issues in ERP projects, Kumar et al. (2003) attempt to establish what it is meant by success of an ERP project. According to the project managers interviewed, the most used project success criteria are the completion of the implementation process on time and on budget. From the point of view of ERP software users, the success of an ERP project means the ease of use and the enhancement of the daily tasks.

The three above-mentioned perspectives represent a unit, in the sense that in order for an organization to harvest the expected benefits from an ERP software, it is important to start with a successful implementation of the package, then to continue with having a system that functions at the expected parameters and that is used according to the established objectives, and ending with the financial returns of the ERP investment.

## **6.4. Hypothesis development**

### **6.4.1. ERP implementation success and financial performance**

Poston and Grabski (2001) examined the impact of ERP systems implementation on firm financial performance during an analysis window of 3 years before and 3 years after implementation. They found no significant improvements in the financial ratios. However, the firms obtained a significant decrease of the COGS as a percentage of revenue, in the third year after implementation.

In a subsequent study, Hunton et al. (2003) make a comparative analysis of the financial performance of ERP adopters and non-ERP adopters. Firm performance was measured over a 3 year time frame. The results showed that the financial performance of non-adopters declined in time whereas the financial performance of adopters remained at an approximatively constant level. The results also pointed to some efficiency benefits measured as Asset Turnover.

On the one hand, the empirical studies show little financial gains associated with ERP implementations. On the other hand, the market and the managers perceive value in

ERP announcements, and ERP implementations, respectively. (Mabert et al., 2001; Hayes et al., 2001; Hunton et al., 2002).

Thus, the question about the realization of the business value of ERP implementations still remains unanswered. One anecdotal answer lies in Hitt and Brynjolfsson's (1996) suggestion that the ERP financial gains are passed on to consumers through lower prices. Or, it may be that ERP financial gains are positively associated with successful ERP implementations. Stratopoulos and Dehning (2000) test whether successful IT projects lead to a superior financial performance compared with ineffective IT projects. Their findings reveal that the successful IT investments entail superior financial performance for 3 or 4 years. However, the superior financial performance is short-lived.

The quality of ERP implementations is a variable that could have explanatory power when looking into how ERP systems affect the financial performance of adopters. The financial impact of successful ERP adoptions is expected to exceed that of less successful ERP adopters, because the asset utilization and the efficiency of the business processes are superior for the former group of companies.

Hypothesis 1: Successful ERP adopters have a higher financial performance than less successful ERP adopters.

#### **6.4.2. ERP implementation effort and ERP implementation success**

Francalani (2001) investigates the impact of the technical size and organizational complexity on implementation effort. The project size is measured as number of modules and sub-modules implemented, while the organizational complexity is measured as the number of users involved and the overall company size. The findings show that both the technical size and the organizational complexity are important factors that determine the implementation effort.

Based on the findings of Mabert et al. (2001), there is clear indication that under/on budget firms make a stronger effort for ERP implementation. In this study, we look at the success of ERP implementations from the operational perspective. Implementation success is measured in terms of functionality of modules, system use, and attainment of the business case. The operational perspective is a long-term way of measuring the success of the ERP system implementation. It tries to measure how the ERP system handles the organizational processes once it is up and running.

Hypothesis 2: The implementation effort affects the success of ERP implementations.

## 6.5. Methodology

### 6.5.1. *The sample selection and validation*

#### 6.5.1.1. *Sample selection*

The sample was selected from the VOITTO database of Finnish companies and their financial statements using the following criteria:

1. We selected parent companies because of the belief that the implementations of different information systems in groups start with the parent company unit.
2. The company should be active.
3. The number of employees should be greater or equal to 50, thus excluding very small companies. It is very unlikely that small Finnish organizations would have implemented an ERP system.

Firms belonging to the banking, insurance and leasing industries were excluded from the sample. The initial sample for the postal survey was 676 companies. 152 responses were received, out of which 114 ERP adopters and 38 non-adopters.

#### 6.5.1.2. *Sample validation*

Besides the sample selection, the following performance related aspects were taken into consideration:

- The time frame for comparing the business performance before and after the ERP implementation. It would have been better to have a longer post-implementation period of 4 or 5 years, but the availability of the financial information in the VOITTO database restricted the post implementation period to three years.
- Establishing the implementation period. Out of the 114 ERP adopters were selected the companies that implemented an ERP package between 1997 and 2001. This resulted in a sample size of 49 ERP adopting companies out of which for 6 it was not possible to calculate the performance indicators for the third year after implementation as they did not publish their annual reports for 2004 yet. Therefore, the sample size was reduced to 43 companies when analyzing the financial performance of ERP adopters in the third year after implementation.
- The classification into successful and less successful ERP adopters. The survey contains questions which attempt to measure the success of ERP implementations from two perspectives: the project perspective and the operational perspective. The success of the implementation project is measured through the time and the budget criteria. The operational success of the ERP software is measured through the system functionality criterion: Once implemented, does the software

function at the expected functionality in terms of modules implemented, and user perceptions? Does the ERP software realize the business case?

The tests were conducted based on the classification of the companies into successful and less successful ERP adopters according to the system functionality measure. The companies for which the system functionality measure was smaller than the median were classified as less successful adopters, and the organizations that had a system functionality measure larger or equal to the median were classified as successful adopters. The sample size of the less successful adopters became of 17 companies, and the sample size of the successful adopters was of 32 organizations.

### 6.5.2. *Measuring financial impact*

The financial impact was measured by means of the following financial indicators: ROA, ROI, Profit Margin, Assets Turnover, Capital Turnover, and the ratio Wages/Total Costs. They were calculated based on the consolidated financial statements of the groups to which the respondent companies belong, for 1995 to 2004.

**Table 1 Calculation of ratios**

Financial impact measure	Calculation
ROA	Profit before extraordinary items, appropriations and taxes plus financial expenses divided by average total assets.
ROI	Profit before extraordinary items, appropriations and taxes plus financial expenses divided by average balance sheet total less period average non-interest bearing liabilities
Profit Margin	Profit before extraordinary items, appropriations and taxes plus financial expenses divided by turnover.
Assets Turnover	Turnover divided by average total assets.
Capital Turnover	Turnover divided by average balance sheet less average non-interest bearing liabilities.

To test hypothesis 1, a non-parametric test was conducted. The Mann-Whitney U test measures whether there are any significant differences in the mean difference between the performance in the post-implementation period and the performance in the pre-implementation period of the successful ERP adopters and less successful ERP adopters.

Hypothesis 2 was tested with a standard multiple regression, in which the number of modules implemented and the ratio implementation cost to overall company size were regressed on the implementation success as follows:

The implementation success variable measures the perception of the respondent of the functionality of their ERP system. The perception of the system functionality is the average of the perceptions of the software functionality, the software usability, and the business case attainment.

## 6.6. Reliability and validity analysis

Before testing the hypotheses, it is necessary to assess the reliability and validity of the set of variables that measure the success of an ERP implementation. Some of variables measure how successful the ERP implementation project was in terms of time and budget compliance. Other variables measure how well the ERP software functions after implementation. (Table 2)

**Table 2 Variables for measuring success and factor analysis for validity of success measures**

Success measure	Variables	Description	Factor loading	Factor component
System functionality	software functionality	On a Likert scale from 1 to 5, the variable measures whether the planned ERP modules were actually implemented and function as expected.	0.839	1
	software usability	On a Likert scale from 1 to 5, the variable measures whether the software users utilize the software as they have been trained to do it.	0.806	1
	business case attainment	On a Likert scale from 1 to 5, the variable measures whether the measurement elements established at the outset of the project have been reached, hence predicting whether ERP will be beneficial or not.	0.613	1
Time	initial implementation time	The variable measures what is the forecasted duration for the ERP project.	0.767	3
	lateness	The variable measures how many months the ERP project was late.	0.632	1
Budget	budget compliance	The variables measures whether the ERP implementation project was developed within the budget established at the outset of the project.	0.834	2

The test of reliability attempts to verify how well these three measures quantify the success latent construct. Cronbach's alpha coefficient was computed. The reliability turned out to be low since the alpha value was 0.456. The low Cronbach's alpha coefficient was obtained due to the fact that the data is multidimensional. The factor analysis was conducted in order to check the multidimensionality of data.

Before undertaking the principal component analysis (PCA), the suitability of data for factor analysis was assessed. The results of the correlation matrix revealed the presence of many correlation coefficients of values larger than 0.3. The Barlett's test of Sphericity reached a high statistical significance ( $p$ -value=0.000), thus supporting the factorability of the correlation matrix.

The PCA revealed that there are three components that have an eigenvalue larger than 1, explaining 76.7% of variance. The three components are extracted. Furthermore, the

Varimax rotation was performed in order to facilitate the interpretation of the factor analysis results. This rotation solution revealed that the variables software functionality, software usability, business case attainment, and lateness have high loadings on Component 1, and the variable budget compliance has high loading on Component 2. The variable initial implementation time has a high loading factor on Component 3. Considering that the variables in Table 2 have high loading values, this implies that the variables for measuring the success are valid. The data is indeed multidimensional due to the fact that the software functionality, the software usability, the business case attainment, and lateness do not measure the same construct as the budget compliance or the initial implementation time.

Thus, the factor analysis results support the use of time and budget as separate measures of success. Additionally, the system functionality variables and the time variable may be used as either combined measures of success or separate. In order to check what is the best way of using the two success measures, a reliability test was performed for the subset of variables software functionality, software usability, business case attainment, and lateness.

In exploratory studies, a Cronbach's alpha value greater than 0.7 is commonly accepted (Pallant 2004). In this paper, the Cronbach's alpha value for the system functionality and time taken as separate measures of success is of 0.747, which is higher than 0.271 alpha value when the system functionality and the time are taken as a common measure of success. This means that the study can further rely on the system functionality variables as one measure of success, and on the time measure as another measure of success.

In conclusion, the implications of the Cronbach's alpha and PCA are that the system functionality, the budget and the time, can be used as separate scales for measuring the success of ERP implementation. The reliability and validity results are congruent with the theoretical arguments and the previous empirical findings regarding the measurement of the success of ERP implementations. (Kumar et al., 2003)

## **6.7. Descriptives regarding the sample**

### **6.7.1. ERP implementation descriptives**

52.2% of the companies belong to the manufacturing sector, 19.6% operate in the services sector, 10.9% of the companies operate in the wholesale sector, and the remaining companies are uniformly distributed in the constructions and transports and logistics sectors. The successful ERP adopters are more uniformly spread throughout the manufacturing, services and wholesale services, whereas the less successful ERP adopters are concentrated mainly in the manufacturing sector. (Table 3)

**Table 3 Industry distribution of the sample**

Industry sector	Successful ERP adopters	Less successful ERP adopters
Manufacturing	41.9%	73.3%
Services	25.8%	6.7%
Wholesale	12.9%	6.7%
Construction	9.7%	0%
Transport and logistics	6.5%	6.7%
Education and healthcare	0%	6.7%
Radio and television activities	3.2%	0%

Regarding the ERP package implemented, 30% of the sample companies implemented SAP R/3, 8% of them implemented Wintime, a product of the local vendor, TietoEnator, another 8% implemented Sonet, the ERP software of WM-data Novo, a software vendor in the Nordic countries.

The distribution of the sample companies by implementation years is displayed in Table 4. More companies started to adopt an ERP software beginning with 1999. The average implementation duration is of 11 months. The average number of modules implemented is 5, which shows that the companies did not go for a full scale ERP implementation.

**Table 4 Implementation years**

Implementation year	Number of implementers	Successful implementers	Less successful implementers
2001	13	9	4
2000	11	9	2
1999	14	8	6
1998	6	5	1
1997	5	3	2

### 6.7.2. Descriptive statistics concerning the size of the sample

According to the information displayed in Table 5, both in the year before the implementation and in the implementation period, the successful ERP adopters were larger than the less successful ERP adopters in terms of sales and total assets. However, the conduct of an independent samples t test did not show any significant difference in the mean of sales or total assets for the two groups of companies ( $p$ -values $>0.10$ ).

**Table 5 Descriptive statistics for size**

Accounting measure	Statistic	ERP adopter	-1	0
Sales	Mean	Successful	292489.7	336132.1
		Less successful	127183.5	145520
	p-value		(0.440)	(0.430)
	Median	Successful	35708.6	42375
Less successful		29906.7	40620.2	
Total Assets	Mean	Successful	357538.4	385170.3

Accounting measure	Statistic	ERP adopter	-1	0
		Less successful	87515.3	161213.6
	p-value		(0.366)	(0.485)
	Median	Successful	27494.2	31833.9
		Less successful	19973.7	29351.8
	N	Successful	32	32
		Less successful	17	17

### 6.7.3. Descriptive statistics concerning financial performance trend

Table 6 displays the development in business performance after implementation for the successful and less successful ERP adopters. The general trend was of a worse post implementation performance for both categories of ERP adopters. However, the successful ERP adopters obtained a positive change in efficiency benefits in term of Assets Turnover and Capital Turnover in the first two years after implementation.

**Table 6 Descriptive statistics regarding the change in financial performance after implementation**

Variable	Statistic	ERP adopter	$\Delta_{+1}$ <sup>1</sup>	$\Delta_{avg+2}$ <sup>2</sup>	$\Delta_{avg+3}$ <sup>3</sup>
$\Delta_{ROA}$	Mean	Successful	-0.0390	-0.0535	-0.0850
		Less successful	-0.0684	-0.0824	-0.0511
	Median	Successful	-0.0158	-0.0347	-0.0334
		Less successful	-0.1217	-0.1452	-0.1712
	Std. Dev.	Successful	0.1378	0.1448	0.1481
		Less successful	0.1535	0.1752	0.1223
$\Delta_{ROI}$	Mean	Successful	-0.0732	-0.0745	-0.1361
		Less successful	-0.1042	-0.1179	-0.1024
	Median	Successful	0.4615	0.0945	0.1519
		Less successful	0.4400	0.1252	0.1921
	Std. Dev.	Successful	0.2645	0.2020	0.0434
		Less successful	0.2469	0.2883	0.0368
$\Delta_{Profit\ margin}$	Mean	Successful	-0.0444	-0.0527	-0.0725
		Less successful	-0.0349	-0.0539	-0.0506
	Median	Successful	-0.0255	-0.0202	-0.0206
		Less successful	-0.0088	-0.0290	-0.0278
	Std. Dev.	Successful	0.1328	0.1316	0.1428
		Less successful	0.1313	0.1337	0.1321
$\Delta_{Assets\ Turnover}$	Mean	Successful	<b>0.1073</b>	<b>0.1006</b>	-0.2177
		Less successful	-0.2996	-0.2170	-0.2407
	Median	Successful	0.0640	0.0437	0.0479
		Less successful	-0.2551	-0.1277	-0.0844
	Std. Dev.	Successful	0.6365	0.5854	0.7031

<sup>1</sup> The difference between the performance in the first post implementation year and the average performance in the three pre implementation years.

<sup>2</sup> The difference between the average performance in the first two years post implementation and the average performance in the three pre implementation years.

<sup>3</sup> The difference between the average performance in the first three years post implementation and the average performance in the three pre implementation years.



Variable	Statistic	ERP adopter	$\Delta_{+1}$ <sup>1</sup>	$\Delta_{avg+2}$ <sup>2</sup>	$\Delta_{avg+3}$ <sup>3</sup>
		Less successful	0.4391	0.3949	0.7919
$\Delta_{CapitalTurnover}$	Mean	Successful	<b>0.2648</b>	<b>0.1289</b>	-0.1817
		Less successful	-0.2472	-0.2087	-0.1256
	Median	Successful	0.1306	0.1376	0.0446
		Less successful	-0.2653	-0.1014	-0.1096
	Std. Dev.	Successful	1.1358	0.5558	0.8676
		Less successful	0.5605	0.9414	0.9548
$\Delta_{Wages / TotalCosts}$	Mean	Successful	-0.0297	-0.0340	-0.0773
		Less successful	-0.0238	-0.0051	-0.0216
	Median	Successful	-0.0389	-0.0435	-0.0483
		Less successful	-0.0277	-0.0172	-0.0110
	Std. Dev.	Successful	0.1661	0.1352	0.1682
		Less successful	0.0757	0.0899	0.1084
N	Successful	32	32	27	
	Less successful	17	17	16	

## 6.8. Results

The results of Mann-Whitney U test<sup>4</sup> for Hypothesis 1 are presented in Table 7. They show that the successful ERP adopters have a statistically significant higher efficiency benefits than the less successful ERP adopters, in the first two years after implementation. (p-value<0.05, and p-value<0.10). No statistical difference was found in the change in ROA, ROI, Profit Margin or Wages/Total Costs between the successful ERP adopters and less successful ERP adopters.

**Table 7 Mann-Whitney U Test for differences between less successful and successful ERP adopters regarding the change in financial performance after implementation**

Variable	Statistics	$\Delta_{+1}$	$\Delta_{avg+2}$	$\Delta_{avg+3}$
$\Delta_{AssetsTurnover}$	Z value	-2.878	-2.226	-0.546
	p value	<b>(0.004)</b>	<b>(0.026)</b>	(0.585)
$\Delta_{CapitalTurnover}$	Z value	-2.753	-1.702	-0.452
	p value	<b>(0.006)</b>	<b>(0.089)</b>	(0.651)

The regression analysis results for Hypothesis 2 are presented in Table 8. The sample is the 31 implementers that responded to the question regarding the actual implementation cost. The results show that the implementation effort measured as number of modules implemented and ratio implementation cost to size makes no statistically significant contribution to the success of ERP implementation (p-value>0.10). The coefficients of both independent variables have a negative sign, which implies that the stronger the implementation effort, the more difficult to manage a successful ERP implementation<sup>5</sup>.

<sup>4</sup> Additionally, an independent samples t-test and multiple regression analysis were conducted and the results confirmed the non-parametric test results for the first year after implementation.

<sup>5</sup> Additionally, the results of Mann-Whitney U test and independent samples t-test support the multiple regression results in that the number of modules implemented is higher for the less successful ERP

**Table 8 Estimated coefficients of the regression model and the corresponding significance levels**

Dependent variable	Independent variables	Model coefficients
Implementation success	Number of modules	-0.232 (0.218)
	$\frac{\textit{implementation cost}}{\textit{Size}}$	-0.001 (0.994)

## 6.9. Discussion and study limits

The main objective of this study was to investigate if the quality of ERP implementations is correlated with how the business performance of the company develops after implementation. To reach this objective, a comparative analysis of the change in financial performance after implementation between 17 less successful ERP adopters and 32 successful ERP adopters was performed. There were used the following financial impact indicators: ROA, ROI, Profit Margin, Assets Turnover, Capital Turnover and Wages / Total Costs.

It was expected that the successful ERP adopters would have a higher financial performance than the less successful ERP adopters because the less successful adoption would hinder the efficiency of assets utilization and business processes. The findings revealed no significant difference in the financial performance change after implementation between the two groups of ERP adopters in terms of ROA and ROI. However, the further decomposition of ROA and ROI indicated that the successful ERP adopters do have significantly better efficiency benefits than the less successful ERP adopters, in terms of Assets Turnover and Capital Turnover, in the first two years after implementation. The post implementation trend in Profit Margin did not differ significantly between the two groups of companies, although it continued to decline over the three years for both groups.

In addition, it was investigated whether the implementation effort is correlated with the success of ERP implementations. The results did not reveal any statistically significant contribution of the number of modules implemented and the ratio implementation cost divided to total assets, to the success of ERP implementations.

These findings are similar to those obtained by Stratopoulos and Dehning (2000) in that the successful implementation ERP systems leads to a significantly superior efficiency in utilizing assets and capital. However, the efficiency benefits turn out to be short-lived.

The second interesting finding is concerned with the relationship between the implementation effort and the success of ERP implementations. In this paper there was found no significant impact, whereas in Mabert et al., (2001) it was found a clear evidence of stronger ERP implementation effort for the companies that completed the ERP implementation project on budget. The contradictory results may be explained by

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adopters than for the successful ERP adopters. However, the difference in the implementation effort between the two groups of companies is not significant.

the fact that in this paper a different construct to measure success was used, that is the system functionality construct. Still, further analysis of the impact of ERP implementation effort on the success of ERP implementations measured as on/over budget projects, revealed also no significant evidence that the successful ERP firms would make a stronger implementation effort. The potential explanation for the two different findings may reside in the fact that the companies in the present study went for partial ERP implementations. The average number of modules implemented is 5 therefore the project size may not constitute a strong enough driver of implementation effort to have any explanatory power on the success of ERP implementation.

The main limitation of this study consists of the fact that it could not capture additional initiatives or industry events that could have had an impact on the financial performance at the same time with the ERP implementation.

The second limitation of the study is related to the macroeconomic influences that were not controlled for to better isolate the business value of ERP implementation. This should be done in a future study in which a control sample of firms should be used for both the successful and less successful ERP adopters. The control companies should be matched on industry code and size, and they should not be ERP adopters.

The third limitation of the paper consists of the small sample size, which combined with the fact that the sample companies went for partial ERP implementations, may hamper the observance of any significant difference in the financial performance trend in the post implementation period between the successful and less successful ERP adopters. Additionally, considering that the findings of this paper are based on data from mid-sized Finnish companies, they can't necessarily be extended to companies in countries characterized by different business practices.

The present findings lead to further research opportunities. One research track consists of the competitive advantage issue. It is possible that a successful ERP adoption leads to a more efficient utilization of valuable and non-substitutable organizational resources that derives in competitive advantage. After a certain time lag, the less successful ERP adopters imitate the utilization of resources hence the competitive advantage becomes unsustainable. The second research track consists of reclassifying the ERP adopters into better and worse financial performers based on the development of their post implementation performance and comparing their implementation experiences.

## REFERENCES

- Brynjolfsson E. (1993) "The Productivity Paradox of Information Technology", *Association for Computing Machinery. Communications of the ACM*, Vol 36, No.12, pp67-77.
- Brynjolfsson E., Malone T.W., Gurbaxani V. and Kambil A., (1994) "Does Information Technology Lead to Smaller Firms?", *Management Science*, Vol 40, No. 12, pp1628-1644.
- Brynjolfsson E., Hitt L., (1996) "Paradox Lost? Firm-Level Evidence on the Returns to Information Systems Spending", *Management Science*, Vol 42, No. 4, pp541-558.
- Brynjolfsson E., Hitt L., (2000) "Beyond Computation: Information Technology, Organizational Transformation and Business Performance", *Journal of Economic Perspectives*, Vol 14, Nr. 4, pp23-48.
- Dedrick J., Gurbaxani V., and Kraemer K.L., (2003) "Information Technology and Economic Performance: A Critical Review of the Empirical Evidence", *ACM Computing Surveys*, Vol 35, No.1, pp1-28.
- Dehning B., Richardson V.J., (2002) "Returns on Investments in Information Technology: a Research Synthesis", *Journal of Information Systems*, Vol 16, No. 1, pp7-30.
- Dehning B., Kevin E.D., Theophanis S., (2004) "Information technology and organizational slack", *International Journal of Accounting Information Systems*, Vol 5, pp51-63.
- Francalani C., (2001) "Predicting the implementation effort of ERP projects: empirical evidence on SAP/R3", *Journal of Information Technology*, Vol. 16, Issue 1, pp33-49.
- Hayes D.C., Hunton J.E., Reck J.L., (2001) "Market Reaction to ERP Implementation Announcements", *Journal of Information Systems*, Vol 15, No. 1, pp3-18.
- Hitt L.M., Brynjolfsson E., (1996) "Productivity, Business Profitability, and Consumer Surplus: Three Different Measures of Information Technology Value", *MIS Quarterly*, Vol 20, No. 2, pp121-142.
- Hunton E.J., McEwen R.A., Wier B., (2002) "The reaction of Financial Analysts to Enterprise Resource Planning (ERP) Implementation Plans", *Journal of Information Systems*, Vol 16, No. 1, pp31-40.

- Hunton J.E., Lippincott B., Reck J.L., (2003) "Enterprise Resource Planning Systems: Comparing Firm Performance of Adopters and Nonadopters", *International of Accounting Information Systems*, Vol 4, pp165-184.
- Kumar V., Bharat M., Uma K., (2003) "An investigation of critical management issues in ERP implementation: empirical evidence from Canadian organizations", *Technovation*, Vol 23, No. 10, pp793 – 807.
- Poston R., Grabski S., (2001) "Financial Impacts of Enterprise Resource Planing Implementations", *International Journal of Accounting Systems*, Vol 2, pp271-294.
- Mabert V.A., Soni A., Venkataramanan M.A., (2001) "Enterprise Resource Planning: Measuring Value", *Production and Inventory Management Journal*, Vol 42, No.3/4, pp46-52.
- Osei-Bryson K-M., Ko M., (2004) "Exploring the Relationship between Information Technology Investments and Firm Performance Using Regression Splines Analysis", *Information & Management*, Vol. 42, No. 1, pp1-13.
- Pallant J., (2004): *SPSS survival manual: a step by step guide to data analysis using SPSS for version 12*, Buckingham: Open University Press
- Stratopoulos T., Dehning B., (2000) "Does Successful Investment in Information Technology Solve the Productivity paradox?", *Information and Management*, Vol. 38, pp103-117.
- Wang E.T.G., Chen J.H.F., (2004) "The Influence of Governance Equilibrium on ERP Project Success", *Decision Support Systems*, Working Paper, pp1-20.

## **7 RESEARCH PAPER 2 “EXPLORING THE EFFECTS OF ERP SYSTEMS ON ORGANIZATIONAL PERFORMANCE – EVIDENCE FROM FINNISH COMPANIES”**

### **7.1. Introduction**

Despite the large investments, the benefits of the IT spending could not be found in the firm-level output in the early 1990's studies. The late 1990's studies showed evidence of positive IT returns in firms which restructured the organization to take advantage of the new technology (Hitt and Brynjolfsson, 1996; Brynjolfsson and Hitt, 1996; Brynjolfsson and Hitt, 2000; Stratopoulos and Dehning, 2000). Thus, the latest research efforts strive to understand “when and why there is a payoff” ( Dehning and Richardson, 2002; McAdam and Galloway, 2005; Rikhardsson and Kraemmergard, 2006).

Dehning and Richardson (2002) put forward a framework that captures five analysis paths of the relation between IT and firm performance. The first and most analyzed link is the direct relation between IT and firm performance. The second, less analyzed link provides insights into the relation between IT and business process measures such as gross margin, profit margin, turnover ratios, inventory turnover, customer service, quality, and efficiency. The third path analyzes how these process measures combine to determine overall firm performance.

Brynjolfsson and Hitt (1998) observe that the IT payoffs are contingent, therefore they encourage the research of factors that leverage the impact of IT on firm performance. Thus, Dehning and Richardson's (2002) framework comprises two more paths that show that contextual factors (e.g. industry, size, financial health, IT intensity) may affect the IT impact on both business processes and overall firm performance.

However, the above-mentioned framework points at the scarcity of studies on the changes in business processes caused by IT investments, and the effect of those process changes on organizational performance in the post-implementation stage. Such studies would provide a deeper understanding into the dynamics of the pre-, during and post-implementation activities (Yu, 2005).

In addition, the measurement of IT investments can be improved. The previous studies have used single approaches to evaluate the IT investment, whether as IT spending, IT type (ERP systems or electronic commerce), or IT management (the level of ability within an organization or successful users of IT). Instead, the triangulation of the IT measures in order to investigate their combined effect on firm performance would represent a contribution to the field. An example of IT measures triangulation is the study of the relation between IT spending and firm performance when the company invests in a certain type of IT.

Furthermore, Arnold (2006) argues that while the IT payoffs are expected, little attention is directed towards understanding how organizations are affected when investing in IT and how the benefits are realized at inter-organizational level. A

triangulation method that combines case studies research, surveys and cross-sectional field studies is suggested in order to enable theory development across organizations.

The present study explores the business process (BP) changes that occur in companies with different motivations for their ERP implementation projects and with different degrees of success in their ERP implementation experience. In addition, the effects of the resulting BP changes on organizational performance are explored.

The remainder of this paper is organized as follows. The next section reviews the literature concerning the motivations, the success measures for ERP implementations, and the ERP generated BP changes as factors leading to the materialization of the ERP benefits in organizations. The following section introduces the multiple-case study method. The “Findings” section presents interview evidence leading to the observation of nine interrelationships between the motivations for ERP implementations and the perceived ERP benefits. The paper concludes with a discussion of the findings and suggestions for future research.

## 7.2. Literature review

### 7.2.1. *Motivations for implementing an ERP*

Researchers concur on the classification of the reasons motivating companies to implement ERP systems into technical and business driven implementations (Mabert et al., 2000; Chand et al., 2005; Botta-Genoulaz and Millet, 2006) (see Table 1).

**Table 1 Motivations for ERP implementations**

Technical reasons	Business reasons
Solve the Y2K problem	Enable business growth
Replace disparate systems	Improve inefficient business processes
Reduce software maintenance burden by outsourcing	Reduce business operating and administrative expenses
Eliminate redundant data entry	Reduce inventory carrying costs
Reduce data errors	Acquire multicurrency IT support
Decrease computer operating costs	Eliminate delays and errors in filling customers' orders
Integrate applications cross-functionally	Standardize procedures across different locations

In the first generation implementations, most of the failures were reported to have a technical perspective rather than a specific business orientation (Omprakash et al., 2004). Yet, Nicolaou (2004) shows that the technically-led implementations positively influence the firms' ability to gain higher financial benefits relative to firms following a different implementation strategy. Depending on the motivations, companies may have different ERP implementation experiences. The technically-led implementations may result in a better designed system that provides a better fit with the organizational processes, which does not necessarily pay off in the short run. Instead, the business-led implementations may be more focused and lead to better financial performance in a shorter time.

This paper further explores the link between the motivations for ERP implementations and the perceived benefits of ERP, by analyzing financial as well as non-financial benefits.

### **7.2.2. *The success of ERP implementations***

Markus et al. (2000) underpin three issues that are relevant when measuring the success of an ERP implementation. First, the way in which success is measured must be determined--success as perceived by the managers of the company implementing ERP, end users, customers, suppliers or investors (Peslak, 2006; Standing et al., 2006).

The perception of ERP success depends on how long-term is the different stakeholders' view on what it means ERP project completion (Willis and Willis-Brown, 2002). The ERP journey does not end with the system "going live". Thus, the second issue raised by Markus et al. (2000) is that the phase in the ERP lifecycle where success is measured must be established:

1. At the project phase – success is measured in terms of project cost, completion time, and system functionality. Other papers evaluate the critical success factors that are considered by the companies implementing ERP: top management support, effective project management, business process reengineering (BPR), education and training, user involvement, and vendor support (Somers and Nelson, 2001; Nah and Lau, 2001; Al-Mashari et al., 2003).
2. At the shakedown phase when the implementing company goes through the post-implementation adjustment period--These measurements are concerned with improvements in BP performance: the lead-time, service time, wait time and utilization (Reijers and Aalst, 2005).
3. At the onward and upward phase when most of the benefits are expected and when the company plans further system and business development-- Success is measured in terms of economic benefits, improved business practices, and improved decision-making.

Third, the criteria for implementation success must be established. Usually, in technology-based evaluations, a way to measure success is through expectations and perceptions of those involved in the implementation. In addition to the internal subjective measures, Markus et al. (2000) recommend the use of external criteria of success, such as operational and financial metrics, and the organization's goal for implementing the ERP system.

In this paper, the focus is on the ERP implementation experiences at the project phase and how the degree of success at this phase can influence the benefits obtained in the later stages of the ERP implementation.



### 7.2.3. *Business process changes*

Ho et al. (2004) and Kohli and Hoadley (2006) consider BPR to be a key factor in maximizing ERP system benefits. Motwani et al. (2005) define the BP changes as:

*“...an organizational initiative to design business processes to achieve significant (breakthrough) improvement in performance (e.g. quality, responsiveness, cost, flexibility, satisfaction, shareholder value, and other critical measures) through changes in the relationships between management, information technology, organizational structure, and people”.* (Motwani et al., 2005, pp. 530)

Furthermore, Larsen and Myers (1999) find that the immediate outcomes of BPR are the creation of new organizational accounting structures, new work processes, and a new financial information system. In this study, BP changes are assumed important factors that should lead to internal process efficiency.

### 7.2.4. *ERP benefits*

Shang and Seddon (2002) propose a comprehensive framework for assessing ERP benefits at five dimensional levels: operational, managerial, strategic, IT infrastructural, and organizational. Operational benefits arise from the automation of BP. Managerial benefits arise from better planning and management of organizational resources and better monitoring of financial performance of products, for example. Strategic benefits result from the ERP system’s ability to support business growth and competitive advantage. IT infrastructural benefits mainly come from the reduction of IT costs related to the maintenance of legacy systems. Organizational benefits are related to the system enabling business learning and staff empowerment.

However, in this framework, the ERP benefits are not linked to the reasons for implementing ERP. Such an interrelation would enable the measurement of the achievement of the desired goals of ERP (Mabert et al., 2000; Markus et al., 2000; Irani and Love, 2001 and Chand et al., 2005).

Chand et al. (2005) suggest an improved tool dubbed ERP scorecard, which integrates Kaplan and Norton’s Balanced Scorecard (BSC) with Zuboff’s automate, informate, or transformate goals for use of the information systems. At the automate and informate levels, the implementing company benefits from improved process efficiency and improved tactical decision making. At the transformate level, the implementing company benefits from the capability to facilitate business agility, to meet the new needs of existing customers or the needs of new customers, to move from content learning to knowledge learning. Using the case of a successful ERP implementation, Chand et al. (2005) showed that the success of ERP implementations and operations was contingent on the three goals of firms to use information systems.

In this paper, the ERP scorecard is applied as a tool to assess the impact of ERP on organizational performance. This ensures a larger view on performance, beyond the financial measures to the customer satisfaction, internal process efficiency, and the

ability to learn and grow. The intentions to use the system to automate, informate and transformate the business are assumed to change as the system moves away from the project phase to the onward and upward phase.

### **7.3. Methodology**

Nordic countries are particularly useful for conducting case studies due to the openness, trust and goodwill that business people show for research. This paper is based on a multiple-case study of eight Finnish companies that were selected from the sample used in Velcu (2005). The companies were contacted by phone and given a research project description. The companies that agreed to be part of the project were interviewed from February till June 2006. The applied snowballing technique enabled different access levels in each of the eight companies. Whereas in five companies, the researcher interviewed only one project manager or chief financial officer (CFO), in the remaining three companies, the researcher had deeper access to two, three and respectively four interviewees. Thus, a total of fourteen interviews were made.

The semi-structured interviews were based on an interview guide, which is presented in Appendix 1. The interviews were tape-recorded and transcribed verbatim. The analyzing process began at the interviewing stage, and continued with transcription and content analysis. The content analysis adopted the cross-case strategy where the answers from different interviewees were grouped together around the central topics of this study (Patton, 1990). Then, the observations were derived by identifying common codes across cases concerning the motivations for implementing ERP, the success measures of the ERP implementation project, the BP changes mentioned by interviewees, and the perceived ERP benefits.

The use of Chand's et al. (2005) ERP scorecard as a framework for identifying the ERP benefits mentioned during interviews avoids the 'drowning in data' experience with respect to the evidence collected (Humphrey and Lee, 2004, p. 237).

The companies are at different implementation phases and vary in size and industry. They are presented in the chronological order of the interviews. The first interviewed company (designated 'Company 1'), a mid-size company, one of the leading food manufacturers in Finland, implemented the Movex system from 2003 till 2005. The second company ('Company 2'), the subsidiary of an American company, and one of the world's leading distributors of electronic products, implemented the tailor-made system, RamBase, in 2002, after merging with another company already using this system. The third company ('Company 3'), a large international stainless steel and technology organization based in Finland, started implementing SAP at the corporate office level in 2001. Implementation is still taking place in different subsidiaries. The fourth company ('Company 4') is a small-size recruitment company, in the development stage of its in-house ERP system since 2002. The fifth company ('Company 5'), a mid-size distributor of spare parts for manufacturers, implemented the Solagem system from 2000 till the beginning of 2003. The sixth company ('Company 6'), a mid-size industrial company, implemented the ERP system in 2000. The seventh company ('Company 7'), a mid-size manufacturer, implemented the Movex system from 2000 till

2003. The eighth company (designated ‘Company 8’), a mid-size structural engineering company, implemented PARM software in 2003.

## **7.4. Findings**

The findings reported in this section are based on the interviewees’ perceptions regarding the motivations for the ERP implementation, the success of the ERP implementation project, the BP changes, and the actual benefits achieved. In Appendix 2, one can see the main interview results.

### ***7.4.1. Motivation for ERP implementations***

The evidence collected from these interviews shows that the most frequent motivation for ERP implementing is to replace the legacy system. Five of the eight participating companies were motivated by the need to replace their old legacy system. Three out of the five companies claimed other technologically-led motivations, such as the Y2K problem, the need for a new integrated system, and the ease of upgrading to new versions.

The remaining three case companies mainly had a business-led motivation, such as the need for a common financial strategy and vision throughout the organization, or the need to have a common system with a newly acquired company.

### ***7.4.2. The ERP implementation project – successful or less successful?***

The participating companies had more or less successful implementation experiences, depending on the implementation cost and time, and the critical factors envisaged during the implementation project.

Company 1 completed the ERP project within four years, but the expenses were within budget. In collaboration with IBM, the company went through a two-phased BPR, which output a requirements list for the request for tender for the ERP package. Each BP personnel were involved in the analysis of the BP functions before implementation. The top management supported the end users training program as it believed that the benefits generated by the system increased when the users were familiar with the software functions. Thus, Company 1 managed a successful ERP implementation project.

Company 2 implemented the ERP software on time and within the budgeted direct costs, although the indirect costs were higher than expected. The company decided on a complete BPR. The key users of each BP trained the end users, and involved them in the implementation project. Change management was the responsibility of both management and the most skilful employees. The overall perception was that Company 2 managed a successful ERP implementation.

The ERP project in Company 3 lasted twice that initially planned because of the business strategy changes and the ERP strategy change from the rollout to the cluster

strategy. Despite the perceived efficiency of the education and training program, the end users had a negative attitude towards change. The communication between the project members was faulty as well. Though the implementation was technically ready, further enhancements, upgrades, and organizational changes were planned. The implementation was perceived successful from the technical perspective.

Company 4 committed too much money and time to building an in-house ERP system. The project had top management support and a project champion in the person of the CFO, but the company would have needed consulting to speed up the implementation. The implementation was considered a less successful one.

Company 5 experienced major business strategy changes during the implementation project. After two years of planning, the ERP implementation cost double than estimated. The BP were changed to fit the ERP package, which was not customized to the company's needs. Each project member responsible for a business area appointed subordinates to be involved in the project. The new ERP system was not fully utilized, as it did not always support the company's data. After the first three years, the software selection proved not to be the best. However, the CIO perceived the ERP implementation project as successful.

Company 6 implemented a full-scale ERP system within nine months. The implementation starting point was considered to be wrong: the old system was used for comparison when formulating the requirements list for the new system. The project leaders also had limited support from top management and the software vendor. Features of the off-the-shelf software were implemented based on their fit to the existing BP within the organization. The education and training offered by the vendor should have been continued during the shakedown, onward, and upward stages. Instead, key users with different degrees of comprehension of the system provided the training. Hence, Company 6 was perceived to have been a less successful implementation project.

Company 7 implemented the ERP package within the established budget. The project involved the reengineering of the sales, financial, manufacturing, warehouse and procurement processes. The end users were involved right from the planning phase of the implementation. Moreover, the education and training continued to be provided in the shakedown period. The implementation project was thus perceived as successful.

Company 8 implemented the system on time and within budget. The project team concurred upon a partial BPR. A complete one would have led to too radical organizational changes. The software vendor and the company project manager provided the education and training, throughout the three years of system use, according to the needs that arose at different times. Company 8 was perceived to have managed a successful implementation.

In Company 3, the ERP strategy and the system requirements were changed to accommodate the latest changes in its business strategy, and extended the implementation duration. In Company 5, the use of the system was not coordinated with the significant changes in business strategy, impacting negatively the system functionality. Thus, coordination between business strategy and system use may lead to

a longer implementation project, but results in good system functionality in the long run. Hence:

*Observation 1: There is a positive relationship between alignment of the ERP implementation and business strategies and the success of the ERP implementation.*

#### **7.4.3. Business process changes**

Most of the reported BP changes consisted of streamlined processes and modified work processes, which mainly involved:

1. New tasks, such as credit invoicing in Company 1. This task aimed to correct the customer invoices which had previously contained errors. This was because the end users were not fully familiar with the system. It would be interesting to observe if credit invoicing is performed less frequently in the long run.

2. Decision-making decentralization and employees' empowerment. In Company 2, the ERP system's users started making real-time decisions, which were previously made at a higher level in the organizational hierarchy.

3. The decentralization of sales reporting and purchasing, reassignment of the finance and control tasks, more accurate responsibilities within the delivery department, segregation of financial reporting. For example, in Company 3, the basic accounting tasks were transferred to the sales department and the financial reporting duties were segregated as Accounts Payables, Accounts Receivables, and General Ledger reporting. In Company 8 the reassignment of the finance and control tasks enabled the project leaders to establish the selling prices, the due dates and other invoice terms. Thus, the project leaders were oriented towards the financial management of their projects, which involves better cost management of the business cases. Hence:

*Observation 2: Technologically-led ERP implementations may lead to reassignment of the tasks concerning the financial management of the business cases, which enables a cost-effective completion of business cases.*

In Company 8, further BP changes consisted of the availability of the information on previously completed projects in the company and the real-time follow-up of the project. Project leaders were able to follow the expenses of each business case and make the necessary adjustments at every stage. Hence, an observation regarding the managerial accounting implications of real-time follow-up of customer cases is made:

*Observation 3: Technologically-led ERP implementations may enable real-time follow-up of business cases, hence better cost control.*

#### **7.4.4. ERP Benefits**

The perceived benefits of ERP are reported through the four perspectives of the BSC: internal processes, customers, learning and growth, and financial.

#### 7.4.4.1. *Internal efficiency benefits*

The internal efficiency benefits come from improvement in process efficiency, improvement in tactical decision-making and adaptation to the radical environment changes in a routine manner (Chand et al., 2005).

Based on the interview data, benefits were perceived in terms of increased transparency of business processes, economies of scale, improved service time in accounting tasks, improved access to information, enhanced process management, and shorter cycle times. However, the respondents could not provide any quantitative measurements such as lead times, service times and wait times, regarding the improvement in process efficiency.

In Company 1, some distribution and invoicing tasks were more inefficient than before ERP implementation (e.g. longer time lags in the warehouse, longer automatic processing of invoices). However, benefits such as more effective routing and scheduling activities were expected. Sales orders and customer enquiries are now transparent.

Company 2 perceived more efficient interdepartmental communication and spare time which is utilized for identifying business growth opportunities. In Company 3 the material costs and finance processes were in the harmonization process, which was expected to lead to job rotation throughout the organization. The financial reporting cycles in companies 3, 4, 7 and 8 were estimated to be shorter. In addition, for the last two companies, the production, sales and invoicing cycle times were improved. Company 5 reported improvement in the accuracy of the sales data. The drill-down feature of the sales module reduced the wait times of the sales personnel, improved their decision-making and allowed them to use their time more efficiently. The CFO of Company 8 perceived improvement in accounts receivables management, thus the following observation is made regarding the perceived impact of increased invoice accuracy on accounts receivables management:

*Observation 4: Technologically-led ERP implementations may increase the accuracy of sales transaction data, thus enabling better account receivables management.*

Further, in Company 8 cash management improvements were reported, hence an observation regarding the impact of the changes in the invoicing process on cash management is formulated:

*Observation 5: Technologically-led ERP implementations may lead to more flexible invoicing, which improves cash management.*

Company 2, Company 6 and Company 8 described improved service time in accounting tasks and improved access to information, which resulted in improved customer service. Thus, the following observation regarding the relationship between ERP motivations, internal process efficiency benefits and customer benefits is made:

*Observation 6: Technologically-led and business-led ERP implementations may lead to improved service time in accounting tasks and improved access to information, thus improving customer service.*

#### *7.4.4.2. Customer benefits*

Customer benefits come from meeting current needs of customers more efficiently, from identifying the customer needs proactively, and from meeting new customer needs or new needs of customers (Chand et al, 2005). The most frequent customer benefits mentioned by five of the case companies were improved customer service and more accurate customer invoices.

In the first two months after implementation, Company 1 received customer complaints showing decrease in customer satisfaction. However, better customer service was expected to result from the connection of the ERP system to other new systems in which the company planned to invest (e.g. the system optimizing the distribution routes).

The ERP system in companies 4, 7, and 8 enabled faster response to customers. For example, Company 4, reported improvement in the customer response for orders with a fulfillment period of less than one week. Based on a customer survey, in Company 7, the new ERP system helped to meet the delivery terms. In Company 8, the ERP system enabled faster customer reports and more accurate customer reports regarding the project stages, the tasks of the project members, and the time spent on performing the respective tasks.

In Company 2, less internal mistakes visible to the customer, better follow-up of the customer relationships, and more flexibility in adapting to business changes were perceived.

The FICO process owner of Company 3 did not consider that there were any customer benefits, yet. Still, increased customer satisfaction and more customer value added were expected once the company enhanced its ERP package with a new module (the sales and distribution module). Companies 5 and 6 did not perceive any customer benefits despite the full-scale implementations and despite their being in the onward and upward stage when most of the benefits should have surfaced.

#### *7.4.4.3. Learning and growth benefits*

The learning and growth dimension refers to the assessment of the capability of employees and information systems to manage the organizational processes and their adaptability to change (Hoque and James, 2000).

The participating companies saw their ERP implementations as an opportunity to increase organizational knowledge regarding the system, the internal processes, and the stakeholders involved in the respective processes.

#### 7.4.4.4. *Financial benefits*

The financial benefits come from reduced costs, increased revenues and improved market value (Chand et al., 2005). The respondents could not make quantitative assessments of the ERP systems impact on their firms' financial performance. One reason is that there are other structural changes occurring at the same time with the system implementation, making it difficult to evaluate the direct contribution of the ERP system to financial performance. However, the respondents admitted they expected indirect financial impacts either at the cost or income level.

For example, Company 1 expected lower distribution costs. The ERP system of Company 2 helped the organization maintain steady profitability. Selling prices were calculated more accurately and this had an indirect effect on profit margins. The CFO of Company 8 perceived also fewer mistakes in the invoiced prices and improvements in revenues. In Company 4, indirect effects on revenues were perceived as the system enabled the sales agents to focus more on current customers and on increasing the customer base. Based on this evidence the following observation is made:

*Observation 7: Technologically-led and business-led ERP implementations may enable more accurate selling prices, which lead to better profit margin maintenance.*

Further, in Company 2, the ERP generated economies of scale reduced the generation of costs, in particular headcount costs. In Company 4 decreased headcount costs and economies of scale were perceived after implementation. Hence:

*Observation 8: Business-led ERP implementations may enable economies of scale, which avoid the generation of additional headcount costs and selling, general and administrative costs.*

Company 3 reported lower costs concerning their legacy system maintenance. After the transfer of basic accounting tasks from the financial to the sales process, the number of accountants was reduced. Additionally, the harmonization of the material costs was expected to empower the company to better negotiate the acquisition cost of input materials.

Company 5 reported improvement in inventory levels hence the following observation is made regarding the effect of such improvement on intermediate financial performance measures:

*Observation 9: Technologically-led ERP implementations may lead to better monitoring of inventory levels, which leads to higher inventory turnover.*

Table 2 summarizes the nine observations and the associated quotations extracted from the interview transcripts.



**Table 2 Observations**

<p>Observation 1: There is a positive relationship between alignment of the ERP implementation and business strategies and the success of the ERP implementation project.</p>	<p><i>"I would say that because of this business strategy changes, we didn't achieve what we targeted, I mean the transparency and we needed a harmonized data already during the roll out phase."</i> (FICO process owner, Company 1)</p>
<p>Observation 2: Technologically-led ERP implementations may lead to the reassignment of the financial management of business cases, which means more cost-effective completion of business cases.</p> <p>Observation 3: Technologically-led ERP implementations may enable real-time follow-up of the business, hence better cost control.</p> <p>Observation 4: Technologically-led and business-led ERP implementations may increase the accuracy of sales transaction data, thus enabling better account receivables management.</p> <p>Observation 5: Technologically-led ERP implementations may lead to more flexible invoicing, which improves cash management.</p>	<p><i>"Everybody takes their own responsibility regarding the projects. At the end of a project you know how much it cost per quadratic meter, per kilogram, and they can have the information very easily."</i>(CFO, Company 8)</p> <p><i>"So we can follow up the projects very easily, and also when doing the project. If something goes wrong we can make the adjustments. Before it was so that it was much slower."</i> (CFO, Company 8)</p> <p><i>"...I think we are able to track our business better, so we can maintain our profitability. We make less mistakes so we don't give out our money to our customers ..."</i> (Managing Director, Company 2)</p> <p><i>"So we can follow up the customer projects very easily, also when doing the project. If something goes wrong we can make the adjustments."</i> (CFO, Company 8)</p> <p><i>"The information is everyday updated, because everyday we have the time sheet entries there, so we can invoice as soon as we want to. Before it took longer ...so at least this is one benefit, to receive some interest benefits or something like that."</i>(CFO, Company 8)</p>
<p>Observation 6: Technologically-led and business-led ERP implementations may lead to improved service time in accounting tasks and improved access to information, thus improving customer service.</p>	<p><i>"We can use better our resources in the finance team. Before, it was input in many phases and now all the input is gone, so we can take that time to serve our client better. More reasonable work, which gives some value, not just some input entries."</i> (CFO, Company 8).</p>
<p>Observation 7: Technologically-led and business-led ERP implementations may enable more accurate selling prices, which lead to better profit margin maintenance.</p> <p>Observation 8: Business-led ERP implementations may enable economies of scale, which avoid the generation of additional headcount costs and selling, general and administrative costs.</p>	<p><i>"... our product pricing is sometimes very complicated. So, if we make mistakes then it impacts on the customers with the wrong invoices, and impacts ourselves with the wrong margins, which can maybe make loose our business."</i> (Managing Director, Company 2)</p> <p><i>"... now when we see positive development in the market again, our system can process more business for us, without the need to increase the headcount, for example."</i> (Managing Director, Company 2)</p> <p><i>"Well, let's just say that after the ERP implementation, the cost has dropped in comparison with the situation before [...] Costs</i></p>

<p>Observation 9: Technologically-led ERP implementations may lead to better monitoring of inventory levels, which leads to higher inventory turnover.</p>	<p><i>related to the management of payroll and billing, and costs related to matching the orders and the staff ... The system provides economies of scale.</i>" (Finance Manager, Company 4)</p> <p><i>"... we have now lesser value of the stock than we used to have, and the things that we have in stock are new ..."</i> (CIO, Company 5)</p>
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## 7.5. Findings and Discussion

The eight case companies had different implementation scales and experiences, and ranged in their ERP life cycle stages, from the project phase to the fifth year of post-implementation in the onward and upward phase. Five companies stated a technologically-led justification for their ERP implementation, whereas another three case companies mentioned business-driven implementations.

The case companies had more or less successful ERP projects, contingent on their abilities to complete the project on time and within budget, and to involve critical factors for the success of the implementation (e.g. top management support, BPR, effective project management, user involvement, education and training, vendor support, and change management). The attitude of end users towards the new system was a key aspect of the success of the ERP implementation, since ERP systems typically start generating benefits when the system utilization improves. This confirms Park's et al. (2007) findings that a users' ability to understand ERP knowledge influences the ERP performance.

Some similarities and differences were observed in how the case companies coordinated their motivations for implementing their system with the BP changes, and the ERP benefits perceived in the post-ERP implementation stage (see Figure 1).

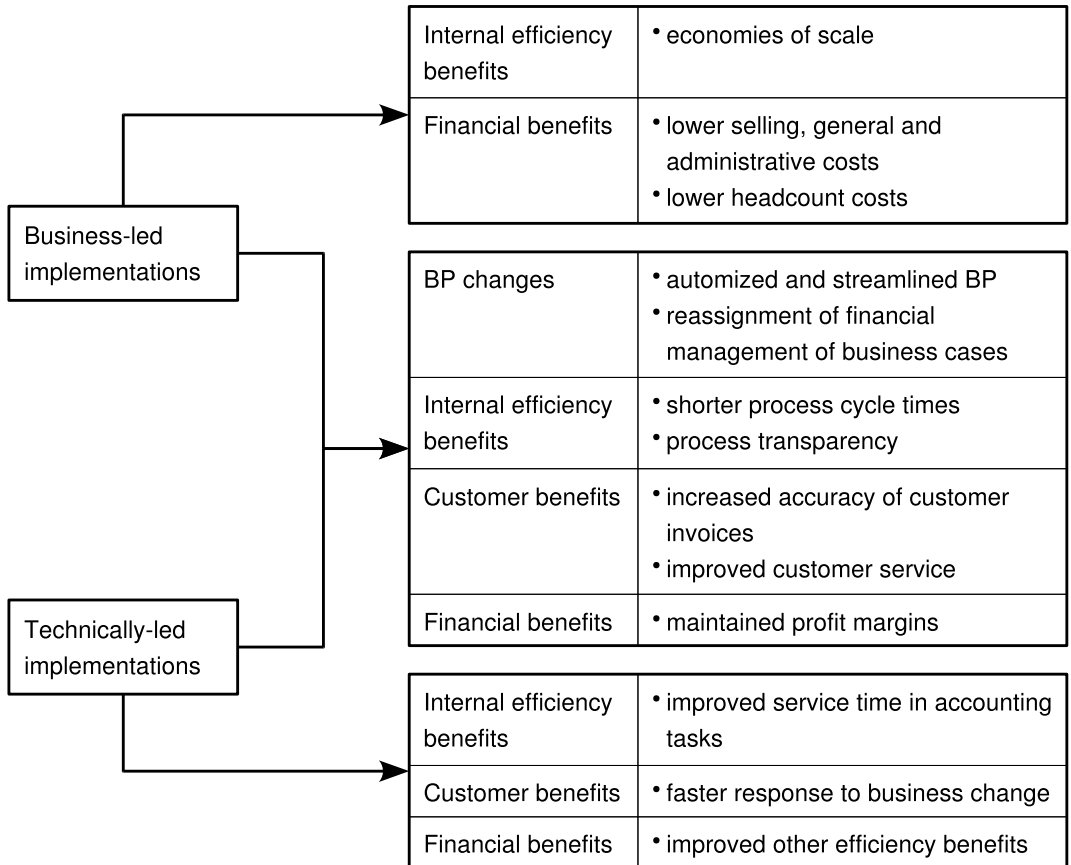
Both technologically-led and business-led companies perceived the same BP changes: automated and streamlined BP, and modified work processes such as decentralized decision-making and improved work assignments.

Both company groups perceived shorter process cycle times and improved process transparency as internal efficiency benefits. However, the improved service time of accounting tasks was a distinct benefit reported by the technologically-led case companies, whereas the business-led companies reported economies of scale.

The increased accuracy of customer invoices and improved customer service were the common perceived customer benefits by both company groups. However, Company 2, with a business-led motivation perceived its faster response to the business change as a different category of customer benefits.

For the technologically-driven companies, other improved efficiency benefits were the main perceived financial benefits. For the business-led companies, the main perceived

financial benefits were the lower headcount costs and selling, general and administrative costs. Both groups of companies perceived the capability to calculate more accurate selling prices as an internal efficiency benefit that maintains profit margins and profitability.



**Figure 3 Similarities and differences between technologically-led and business-led implementations**

## 7.6. Conclusions and future research

The purpose of this study was to explore what BP changes happen in companies implementing ERP systems with different motivations and implementation experiences. Additionally, the study explores the impact of the respective process changes on organizational performance. The results provide a perspective into the interrelationships between ERP motivations and the benefits of ERP. However, this paper does not offer

an exhaustive account of how ERP systems influence BP that ultimately affect performance. This is due to the analytical framework, which provides the lenses through which the interview-based data is interpreted, but which focuses the analysis, interpretation and reporting of the multiple-cases (Patton, 1990). The quality and reliability of the observations made are enhanced by providing relevant quotations extracted from the transcribed interviews.

Furthermore, the validation of this qualitative analysis is enhanced by applying the methods triangulation (Arnold, 2006). Thus, the nine observations drawn from the interview data will be tested in a future quantitative study. Alignment between ERP and business strategy emerged as a new dimension in this analysis and is proposed as a variable, which contributes to the success of ERP projects. Observations 2, 3, 4 and 5 offer a perspective into how successful ERP implementations – either business or technologically justified - lead to BP changes, which then result in perceived internal efficiency benefits. Observations 6, 7, 8 and 9 relate to the link between successful ERP implementations – either business or technologically justified – and internal efficiency benefits, which then reflects in perceived customer benefits and financial benefits. These benefits of ERP are obtained at the automate and informate stages. There were no perceived benefits at the transformate level due to the fact that the case companies have not reached that stage in their system use.

These findings are characterized by a lack of generalisability to settings in other industries or countries. However, the multiple-case study format has the advantage of enabling a better understanding of the BP, companies implementing ERP experience in their natural settings. Koh et al. (2006) shows that the implementation and performance of ERP systems differs between countries, industry sectors, business types and system types, whereas the reasons for implementing ERP are similar. Future case studies may thus be undertaken in different settings to understand the particulars of the interrelationships between reasons for implementing ERP systems and the realized ERP benefits.

One trend in ERP systems consists of the integration of external parties into the system, for example customer relationship management (Elbersten et al., 2006). Hence, one future research path on ERP benefits should focus on intra-organizational relationships, and on how companies can maximize their ERP benefits as a result of integrating their ERP system with the ERP systems of the suppliers and customers within the same supply chain. Then, considering O’Leary (2004) findings that the financial benefits are constant across industries and that the non-financial benefits vary from one industry to another, future research should analyze the non-financial ERP benefits across different industry supply chains.

**APPENDIX 1 INTERVIEW GUIDE**

1. What were the reasons for which the company decided to implement the ERP package?
2. What are the ERP packages you have implemented in your organization?
3. What was the implementation cost?
4. How long did the implementation take place?
5. What is your opinion about the system functionality of the ERP software?
6. What is your opinion about the degree of utilization of the ERP system capabilities?
7. What modules have been implemented?
8. How was the implementation project managed? (critical success factors considered during implementation)
9. What business processes did the ERP system change?
10. How did the ERP system change business processes?
11. Were any metrics established for determining how well the company achieved the ERP implementation objectives? Was any cost /benefit analysis performed prior to or post implementation?
12. I would like to find out more about how the ERP system has affected your organization. What would be the best way for me to learn more from you about it?
13. What are the financial benefits as a result of using ERP?
14. What customer benefits does the company derive from ERP use?
15. Are there perceived internal process effectiveness and efficiency benefits from the use of ERP? If yes, please list them.
16. Does the ERP system contribute to improvement of processes and value creation within company? If yes, please describe how.
17. How are the benefits measured?

## APPENDIX 2 SUMMARY OF INTERVIEW RESPONSES

	Company 1	Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8
Intention to use the ERP system	Automate and informate	Automate, informate, transformate, with emphasis on automate	Automate, informate, transformate	Automate	Automate, informate, transformate	Automate, informate, transformate	Automate, informate, transformate	Automate, informate, transformate
Justification for the ERP implementation	Technologically-led.	Business-led.	Business-led, mainly, technologically-led, secondarily.	Business-led.	Technologically-led.	Technologically-led.	Technologically-led.	Technologically-led.
Management of the implementation project	Successful.	Successful	Technically successful.	Less successful.	Successful.	Less successful.	Successful.	Successful.
Business process changes	Streamlining the sales, invoicing and distribution processes.  The streamlining engendered new tasks, like the credit invoicing.	Streamlining the sales, purchasing, financial, and supporting processes that changed the workflow management system.	The transfer of the basic accounting tasks from the financial process to the sales process.  Changes in the financial reporting workflow - - segregation at group level.	The automatization of the processes.	Availability of the sales transactions data to stakeholders in the sales process.  The decentralization of the purchase task and its transfer to the sales process.  The sales reporting decentralization.	The only company shareholder did not want to make any changes in the business processes.	More accurate responsibilities in the delivery department.  Automation of the dispatch and finance processes.	The reassignment of the monitoring of financial profitability of business cases to the project leaders.  The decentralization of responsibilities within projects.  Real-time follow-up of the projects.  Availability of financial information about completed projects.

	Company 1	Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8
Internal process efficiency benefits	<p>Sales order transparency.</p> <p>Customer enquiry transparency.</p>	<p>Transparent business processes.</p> <p>Improved interdepartmental communication.</p> <p>Economies of scale.</p> <p>Focus on business growth.</p>	<p>Harmonized material costs.</p> <p>Purchase data transparency.</p> <p>Flexibility in financial reporting.</p> <p>Improved financial reporting cycles with one week.</p>	<p>Economies of scale.</p> <p>Improved financial cycle times.</p>	<p>Faster data processing.</p> <p>More accurate sales transaction data.</p> <p>Service time improved.</p>	<p>Better material management.</p>	<p>Better transparency of production and delivery processes.</p> <p>Production, sales and invoicing, finance cycles improved.</p>	<p>Improved service time of accounting tasks.</p> <p>Shorter invoicing cycles.</p>
Customer benefits	<p>Current customer complaints due to mistakes in customer invoices and deliveries.</p> <p>Expected improved customer service.</p>	<p>Faster customer response, more accurate customer invoices, faster response to business changes.</p>	<p>Expected increased customer satisfaction and customer value-added once the company enhances the ERP package with the sales and distribution module.</p>	<p>Improved customer satisfaction, more accurate invoices and faster customer response.</p>	<p>No perceived benefits.</p>	<p>No perceived benefits.</p>	<p>Improved customer satisfaction with company's delivery terms.</p>	<p>Improved customer satisfaction, more accurate customer invoices and faster and more detailed customer reports.</p>
Learning and growth benefits	<p>Employees understand better the business processes.</p>	<p>Improvement of business areas.</p>	<p>Employees understand better the business processes.</p>	<p>For new employees, the system facilitates faster learning of the business processes.</p>	<p>Improvement of the internal processes and organizational culture.</p>	<p>The system helps the employees understand better the business, but it helps more the employees who are not acquainted with the old system.</p>	<p>Increase the understanding of other process stakeholders' responsibility.</p>	<p>Finance employees become more aware about how much they cost the company.</p>

Financial benefits	Company 1	Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8
	Expected lower distribution costs.	Maintained profitability. Improved Accounts Receivables. Improved Profit Margin. Maintained headcount costs.	Lower maintenance costs for the legacy systems. Lower headcount costs. Net income maintenance.	Lower headcount costs. Higher sales.	Lower inventory.	Lower operational costs.	<i>"... that is the main problem. I can't answer based on numbers because I don't have them."</i> (CIO)	Improved cash management Improved revenues Better acquisition prices Improved Accounts Receivables.



## REFERENCES

- Al-Mashari M., Al-Mudimigh A. and Zairi M., (2003), "Enterprise Resource Planning: a Taxonomy of Critical Factors", *European Journal of Operational Research*, Vol. 146, pp.352-364.
- Arnold V., (2006), "Behavioural reserch opportunities: Understanding the impact of enterprise systems", *International Journal of Accounting Information Systems*, Vol. 7, No. 1, pp.7-17.
- Barua A., Kriebel C.H., and Mukhopadhyay T., (1995), "Information Technologies and Business Value: An Analytic and Empirical Investigation", *Information Systems Research*, Vol. 6 No.1, pp. 3-23.
- Botta-Genoulaz V., Millet P.-A., (2006), "An investigation into the use of the ERP systems in the service sector", *International Journal of Production Economics*, Vol. 99, pp.202-221.
- Brynjolfsson E., Hitt L., (1996), "Paradox lost? Firm-level evidence on the returns to information systems spending", *Management Science*, Vol. 42 No. 4, pp.541-560.
- Brynjolfsson E., Hitt L., (1998), "Beyond the productivity paradox", *Communications of the ACM*, Vol. 41 No. 8, pp.49-55.
- Brynjolfsson E., Hitt L., (2000), "Beyond Computation: Information Technology, Organizational Transformation and Business Performance", *Journal of Economic Perspectives*, Vol. 14 No. 4, pp.23-48.
- Chand D., Hachey G., Hunton J., Owoso V. and Vasudevan S., (2005), "A balanced scorecard based framework for assessing the strategic impacts of ERP systems", *Computers in Industry*, Vol. 56, pp.558-572.
- Dedrick J., Vijay G., and Kenneth L. K., (2003), "Information technology and economic performance: A critical review of the empirical evidence", *ACM Computing Surveys*, Vol. 35 No. 1, pp. 1-28.
- Dehning B., Richardson V.J., (2002), "Returns on Investments in Information Technology: A Research Synthesis", *Journal of Information Systems*, Vol. 16 No.1, pp. 7-30.
- Elbertsen L., Benders J., and Nijssen E., (2006), "ERP use: exclusive or complemented?", *Industrial Management and Data Systems*, Vol. 106 No. 6, pp.811-824.

- Hitt L.M., Brynjolfsson E., (1996), "Productivity, Business Profitability, and Consumer Surplus: Three Different Measures of Information Technology Value", *MIS Quarterly*, Vol. 20 No. 2, pp.121-142.
- Ho C-F., Wu W-H., and Tai Y-M. (2004), "Strategies for the adoption of ERP systems", *Industrial Management and Data Systems*, Vol. 104 No. 3, pp.234-251.
- Hoque Z., James W., (2000), "Linking Balanced Scorecard Measures to Size and Market Factors: Impact on Organizational Performance", *Journal of Management Accounting Research*, Vol. 12, pp. 1-17.
- Hoque Z. (2004), "A contingency model of the association between strategy, environmental uncertainty, and performance measurement: impact on organizational performance", *International Business Review*, Vol.13, pp.485-502.
- Hunton JE., Lippincott B., and Reck JL. (2003), "Enterprise Resource Planning Systems: Comparing Firm Performance of Adopters and Nonadopters", *International Journal of Accounting Information Systems*, Vol. 4, pp.165-184.
- Humphrey C., Lee B. (2004): *The Real Life Guide to Accounting Research: A Behind-the Scenes View of using Qualitative Research Methods*, Elsevier Ltd.
- Irani Z., Love P.E.D. (2001), "The propagation of technology management taxonomies for evaluating investments in information systems", *Journal of Management Information Systems*, Vol. 17 No. 3, pp. 161-178.
- Koh S.C.L., Simpson M., Padmore J., Dimitrias N., and Misopoulos F. (2006), "An exploratory study of enterprise resource planning adoption in Greek companies", *Industrial Management & Data Systems*, Vol. 106, No. 7, pp.1033-1059.
- Kohli R., Hoadley E. (2006), "Towards Developing a Framework for measuring Organizational Impact of IT-Enabled BPR: Case Studies of Three Firms", *The DATA BASE for Advances in Information Systems*, Vol. 37 No. 1, pp. 40-58.
- Kumar V., Bharat M., and Uma K. (2003), "An investigation of critical management issues in ERP implementation: empirical evidence from Canadian organizations", *Technovation*, Vol. 23 No. 10, pp.793 – 807.
- Larsen M.A., Myers M.D. (1999), "When success turns into failure: a package-driven business process re-engineering project in the financial services industry", *Journal of Strategic Information Systems*, Vol. 8 No. 4, pp.395-417.

- Mabert V.A., Soni A., and Venkataramanan M.A. (2000), "Enterprise resource planning survey of U.S. manufacturing firms", *Production and Inventory Management Journal*, Vol. 41 No. 2, pp.52-58.
- Markus M.L., Axline S., Petrie D., and Tanis C. (2000), "Learning from adopters' experiences with ERP: problems encountered and success achieved", *Journal of Information Technology*, Vol. 15 No. 4, pp.245-266.
- McAdam R., Galloway A. (2005), "Enterprise resource planning and organizational innovation: a management perspective", *Industrial Management and Data Systems*, Vol. 105 No. 3, pp. 280-290.
- Motwani J., Subramanian R., and Gopalakrishna P. (2005), "Critical factors for successful ERP implementation: Exploratory findings from four case studies", *Computers in Industry*, Vol. 56 No. 6, pp.529-544.
- Nah FF-H., Lau J. L-S. (2001), "Critical Success Factors for Successful Implementation of Enterprise Systems", *Business Process Management Journal*, Vol. 7 No.3, pp. 285-296.
- Nicolaou A.I. (2004), "Firm Performance Effects in Relation to the Implementation and Use of Enterprise Resource Planning Systems", *Journal of Information Systems*, Vol. 18 No.2, pp.79-105.
- O'Leary D.E. (2004), "Enterprise Resource Planning (ERP) Systems: An Empirical Analysis of Benefits", *Journal of Emerging Technologies in Accounting*, Vol. 1, pp. 63-72.
- Omprakash G., Priyadarshini K., Massoud S., and Agrawal S. K. (2004), "Enterprise resource planning: a case of a blood bank", *Industrial Management and Data Systems*, Vol. 104 No. 7, pp. 589-603.
- Park J-H., Suh H-S., and Yang, H-D. (2007), "Perceived absorptive capacity of individual users in performance of Enterprise Resource Planning (ERP) usage: The case for Korean firms", *Information & Management*, Vol. 44 No. 3, pp. 300-312.
- Patton M.Q. (1990): *Qualitative Evaluation and Research Methods*, Sage Publications, Inc., second edition
- Peslak A.R. (2006), "Enterprise resource planning success – An exploratory study of the financial executive perspective", *Industrial Management and Data Systems*, Vol. 106 No. 9, pp.1228-1303.

- Poston R., Grabski, S. (2001), "Financial Impacts of Enterprise Resource Planning Implementations", *International Journal of Accounting Systems*, Vol. 2 No.4, pp.271-294.
- Reijers, H.A. and Van der Aalst, W.M.P (2005), "The effectiveness of workflow management systems: Predictions and lessons learned", *International Journal of Information Management*, Vol. 25, pp.458-472.
- Rickardsson P., Kraemmergaard, P. (2006), "Identifying the impacts of enterprise system implementation and use: Examples from Denmark", *International Journal of Accounting Information Systems*, Vol. 7 No. 1, pp.36-49.
- Shang S., Seddon B.P. (2002), "Assessing and managing the benefits of enterprise systems: the business manager's perspective", *Information Systems Journal*, Vol. 12 No. 4, pp. 271-299.
- Somers T. M., Nelson K. (2001), "The Impact of Critical Success Factors across the Stages of Enterprise Resource Planning Implementations", *Proceedings of the 34th Hawaii International Conference on System Sciences, IEEE*
- Standing C., Guilfoyle A., Lin C., and Love P.E.D. (2006), "The attribution of success and failure in IT projects", *Industrial Management and Data Systems*, Vol. 106 No. 8, pp.1148-1165.
- Stratopoulos T., Dehning B. (2000), "Does Successful Investment in Information Technology Solve the Productivity paradox?", *Information & Management*, Vol. 38 No.2, pp.103-117.
- Velcu O. (2005), "Impact of the Quality of ERP implementations on Business Value", *Electronic Journal of Information Systems Evaluation*, Vol. 8 No. 3, pp. 227-237.
- Yu C-S. (2005), "Causes influencing the effectiveness of the post-implementation ERP system", *Industrial Management and Data Systems*, Vol. 105 No. 1, pp.115-132.
- Willis T.H., Willis-Brown A.H. (2002), "Extending the value of ERP", *Industrial Management and Data Systems*, Vol. 102 No. 1, pp.35-38.

## **8 RESEARCH PAPER 3: “A MODEL OF ORGANIZATIONAL AND IMPLEMENTATION FACTORS THAT ENABLE THE BENEFITS OF ERP SYSTEMS”**

### **8.1. Introduction**

A global provider of market intelligence and advisory services for the IT and consumer technology markets, International Data Group (IDC), conducted a study which forecasted that the spending on ERP systems at a worldwide level increased at an aggregate annual rate of 13.5% between 2001 and 2006, reaching \$187 billion in 2006 (Newman and Westrup, 2005). A further study by IDC forecasted a 5% annual growth of the ERP applications market from 2006 to 2010 (Bruin and Lykkegaard, 2007).

IT represents the actual hardware, software and networks on which different types of information systems (IS) are built. Unlike legacy IS which support particular business functions within organizations, ERP systems melt down the distinctions between different business applications by integrating the business processes and IT technologies into one system. ERP systems are usually implemented based on business justifications like improved productivity, reduced costs, operational efficiency, or better supply chain management. Therefore, ERP systems are expected to contribute to the business performance of the implementing companies.

At present, ERP systems are less heterogenous within industries, and the way companies exploit their ERP systems may be an opportunity for achieving competitive advantage (Beard and Sumner, 2004). The effective exploitation of ERP systems relies on the successful ERP project planning, implementation, alignment and utilization. Successful ERP planning and implementation depend upon business process reengineering, effective project management, and the creation of cross functional teams, among other factors (Willcocks and Sykes, 2000; Markus, Axline, Petrie, & Tanis, 2000). Effective project management involves the alignment of organizations to ERP systems.

Strategic alignment of business with IS strategies has been an important topic in the 1980's and 1990's and it refers to the extent to which the IS portfolio of a company provides support to the business strategy. Some studies point out the leveraging effects of the alignment of business with IS strategies on the relationship between IS and business performance (Law and Ngai, 2007; Byrd et al., 2006; Stratopoulos and Dehning, 2000). However, extant research has not empirically tested the role of strategic alignment for the success of ERP implementations. This issue will be addressed in this paper.

The need for aligning the ERP and business strategies is also emphasized by the three main implications that ERP systems have for the companies implementing the system: 1) the company implementing the system may need to make changes to its business processes and procedures, 2) the company may need to do some customizations to the system, 3) the company becomes dependent on the system vendor for support and updates (Lucas et al., 1988). The first implication underlines the business process changes that are enabled by ERP projects. Yet, Dehning and Richardson (2002)

conclude that the underlying business processes are ignored in most of the reviewed literature on IS business value, which mainly focuses on the direct relation between IS and business performance. Within the context of ERP implementations, the critical role of aligning business processes to the ERP package during implementation is noted (Markus et al., 2000; Parr and Shanks, 2000). Therefore, regarding the field of ERP business value, further investigation is needed on the effects on business performance of process changes enabled by ERP implementations.

This paper is further based on the assumption that ERP implementations necessitate a continuous improvement effort. The way companies manage the implementations at every stage of the system lifecycle may influence the impact of ERP systems on business performance in the long run. Therefore, for a better understanding of the contribution of ERP to business performance, it is worthwhile studying how different factors of ERP implementations at every stage impact the business performance. Hence, overall this study examines the interrelations between strategic alignment, the management of ERP projects, the process changes and their effect on the business performance of companies implementing ERP.

The remainder of this paper is structured as follows: The following section presents the theoretical standpoints concerning the conceptualization of strategic alignment. The next section introduces the theoretical framework to which this paper contributes. Then, the seven hypotheses are developed. The empirical part starts with the description of the sample selection, and continues with a non-response bias assessment and the operationalization of strategic alignment construct. Then, the results of the PLS analysis are reported, namely the specification of constructs and indicators, the assessment of reliability and validity and the assessment of the structural model. The main findings of this paper and their implications are summed up in the conclusions.

## **8.2. Strategic alignment conceptualizations**

Strategic alignment refers to the implementation of IS so that it integrates and develops the business strategies and organizational goals (Papp, 1999; Henderson and Venkatraman, 1991). Thus, strategic alignment analyzes the potential of IS strategy to influence the business strategy of the firm.

Strategic alignment represents the starting point of the model developed in this study. While the study aims to build a model of factors that enable companies to obtain benefits from their ERP systems use, it uses a model of strategic alignment that develops a set of tools that can show if the ERP strategy supports the business strategy. By comparing the different theoretical views on strategic alignment, the view implemented by Chan, Huff, Barclay and Copeland (1997) is selected, which better fits the model developed in this paper.

Mintzberg (1978) differentiated between planned and realized business strategy and emphasized the importance of analyzing not only what companies plan but also the actual result of planning. The strategic intent is the official strategy that is documented in some companies, whereas in some other companies, it is just verbalized. The realized business strategy is defined as a “pattern in a stream of decisions” (Mintzberg, 1978,

p.934) and describes the assortment of managerial choices actually implemented in the decisions made and in the employees' actions to achieve the desired business goals.

Intention versus realization is one of the four theoretical questions on which Venkatraman (1989) conceptualizes the business strategy construct: 1) scope: should the strategy definition distinguish between "means" and "ends"?; 2) hierarchical level: should the construct be defined at the corporate, business or functional level?; 3) domain: should the definition have a functional focus, such as marketing or manufacturing, or a broader perspective?; and 4) Intentions versus Realizations: is the distinction between intended and realized strategies relevant for conceptualizing and measuring the construct?

The answers to these questions conceptualize the construct as a realized strategy consisting of patterns of resource deployments to achieve the desired goals at the business level along a broader perspective. Six dimensions of strategic orientation, which are not industry specific, are identified:

- **Aggressiveness** – this dimension reflects the allocation of resources within an organization to improve its market positions faster than its competitors in the respective market segments.
- **Analysis** - this dimension refers to the decision-making behavior of organizations, to the internal consistencies in the resource allocation, and to the use of appropriate management systems.
- **Defensiveness** – this dimension reflects the behavior of companies, which focus on cost reduction, efficiency seeking methods, and defending their core technologies.
- **Futurity** – the concept of strategy is based upon the idea of desired future, hence this dimension reflects key strategic decisions that have either a long-term or short-term focus. For example, emphasis on basic research represents a strategy with a long-term consideration whereas emphasis on application-oriented research programs shows a short-term strategy.
- **Proactiveness** – is related to the proactive behavior concerning the involvement in emerging industries, the continuous search for market opportunities and trying out potential responses to the changing environment.
- **Risk Aversion** – reflects the degree of risk involved in the resource allocation decisions, and the choice of products and markets.

Thus, based on the above-mentioned six dimensions, Venkatraman (1989) conceptualizes a business strategy construct, termed strategic orientation of business enterprises (STROBE). For each dimension, operational indicators are developed and validated.

The two perspectives on business strategy, the intended and the realized view, are applied to the strategic alignment concept as well (Chan et al., 1998). The research

stream on the intended strategic alignment conceptualizes and operationalizes frameworks for thinking about strategic alignment thinking (Coleman and Papp, 2006; Papp, 1999; Luftman and Brier, 1999; Henderson and Venkatraman, 1993; Henderson and Venkatraman, 1991). However, it may happen that organizations do not implement the formulated strategies, and end up following strategies that were not intended at the planning stage.

In the current paper, the focus is on the realized view on strategic alignment, which becomes part of the behavior of organizations (Mintzberg and Waters, 1982). In order to investigate the implications of strategic alignment on the ERP business value, the realized perspective is assumed more appropriate than the planning perspective on strategic alignment because the intended strategies for implementing the ERP system may not be applied in the actual selection stage of the system. Additionally, the realized view is assumed to better clarify the difference between the company's ERP priorities and capabilities by viewing ERP in terms of the business needs and activities it supports.

### **8.3. Theoretical framework**

The belief of the research stream that explores the leveraging effect of strategic alignment on IT investments is that one reason for the inability to realize value from IT investments is the lack of alignment between the business and IT strategies. Previous research shows that companies with high strategic alignment are better performing companies (Duh et al., 2006; Byrd et al., 2006; Dehning et al., 2005; Somers and Nelson, 2003; Hong and Kim, 2002; Kotha and Swamidass, 2000; Papp, 1999; Luftman and Brier, 1999; Chan et al., 1997; Chan and Huff, 1993; Henderson and Venkatraman, 1991; Simons, 1987).

Floyd and Wooldridge (1990) show that when IT represents a strategic necessity, its effect on performance is modestly positive or neutral, and when IT is strategically misaligned, its impact on performance is negative. This implies that the impact of IT investments on the financial performance depends on the strategic role of IT within the organization.

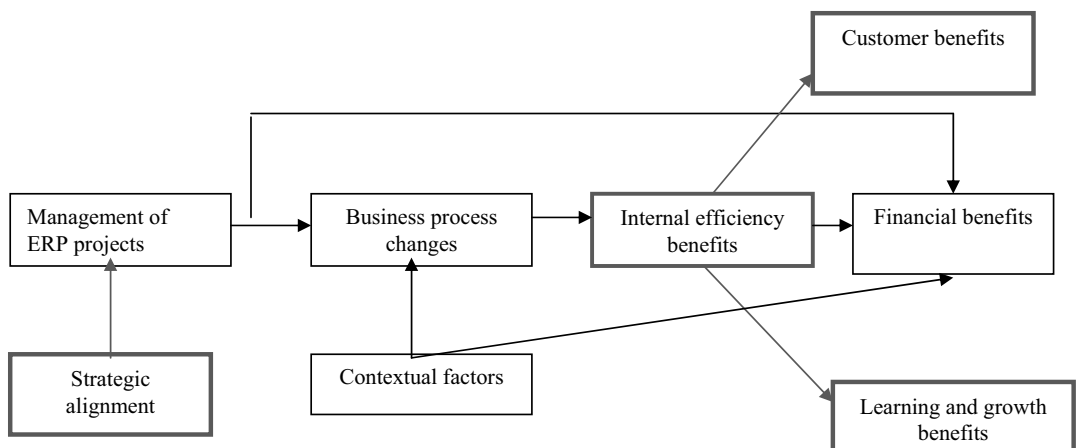
Brynjolfsson and Hitt (1996) find that the companies that invested in a mix of mainframes and PCs were better performers than the companies that used mainly either mainframes or PCs. Stratopoulos and Dehning (2000) show that companies that successfully use their IT to support the business goals have a superior financial performance compared to companies that align less successfully the IT use to the business goals. Dehning and Richardson (2002) concur that IS that provide managerial information responding to the business strategy, are associated with higher performance.

Byrd et al. (2006) find that alignment between business and IS strategies is important for achieving gains in business performance. They use both the planning and realized view on strategic alignment and find that the coordination of the planning process of strategic alignment and the realized process of strategic alignment have a leveraging effect on the relationship between IT investment and firm performance. However,



within ERP context, the leveraging effect of strategic alignment on ERP performance was not tested.

Dehning and Richardson (2002) propose a framework for guiding future research in the evaluation of IT business value. The framework describes three ways of measuring the investments in IT as: 1) IT spending, 2) type of IT strategy, which refers to the type of system bought (e.g. ERP or electronic commerce) and 3) IT management, which refers to the degree of success with which companies use IT. This model shows that the 1990's research examines both the direct relationship between IT investments and firm performance, and the indirect relationship between the two variables, intermediated by the business process changes. The framework also includes the papers that investigate the effect of contextual factors such as industry, size, or IT intensity on the IS – firm performance relationship. In light of the strategic alignment research field, this framework can be extended to comprise the effect of strategic alignment on the IT business value. Thus, this paper suggests an enlarged framework of Dehning and Richardson's (2002) that can be seen in Figure 1. In the extended framework, a more specific measure of IT investments is suggested; ERP systems, which are a specific deployment of IT strategy in organizations. Another proposed extension relates to Dehning and Richardson's (2002) construct "process measures", which is split into the constructs "business process changes" and "internal efficiency benefits". ERP systems incur changes in business processes, which are expected to increase the efficiency at process level. Therefore, the two latter constructs represent a more detailed reflection of the organizational effects of ERP systems implementations.



**Figure 1** Theoretical framework (adapted from Dehning and Richardson, 2002, p. 10)

According to Dehning and Richardson's (2002) analysis, business performance is analyzed using accounting measures (return on assets, return on equity, return on sales) or market value measures (Tobin's q, short-window abnormal stock returns). In this

paper, it is proposed that the organizational performance is analyzed through the Balanced Scorecard (BSC) perspective that provides a multidimensional view of performance at the internal processes dimension, the customer dimension, and the learning and growth dimension in addition to the financial dimension (Boulianne, 2007; Duh et al, 2006; Hoque and James, 2000; Ittner and Larcker, 1998).

#### **8.4. Hypotheses development**

Velcu (2007) conducts a multiple-case study to explore the business process changes in companies that implement ERP systems with different motivations for the ERP project and different degrees of implementation success. The study further explores the impact of the respective process changes on the business performance and derives nine observations. Some observations capture the links between the management perception of successful ERP implementations – initially business or technologically driven – and business process changes, which then result in internal efficiency effects. Other observations offer perspectives into the links between the management perception of successful ERP implementations – initially business or technologically driven – and internal efficiency benefits, which then impact the perceived customer and financial benefits. Learning and growth benefits were perceived in terms of integration effects but further links to other types of benefits were not reported. Based on the above-mentioned observations and on additional previous research findings, hypotheses are formulated and tested in this paper.

##### ***8.4.1. Strategic alignment and successful ERP implementations***

Markus et al. (2000) argue that one way of measuring the success of ERP implementations includes project measures (e.g. time and cost of the project), operational metrics, and long-term business results. The companies implementing ERP may be at different stages of implementation. In order to provide a consistent success measure, in this paper, the success is gauged at the ERP project phase.

Previous research reports significant gaps between the functionality imbedded in ERP systems and the functionality required by the companies implementing ERP (Sheu et al., 2004; Soh et al., 2000). If companies implement ERP systems that do not meet their business strategies and attempt to customize the system to meet their own needs, this increases the risk of the implementation project. Furthermore, Velcu (2007) observes that when companies change the business strategy, there is the need to adapt the ERP use according to the subsequent strategy change. Hence, in this paper, the following hypothesis is generated:

H1: There is a positive association between strategic alignment and the management perception of successful ERP implementation.

#### ***8.4.2. Motivations for implementation and the ERP implementation success***

When implementing ERP systems, companies may have either a business (e.g. enable business growth, reduce inventory costs) or a technological drive (e.g. solve the Y2K problem, replace disparate systems) or both. Previous research emphasizes the importance of the analysis of the relationship between ERP motivations and the benefits of ERP, though it was not empirically tested (Chand et al, 2005; Nicolaou, 2004; Markus et al., 2000). The importance is explained by the fact that based on the motivation for the ERP implementation, companies should make the appropriate choice of an ERP package that matches the organizational strategy, structure and culture. Any mismatch results in higher implementation costs and longer time. For example, one of the reasons for the ERP system implementation in a hospital was to decrease the computer operating costs. The legacy system allowed the doctors to trace the patients' location by querying the system. The new ERP system considered doctors as users and additional license fees had to be paid, which increased the cost of the functionality compared to the previous system (Soh et al., 2000). Hence, in this paper it is hypothesized that:

H2: There is a positive association between the motivation for ERP implementations and the management perception of success of ERP implementation.

#### ***8.4.3. Successful ERP implementations, business process changes and internal efficiency benefits***

Successful ERP implementations frequently require organizational adaptations to the ERP package through extensive business process reengineering. The research field on critical success factors of ERP implementations posits that a central factor to the success of ERP systems is the redesign of business processes (Somers and Nelson, 2003; Sumner, 2000; Bingi et al, 1999). However, a complete business process redesign may result in losing the unique business processes of the company implementing ERP. If the company implements the system as it is from the vendor, the customization costs, the future maintenance and upgrading costs are kept to a necessary minimum. Somers and Nelson (2003) report on a study which did not obtain any significant correlation between the most reengineered processes and the benefits from ERP implementations. On the other hand, when the company customizes the ERP software to suit its business needs, the total cost and risks of the implementation increase.

In this paper it is believed that the successful ERP implementations bring along an enterprise-wide transformation in which the business process redesign has a major role. Companies implementing ERP systems should establish their implementation project duration and budget depending on whether the business process reengineering is partial or complete. Furthermore, in the first post-implementation years, the use of the ERP system facilitates efficiency benefits (Velcu, 2005).

Hence, the following two hypotheses are generated:

H3: The management perception of success of the ERP implementation project is positively associated to the ERP incurred business process changes.

H4: The business process changes incurred by ERP are positively associated to the ERP perceived internal efficiency benefits.

In describing the implementation experiences of companies that achieved partial business process reengineering, Velcu (2007) reported process changes in terms of reassignment of the financial management of business cases, real-time follow-up of business, accuracy of sales transaction data and more flexible invoicing. These process changes are engendered by successfully perceived ERP implementations. The process efficiency was perceived in terms of accuracy of the selling prices, better cost control, improved accounts receivables management and cash management.

#### ***8.4.4. Successful ERP implementations, internal efficiency benefits and customer benefits***

Chand et al. (2005) suggest that the success of ERP implementations and operations depends on the firm's initial intention to use the system to automate the business processes. The benefits of ERP systems may not be achieved if the automation results in inefficient business processes. Hence:

H5: The management perceived success of ERP implementations is positively associated with perceived internal process benefits of ERP.

Automating the business processes is the initial goal of companies implementing ERP. Chand et al. (2005) further suggest that when using the ERP system organizations realize that it can be used to inform the stakeholders involved in the value chain. Furthermore, the ERP use enables the companies to transform their processes to provide value-added services to stakeholders. Therefore, at different stages of ERP use, different benefits result. Velcu (2007) observes that improved service time in accounting tasks and improved access to information may lead to improved customer service. Hence, the following hypothesis is formulated:

H6: The internal process benefits of ERP are positively associated with the perceived customer benefits of ERP.

#### ***8.4.5. Internal efficiency benefits and financial benefits***

Chand et al. (2005) note some sort of ordering among the benefits of ERP; first the organizations achieve the automate and informate level benefits, and then the transformate level benefits. This supports Markus et al.'s (2000) suggestion that the benefits of ERP should be measured at different points in time during the ERP life cycle. The financial benefits should be measured in a later stage.

Velcu (2007) observes that more accurate selling prices, economies of scale, and better monitoring of inventory levels may contribute to profit margin maintenance, reduced headcount costs and selling, general and administrative costs, and higher inventory turnover. Thus, the following hypothesis is derived:

H7: The internal efficiency benefits of ERP are positively associated with the perceived financial benefits of ERP.

The seven hypotheses can be collected in a path model that has as a starting point the importance of strategic alignment and motivation for ERP implementation for the success of ERP projects (see Figure 2, p.92). Then, the model captures the relations between the degree of success of ERP projects, the associated business process changes and the subsequent internal efficiency benefits. At last, the model captures the effect of internal process efficiency on customer benefits and financial benefits.

The survey design is shown in Appendix 1 and contains six sections.

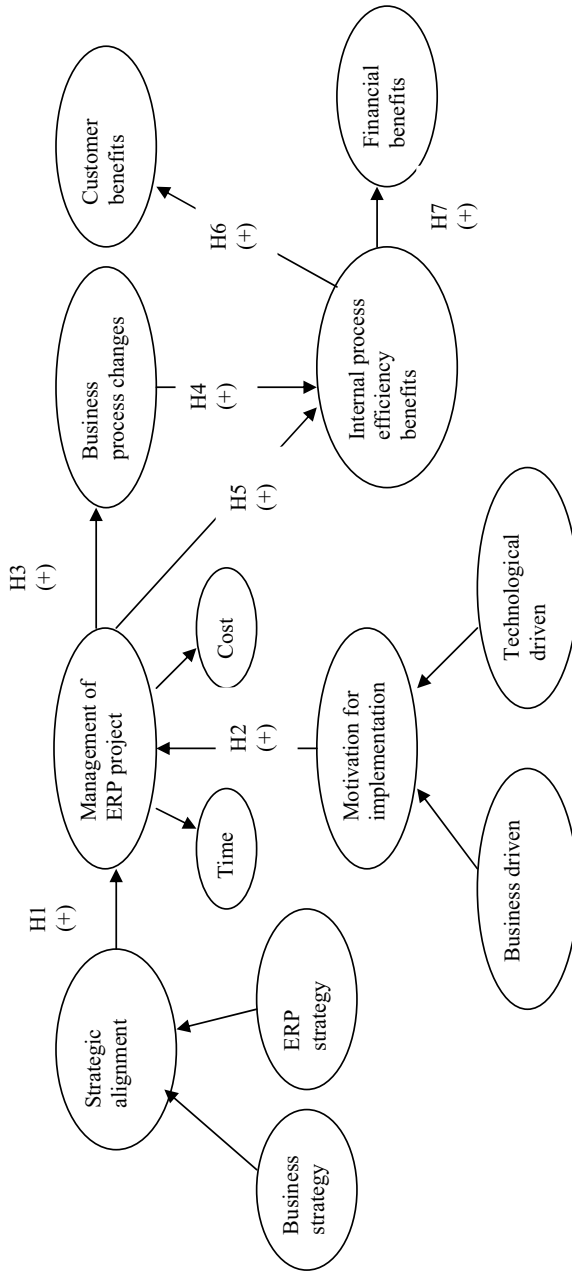


Figure 2 Path Model

## 8.5. Sample selection

The sample was selected from the database of the Largest Companies in the Nordic Countries. The first survey was sent by email on the 31st January 2007 to the CEOs, CIOs or CFOs of 1670 companies from different industries. The CIOs were the main target. The CEOs contact information was the second preferred target. However, in the companies for which the CIO or CEO contact information was not found, the CFO's contact information was used.

On the 3rd February 2007, the same survey was sent to the CFOs of an additional population of 1279 companies, out of which 158 were not delivered. Thus, 1121 CFOs actually received the online survey. On the 12th February and 19th February another two reminders were sent. Each time, most of the responses came in the first two days after submission. 17 targeted respondents informed that they could not answer because the company did not implement an ERP system. Another 17 informed that they could not participate in the survey due to time constraints. In addition, the researcher received 187 out of office emails.

In total, 97 responses were received, out of which 88 were usable. Table 1 provides information on the size and industry of the responding companies and the job titles of the respondents. The other nine responses contained more than 3.5% missing fields or N/A answers to be taken into account without biasing the results (Van der Stede et al., 2005). Although the response rate is low, the usable number of responses is typical in this research stream (Laukkanen et al., 2007; Boulianne, 2007; Byrd et al, 2006; Hong and Kim, 2002). Different factors may have contributed to the low response rate of 3.4%: the high position in the organization of the target respondents, the motivation and the capacity of the respondents, the timing of the survey, the interest level in the survey topic, the length and tone of the survey, the order of the items and the follow-up mechanism (Werner et al., 2007; Rogelberg and Stanton, 2007; Van der Stede et al., 2005; Viswesvaran et al., 1993).

Waarts and Van Everdingen (2005) study the influence of national culture on the ERP implementation status within 10 EU countries. The findings show that the national culture explains the variance in the implementation decisions. However, the Nordic European countries seem to be the most receptive to the ERP adoption. This may show that there are similarities in the culture of the Nordic countries, which result in a positive attitude towards the ERP adoption decisions. Thus, in this paper, the responses from the Nordic region may be treated as one set (Björkman and Forsgren, 2000).

**Table 1 Responding companies by size and industry and job title of respondents.**

<b>Responding companies size by number of employees</b>	<b>n</b>
0-100	32
101-500	36
501-1500	10
1501-2000	2
2001 +	5
N/A	7
<b>Responding companies by industry sector</b>	<b>n</b>

Services	17
Manufacture	48
Other	23
<b>Respondents by job title</b>	n
CIO	2
CEO	30
CFO	56
Total	88

### 8.6. Assessment of non-response bias

In order to increase the external validity of the survey and determine if the reported results exhibit bias, a non-response bias test is performed, which is the most common technique of non-response analysis in management accounting. This approach assumes that late respondents are more likely to be similar to non-respondents and consists of the comparison of early vs. late respondents with regard to the means of all variables for both samples (Rogelberg and Stanton, 2007; Van der Stede et al., 2005). If late respondents differ from early respondents, it means there is a level of bias. It is thus analyzed whether the low response rate has any substantive impact on the conclusions drawn from the data.

The early responses are defined as the responses received in the weeks in between the first email and the first reminder, which is 45% of the returned usable questionnaires. 54% of the returned usable questionnaires are late responses, which are the responses received in the first weeks after each of the two reminders. In this paper, the non-response bias was assessed between the first week responses and the last week responses. No significant difference between the 93 variables of the two samples was found. However, for two variables, “improved management of cost centers” and “ERP support for calculating risks”, a significant difference was found. The two variables have been dropped in the estimation of the measurement model stage of the PLS analysis because they did not fulfill the required threshold value for loadings. Consequently, the response bias is not considered a significant problem in the study.

### 8.7. Operationalizing strategic alignment

Building on Venkatraman’s (1989) scale for strategic business orientation (STROBE), Chan et al. (1997) develop and evaluate an instrument to measure the strategic orientation of the existing portfolio of information systems, dubbed STROEPIS. A parallel STROEPIS questionnaire item was designed for each STROBE questionnaire item. However Chan et al. (1997) operationalize the STROEPIS scale in terms of the initial eight dimensions of the STROBE instrument developed by Venkatraman in his doctoral thesis. Table 2 contains the definitions of the eight dimensions of the STROEPIS scale.



**Table 2 Definitions of STROEPIS dimensions**

STROEPIS dimensions	Definitions
IS to support Aggressiveness	The IS deployments that the company uses when it follows aggressive market actions.
IS to support Analysis	The IS deployments that the company uses when analyzing the business situations.
IS support to Internal defensiveness	The IS deployments that the company uses to improve the business processes efficiency.
IS support to External defensiveness	The IS deployments that the company uses to strengthen the business network with the suppliers and customers.
IS support to Futurity	The IS deployments that the company uses for planning and forecasting.
IS support to Proactiveness	The IS deployments that the company uses to accelerate the introduction of products/services.
IS support to Risk aversion	The IS deployments that the company uses to assess the business risks.
IS support to Innovativeness	The IS deployments that the company uses to enable the creativity and experimentation.

The current paper adopts these operational measurements of realized strategy, but within the context of ERP implementations.

Alignment of IS with business strategy is measured by investigating whether the implemented business and IS strategies match or whether they have a moderating effect on each other. The matching effect involves the calculation of the difference between the eight corresponding dimensions of STROBE and STROEPIS scales. The greater the distance between the two corresponding dimensions, the greater the misalignment between the two strategy outcomes. The moderating effect of the realized view on strategic alignment involves the leveraging effect of IT support on business strategy by multiplying the scores of the two scales. The higher the scores of both STROBE and STROEPIS scales the higher the measure for the moderation form of strategic alignment. This paper adopts the matching approach.

### **8.8. Constructs and indicators specification**

The survey collected information on “strategic alignment”, “management of ERP projects”, “motivation for implementation”, “business process changes” and impact on business performance measured through the lens of BSC. The only established measurement instrument was for strategic alignment. For the remaining constructs in the model, new measures were developed. This involved the construction of indicators based on the theoretical nature of the constructs “motivation for implementation” and “management of ERP projects” and based on the findings in Velcu (2007) regarding the business process changes and impact on business performance. A description of what indicators are used to measure what constructs is given in Appendix 2.

The data was analyzed using PLS. PLS is considered an appropriate method to estimate the developed model due to the small data sample and to the existence of unobservable variables in the model. The PLS analysis consists of estimating both the measurement model (the links between indicators and constructs) and the structural model (the links between constructs). There are two rules of correspondence between measures and constructs: reflective indicators and formative indicators (Hulland, 1999). Reflective indicators are reflected by the underlying construct, they are caused by the underlying

construct. On the other side, formative indicators define or cause the underlying construct.

The model to be estimated contains three second order latent variables: “strategic alignment”, “management of ERP projects”, and “motivation for implementation”. The remaining variables, “business strategy”, “ERP strategy”, “business driven”, “technical driven”, “time”, “cost”, “business process changes”, “internal process efficiency”, “customer benefits” and “financial benefits” are first order variables that are a linear combination of the indicators (also known as manifest variables). The indicators are measured with Likert-type scales, which provide the advantage that they standardize and quantify relative effects (Somers and Nelson, 2003). Each question required respondents to agree or disagree on a seven-point scale.

Based on Chan et al. (1997), “business strategy” and “ERP strategy” are considered formative variables for the “strategic alignment” construct. “Motivation for implementation” is also taken as a formative construct, defined by the “business driven” and “technology driven” constructs, which are first order variables. The rest of the constructs in the measurement model are evaluated through reflective indicators: “management of ERP projects”, “changes in business processes”, “internal process efficiency”, “customer benefits” and “financial benefits”.

In order to approximate the second order factors, the hierarchical component model is recommended as the easiest way to implement (Chin, 2000a). According to this method, the second order factor is directly measured by the observed variables of all the first order factors that are measured with reflective indicators. All the first order factors used in this paper are measured with reflective indicators.

## 8.9. Reliability and validity assessment

Only the reflective indicators are assessed for reliability and validity. The formative indicators can have positive, negative or no correlation with one another, thus the individual item reliability and validity become irrelevant assessments (Bollen and Lennox, 1991). The parameters of the estimated measurement model are presented in Table 3.

**Table 3 Estimates for the measurement model**

Construct	Indicators	Loadings	Composite reliability	AVE
Management of ERP projects			0.929	0.653
	Costs of consultants	0.78		
	Training costs	0.73		
	Actual cost compared to the budgeted one	0.88		
	Estimated work volume	0.89		
	BPR	0.73		
	Initial project schedule	0.81		
	Actual duration of implementation	0.82		
Time			0.914	0.728
	Estimated work volume	0.92		

Construct	Indicators	Loadings	Composite reliability	AVE
	BPR	0.78		
	Initial project schedule	0.86		
	Actual duration of implementation	0.83		
Cost			0.906	0.763
	Costs of consultants	0.89		
	Training costs	0.83		
	Actual cost compared to the budgeted one	0.90		
Business process changes			0.902	0.822
	Real-time follow up	0.89		
	Easy follow-up of business	0.92		
Internal process efficiency benefits			0.891	0.622
	Increased accuracy of sales data	0.79		
	Better resource management	0.88		
	Economies of scale	0.74		
	Automation of cost control of operations	0.82		
	Improvement in accounts receivables management	0.69		
Financial benefits			0.787	0.552
	Lower headcount costs	0.74		
	Lower selling, general and administrative costs	0.74		
	Higher inventory turnover	0.74		
Customer benefits			0.868	0.622
	Improved customer service	0.79		
	Focus on customer value-added activities	0.75		
	Better monitoring of due payments	0.76		
	More accurate customer invoices	0.84		

The reliability is assessed by examining the loadings (or correlations). A general rule of thumb is that the items with loadings less than 0.7 should be eliminated. However, studies using PLS vary in the accepted threshold, pushing it down from 0.7 to 0.4. In this paper, the accepted threshold is 0.7. The items with loadings lower than 0.7 were removed in order not to endanger the explanatory power of the model. The model was run again, and the output estimates are reported in Table 3. After the second estimation of the measurement model, the construct “internal process efficiency benefits” has one item with the loading 0.69. Considering that it is a loading extremely close to the accepted threshold, the item is kept in the model.

The reliability measures if the shared variance between an individual item and its construct is higher than the error variance. However, for a single construct, multiple items are usually used, in which case the extent to which the measures show convergent validity has to be checked (in this study referred as composite reliability). Hulland (1999) suggests a cut-off point of 0.7 for a “modest” composite reliability. The composite reliability of the constructs in the model estimated in this paper complies with the recommended cut-off point. This means that the constructs are well-defined and uni-dimensional.

Discriminant validity complements convergent validity and it shows the extent to which the measures of an underlying construct are different from the measures of another construct in the model. According to Fornell and Larcker (1981), discriminant validity is assessed based on Average Variance Extracted (AVE), which shows the average variance shared between a construct and its measures. This measure should be higher than the variance shared between the construct and other constructs in the model (Chin, 1998). As can be seen in Table 4, all constructs fulfill these criteria.

**Table 4 Correlation Matrix of the constructs measured through reflective indicators**

	Management of ERP projects	Business process changes	Internal process efficiency benefits	Financial benefits	Customer benefits
Management of ERP projects	<b>0.808<sup>6</sup></b>				
Business process changes	0.253	<b>0.873</b>			
Internal process efficiency benefits	0.201	0.383	<b>0.788</b>		
Financial benefits	0.192	0.497	0.608	<b>0.742</b>	
Customer benefits	0.157	0.583	0.749	0.608	<b>0.788</b>

From Table 4, it can be seen that the correlation between “customer benefits” and “internal process efficiency benefits” is higher than the absolute value of AVE for these two constructs. Therefore, an additional exploratory factor analysis was carried out. For both constructs, the correlation matrixes have most coefficients higher than 0.3. The Kaiser-Meyer-Okin value was 0.757 for “customer benefits” and 0.859 for “internal efficiency benefits”, which are higher than the recommended value of 0.6 (Pallant, 2007). The Barlett’s Test of Sphericity had a significance level of 0.000 for both constructs, which supports the factorability of the correlation matrix. In addition, for both constructs, the exploratory factor analysis revealed two components with eigenvalues higher than 1. However, the screeplot displayed an obvious break after the first component, which led to the decision to retain only one component for “customer benefits” and one component for “internal efficiency benefits”. Appendix 4 contains the screeplots output by the exploratory factor analysis on which the decision of uni-dimensionality of “customer benefits” and “internal efficiency benefits” was based on. Thus, the results of exploratory factor analysis show that both of these two reflective indicators are uni-dimensional, which supports the convergent and discriminant validity results.

An additional test that confirms the results of the discriminant validity between the “customer benefits” and the “internal efficiency benefits” is to verify if the indicators of each of the two constructs load more strongly on their corresponding construct than the other construct (Agarwal and Karahanna, 2000; Chin, 2000b). As can be seen in Table 5, all the indicators load higher on their own construct than on the other construct. In

<sup>6</sup> The Square root of the AVE for each of the constructs along the diagonal.

conclusion, both the exploratory factor analysis and the estimation of the item-loadings and cross-loadings of the constructs “customer benefits” and “internal efficiency benefits” support the convergent and discriminant validity results.

**Table 5 Loadings and cross loadings of indicators for “customer benefits” and “internal efficiency benefits”**

	“Internal efficiency benefits” construct	“Customer benefits” construct
Increased accuracy of sales data	0.79	0.70
Better resource management	0.88	0.67
Economies of scale	0.74	0.47
Automation of cost control of operations	0.82	0.60
Improvement in accounts receivables management	0.70	0.46
Improved customer service	0.60	0.79
Focus on customer value-added activities	0.58	0.75
Better monitoring of due payments	0.56	0.76
More accurate customer invoices	0.62	0.84

### 8.10. Structural model assessment

At the same time as with the estimation of the measurement model, the PLS analysis also outputs the estimates of the structural model, that is the relationships between constructs, which are referred to as path coefficients (see Appendix 5). In order to interpret the significance of the path coefficients, bootstrapping was run with 500 re-sampling option. The estimates of the structural model are presented in Table 6. The results of the bootstrap technique are displayed in Appendix 3. The estimation of the path coefficients according to the bootstrap technique shows that except hypotheses H2 and H5, the other five hypotheses are statistically validated.

**Table 6 Structural model estimates**

Hypothesis	PLS Path coefficient	t-statistics <sup>7</sup>	p-values
H1: Strategic alignment → Management of ERP projects (+)	$\beta = 0.297$	2.35	< .01
H2: Motivation for implementation → Success of implementation (+)	$\beta = 0.016$	0.10	
H3: Management of ERP projects → Business process changes (+)	$\beta = 0.253$	2.27	< .01
H4: Business process changes → Internal process efficiency benefits (+)	$\beta = 0.739$	13.59	< .001
H5: Management of ERP projects → Internal process efficiency benefits (+)	$\beta = 0.013$	0.15	
H6: Internal process efficiency benefits → Customer benefits (+)	$\beta = 0.749$	12.55	< .001
H7: Internal process efficiency benefits → Financial benefits (+)	$\beta = 0.608$	8.05	< .001

$\beta$  is the path coefficient between two endogenous constructs in the model

The explanatory power of the structural model is estimated by calculating the average  $R^2$  of the endogenous constructs in the model, which is 0.32, and which shows a moderate explanatory power (see Table 7, p.100). Except for the  $R^2$  of “business process changes”, the individual  $R^2$  of the other three constructs are much higher than the minimum threshold of 0.1.

<sup>7</sup> One tailed t test

**Table 7 R<sup>2</sup> of endogenous constructs**

Endogenous construct	R <sup>2</sup>
Management of ERP projects	0.1
Business process changes	0.06
Internal process efficiency	0.55
Customer benefits	0.56
Financial benefits	0.36

Thus, the expectations that strategic alignment has a significant positive impact on the management perceived success of implementation ( $\beta = .297$ ;  $t=2.35$ ;  $p < .01$ ) and that successfully perceived ERP implementations lead to positive business process changes ( $\beta = .253$ ;  $t=2.27$ ;  $p < .01$ ) were confirmed (H1 and H3). However, the expected links between the motivation for implementation and management of ERP projects ( $\beta = .016$ ;  $t=0.10$ ) and management of ERP projects and internal process efficiency ( $\beta = .013$ ;  $t=0.15$ ) were not found significant (H2 and H5). Yet, there is a positive significant relationship between changes in business process and internal process efficiency ( $\beta = .739$ ;  $t=13.59$ ;  $p < .001$ ) (H4). Furthermore, internal process efficiency benefits lead to statistically significant customer benefits ( $\beta = .749$ ;  $t=12.55$ ;  $p < .001$ ) and financial benefits ( $\beta = .608$ ;  $t=8.05$ ;  $p < .001$ ) (H6 and H7).

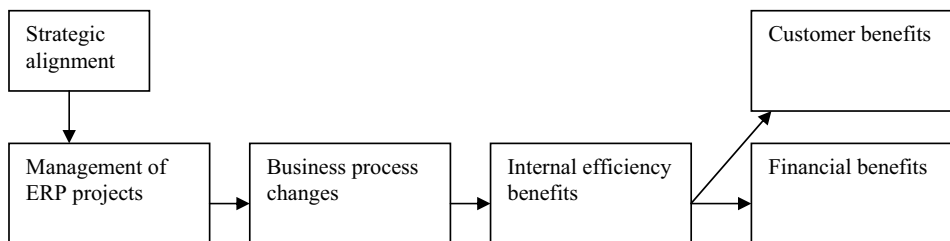
A current debate in the theory-based management accounting research is around the issue of endogeneity; whether it makes sense to worry about endogeneity (Chenhall and Moers, 2007; Van Lent, 2007; Larcker and Rusticus, 2007). The empirical analysis is subject to endogeneity when there is correlation between the error term in the structural equation and any explanatory variables. Endogeneity leads to biased and inconsistent estimators within equations used to test theoretical propositions, thus having implications for the validity of the results. The role of the error term in regression equations is very important for understanding the unbiasedness and consistency aspects of endogeneity. The estimator is unbiased when its expected value is equal to the true value. Consistency shows that the distribution of the expected value of the estimator concentrates on the true value of the estimator as the size of the sample increases. In general, there are three endogeneity issues to consider: omitted variables, simultaneity, and equilibrium conditions. Omitted variables are correlated with both the explained and explanatory variables and when included in the model, they add to the predictive power of the model. In the simultaneity case, the causal relationship between the explained and explanatory variables runs in both ways. If equilibrium is assumed, then there should be no relationship between the choice variables and the business performance.

Chenhall and Moers (2007) agree that it is unlikely that any management accounting study is free of endogeneity issues and that the consideration of this issue should start with careful theory construction. However, Van Lent (2007) and Larcker and Rusticus (2007) agree that theory in management accounting cannot solve the endogeneity problem. Theory is considered too incomplete and underdeveloped to provide certainty regarding the correct specification of the structural model. Hence, one possible solution is to evaluate the research questions in the presence of potential endogeneity issues.

In this paper, the only endogeneity assumption may be the omitted contextual variables. According to Dehning and Richardson's (2002) framework, the contextual variables influence the relationship between IT investments and firm performance. Thus, it may be that the predicted relationships between strategic alignment and ERP benefits are influenced by different types of environmental dynamism, uncertainty and information intensity. However, in this paper the focus is on the internal environment of the company. In further studies it can be tested if the leveraging role of strategic alignment for the benefits from ERP use depends on contextual variables.

### 8.11. Discussion and Conclusions

This paper investigates the association between strategic alignment, management of ERP projects, business process changes and the business performance of the ERP systems. The results of this investigation are presented in Figure 3.



**Figure 3 Results Model**

The “strategic alignment” concept has a central role in the Results Model. There is a whole body of literature on perspectives on strategic alignment, but this study focuses on the nature of strategic alignment. The processes involved in formulating strategy and achieving alignment were not the concern of this study. First, the results show that the more the ERP system strategy is aligned with the business strategy, the more the ERP implementation project is completed on budget and within the time established by the implementation team. This implies that one way to ensure successful ERP implementations at the project stage is to do a pre-implementation evaluation of the current business strategies and the organizational context in terms of characteristics, capabilities and needs for information. Thus, the decisions regarding the ERP system implementation should be made in connection with the overall business strategy. In this way, in the long run, the business strategy is more likely to be supported by the ERP strategy. In addition, by planning the ERP implementation so that it supports the business strategy, the project estimated budget and time are more accurate, and during implementation, the actual costs do not overrun the budget.

Second, the findings show a positive relation between the management perception on the success of ERP projects, business process changes and internal efficiencies in the post-implementation stage. This suggests that managers perceive the ERP projects to be successful when the implementations entail process re-engineering, which makes the

outcome processes more efficient and effective at later stages of the ERP system lifecycle.

Third, internal efficiency benefits are shown to lead to customer benefits and financial benefits. Considering that these benefits are normally obtained at different stages in the ERP implementation, this shows that organizations need to be aware of the implementation stage of their system to be able to identify and measure the appropriate benefits. The respondents have been using their ERP systems for eight years at maximum. During this time, the benefits were obtained from automating the business processes and using the ERP system to improve the decision-making at all levels in the organization. Benefits of ERP are yet to be expected as a result of the transformation of business to survive in competitive markets. Therefore, this finding emphasizes the central role of the business processes efficiency in increasing the ERP system value at customer and financial levels.

A general conclusion of this paper is that companies will be able to increase the benefits obtained from their ERP operations when there is a better coordination between strategic alignment and the management of their ERP implementations. This conclusion is reinforced by Law and Ngai (2007), who show that strategic intent to use ERP is correlated with business process improvement, success of ERP use and business performance. If at the outset of the ERP implementation, the project management team is aware of the business needs that system is to support, then the project management will establish the budget accordingly and will coordinate the team to complete the project within a reasonable extent of time. The sooner the ERP system goes live and with less costs, the quicker the benefits will be achieved through implementation, which may provide a head start compared to competitors.

Comparing the theoretical framework in Figure 1 with the Results Model in Figure 3, there are three differences that need to be discussed. First, the Results Model validates the indirect link between the management of ERP implementations and financial benefits that is specified in Figure 1. It does not validate the direct link, which has already been empirically verified in previous research.

Second, the construct “learning and growth benefits” is not captured in the Results Model. The Results Model builds upon the findings of the multiple case study in Velcu (2007), in which the interviewed managers did not identify any implications of the knowledge gained from their ERP implementation projects. However, the relationship between the learning and growth benefits and other types of ERP benefits is an issue worth investigating in the future because it would show the potential of ERP systems to enable future changes and contribute to organizational performance in the long-run.

Third, this study focuses on the management of ERP implementation projects and its effects on the internal environment of the organization. Hence, the contextual factors mentioned in the theoretical framework in Figure 1 are not captured in the Results Model.

The study is subject to limitations, some of them regarding the measurement error of the constructs. The use of perceptual measures of a single respondent from each company in the sample may lead to some informant bias hence the mentioned results should be



interpreted carefully. However, the mono-method measures have been previously used (Chenhall, 2005; Somers and Nelson, 2003). Then, most of the variables, except strategic alignment, were measured and validated for the first time in this study. Although the measurement validity was good, it would be useful to refine the respective constructs by further developing the underlying items of the constructs.

## APPENDIX 1 SURVEY DESIGN

1) Please indicate the business strategy your company adopts, by expressing to what extent you agree with the following statements:

1 - about the proactiveness of your business:

	Strongly Agree							Strongly Disagree						
1. We are almost always searching for new business opportunities.	1	2	3	4	5	6	7	1	2	3	4	5	6	7
2. We regularly are on the lookout for business units to acquire.	1	2	3	4	5	6	7	1	2	3	4	5	6	7
3. We generally expand capacity ahead of our competitors.	1	2	3	4	5	6	7	1	2	3	4	5	6	7
4. We seem to be always exploring new business opportunities.	1	2	3	4	5	6	7	1	2	3	4	5	6	7

2 – about the riskiness of your business:

5. In general, our mode of operations is riskier than our competitors'.	1	2	3	4	5	6	7
6. We adopt a rather conservative view when making decisions.	1	2	3	4	5	6	7
7. Our business operations generally follow “tried and true” paths.	1	2	3	4	5	6	7
8. We tend to be risk averse.	1	2	3	4	5	6	7

3 – about the internal defensiveness of your business:

9. We optimize coordination among our functions.	1	2	3	4	5	6	7
10. We constantly drive to improve operating efficiency.	1	2	3	4	5	6	7
11. We devote a great deal of attention to improving the efficiency of our business operations.	1	2	3	4	5	6	7

4 – about the futurity of your business:

12. Our criteria for budget allocations generally reflect short-term considerations.	1	2	3	4	5	6	7
13. We carry out long-term research to provide us with a future competitive advantage.	1	2	3	4	5	6	7
14. We tend to be future-oriented (focused on the long-term).	1	2	3	4	5	6	7

5 – about the aggressiveness of your business:

15. We strive to be one of the top three firms in each of our markets.	1	2	3	4	5	6	7
16. We constantly attempt to be ahead of the competition.	1	2	3	4	5	6	7
17. We tend to act aggressively in our marketplace.	1	2	3	4	5	6	7

6 – about the external defensiveness of your business:

18. We develop strong relationships with our major customers.	1	2	3	4	5	6	7
19. We develop strong relationships with our suppliers.	1	2	3	4	5	6	7
20. We put a lot of emphasis on building relationships with major customers.	1	2	3	4	5	6	7
21. We put a lot of emphasis on building relationships with major suppliers.	1	2	3	4	5	6	7

## 7 – about the analysis of your business:

22. We require a great deal of factual information to support our day-to-day decision-making.	1	2	3	4	5	6	7
23. When confronted with major decisions, we typically develop comprehensive analyses of the business situation faced.	1	2	3	4	5	6	7
24. We tend to be highly analytical in our decision-making.	1	2	3	4	5	6	7

## 8 – about the innovativeness of your business:

25. We seek innovative and imaginative solutions for most business problems.	1	2	3	4	5	6	7
26. We are early adopters of innovations.	1	2	3	4	5	6	7
27. We tend to be creative and original.	1	2	3	4	5	6	7

**2) Please indicate if the implemented ERP system supports the business strategy of your company, by expressing to what extent you agree with the following statements:**

1 - about the ERP support for the proactiveness characteristic of your business:

	Strongly Agree						Strongly Disagree
1. The system used helps us take calculated risks.	1	2	3	4	5	6	7
2. The system helps us identify companies we may be interested in acquiring.	1	2	3	4	5	6	7
3. The system allows us to keep track of our competitors and assist us in pre-empting them if necessary.	1	2	3	4	5	6	7
4. The system gives us information we need to grasp opportunities that come our way.	1	2	3	4	5	6	7

## 2 - about the ERP support for the riskiness characteristic of your business:

5. The system helps us take calculated business risks.	1	2	3	4	5	6	7
6. The system provides sufficiently detailed information to support conservative decision-making.	1	2	3	4	5	6	7
7. The system provides us with the data we need to steer clear of overly risky business opportunities.	1	2	3	4	5	6	7
8. The system gives us the information we need in order to minimize business risks.	1	2	3	4	5	6	7

## 3 - about the ERP support for the internal defensiveness of your business:

9. The system supports effective coordination among functions.	1	2	3	4	5	6	7
10. The system improves the efficiency of our business operations.	1	2	3	4	5	6	7
11. The system helps us maximize the efficiency of our business operations.	1	2	3	4	5	6	7

## 4 - about the ERP support for the futurity of your business:

12. The system allows us to adjust budget allocation decisions based on short-term considerations.	1	2	3	4	5	6	7
13. The system represents investments geared at providing us with future competitive advantage.	1	2	3	4	5	6	7

14.The system assists us more with long-term planning than with short-term planning.	1	2	3	4	5	6	7
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## 5 - about the ERP support for the aggressiveness of your business:

15.The system provides for forecasting of key indicators of business operations.	1	2	3	4	5	6	7
16.The system helps us be (or become) one of the top firms in our market(s).	1	2	3	4	5	6	7
17.The system helps us stay ahead of (or catch up with) the competition.	1	2	3	4	5	6	7

## 6 - about the ERP support for the external defensiveness of your business:

18.The system helps us aggressively go after market share.	1	2	3	4	5	6	7
19.The system enables us to develop stronger ties with major customers.	1	2	3	4	5	6	7
20.The system enables us to develop stronger ties with major suppliers.	1	2	3	4	5	6	7
21.The system helps us establish strong market links in general.	1	2	3	4	5	6	7

## 7 - about the ERP support for the analysis of your business:

22.The system provides us with the facts and figures we need to support our day-to-day decision-making.	1	2	3	4	5	6	7
23.The system enables us to develop detailed analyses of our present business situation.	1	2	3	4	5	6	7
24.The system used enables us to carry out detailed analyses of our major business decisions.	1	2	3	4	5	6	7

## 8 - about the ERP support for the innovativeness of your business:

25.The system helps us generate innovative solutions for business problems.	1	2	3	4	5	6	7
26.The system employs innovative, leading-edge technologies.	1	2	3	4	5	6	7
27.The system is creative and original.	1	2	3	4	5	6	7

**3) Please indicate if the ERP implementation was completed on time and within budget, by expressing to what extent you agree with the following statements:**

Strongly  
AgreeStrongly  
Disagree

1. The work volume involved by the implementation project was underestimated.	1	2	3	4	5	6	7
2. The business process reengineering and development activities took too long.	1	2	3	4	5	6	7
3. The initial project schedule was unrealistic.	1	2	3	4	5	6	7
4. The actual duration of the implementation project exceeded the scheduled duration.	1	2	3	4	5	6	7
5. The consultant's costs were very high.	1	2	3	4	5	6	7

6. The training costs were higher than planned.	1	2	3	4	5	6	7
7. Retraining was required due to changes in the systems.	1	2	3	4	5	6	7
8. During the implementation project, the company had to add hardware capacities and change some existing hardware, which was not budgeted for initially.	1	2	3	4	5	6	7
9. The actual cost of the implementation project was higher than the budgeted cost.	1	2	3	4	5	6	7

**4) Please indicate what the motivation was for the ERP implementation, by expressing to what extent you agree with the following statements:**

Strongly  
Agree

Strongly  
Disagree

1. The company motivation to implement the ERP system was to replace the legacy systems.	1	2	3	4	5	6	7
2. The company motivation to implement an ERP system was to simplify and standardize systems.	1	2	3	4	5	6	7
3. The company motivation to implement an ERP system was to improve interactions and communication with suppliers and customers.	1	2	3	4	5	6	7
4. The company motivation to implement an ERP system was to gain strategic advantage.	1	2	3	4	5	6	7
5. The company motivation to implement an ERP system was to link global activities.	1	2	3	4	5	6	7
6. The company motivation to implement an ERP system was to solve the Y2K problem.	1	2	3	4	5	6	7
7. The company motivation to implement an ERP system was the pressure to keep up with the competitors.	1	2	3	4	5	6	7
8. The company motivation to implement an ERP system was the ease of upgrading systems.	1	2	3	4	5	6	7
9. The company motivation to implement an ERP system was the restructure of company organization.	1	2	3	4	5	6	7

**5) Please indicate to what extent you agree with the following business process changes in the ERP post-implementation period:**

Strongly  
Agree

Strongly  
Disagree

1. After the ERP system implementation, the finance and control tasks were decentralized.	1	2	3	4	5	6	7
2. After the ERP system implementation, the responsibility of following up the costs is delegated down in the organization.	1	2	3	4	5	6	7
3. The ERP system offers real-time follow-up of the business.	1	2	3	4	5	6	7
4. The ERP system offers easy follow-up of the business.	1	2	3	4	5	6	7

**6) Please indicate to what extent you agree with the following benefits of the ERP system implemented in your organization:**

Strongly  
Agree

Strongly  
Disagree

<i>Internal efficiency benefits</i>							
1. The ERP system offers increased accuracy of sales transactions data.	1	2	3	4	5	6	7

2.The ERP system enables better resource management.	1	2	3	4	5	6	7
3.The ERP system enables better monitoring of inventory levels.	1	2	3	4	5	6	7
4.The ERP system increases the flexibility of the invoicing possibilities.	1	2	3	4	5	6	7
5.The ERP system enables the organization to reach economies of scale.	1	2	3	4	5	6	7
6.The ERP implementation led to automation of the cost control of operations.	1	2	3	4	5	6	7
7.The ERP implementation improved the management of cost centers.	1	2	3	4	5	6	7
8.The ERP system monitors all tasks in the organization.	1	2	3	4	5	6	7
9.The ERP system leads to improvement of cash management.	1	2	3	4	5	6	7
10.The ERP system leads to improvement in the accounts receivables management.	1	2	3	4	5	6	7
11.The ERP system enables more accurate calculation of the selling prices.	1	2	3	4	5	6	7
<i>Customer benefits</i>							
12.The ERP system helps in improving the customer service.	1	2	3	4	5	6	7
13.The ERP system increases the focus on customer value-added activities.	1	2	3	4	5	6	7
14.The ERP system enables better monitoring of due payments.	1	2	3	4	5	6	7
15.The ERP system enables more accurate customer invoices.	1	2	3	4	5	6	7
<i>Financial benefits</i>							
16.The ERP system enables lower headcount costs.	1	2	3	4	5	6	7
17.The ERP system leads to lower selling, general and administrative costs.	1	2	3	4	5	6	7
18.The ERP system enables higher inventory turnover.	1	2	3	4	5	6	7
19.The profit margins are maintained at the same level in the post-ERP implementation, compared to the pre-ERP implementation period.	1	2	3	4	5	6	7

## APPENDIX 2 MEASUREMENT MODEL

1) Business strategy, first order latent variable (Venkatraman, 1989, Chan et al., 1997 and Byrd et al., 2006) inferred from:

1. Proactiveness (items 1.1- 1.4)
2. Riskiness (items 1.5 – 1.8)
3. Internal defensiveness (items 1.9 – 1.11)
4. Futurity (items 1.12-1.14)
5. Aggressiveness (items 1.15-1.17)
6. External defensiveness (items 1.18-1.21)
7. Analysis (items 1.22-1.24)
8. Innovativeness (items 1.25-1.27).

2) ERP strategy, first order latent variable (adapted based on Chan et al., 1997 and Byrd et al., 2006) inferred from:

1. Proactiveness (items 2.1- 2.4)
2. Riskiness (items 2.5 – 2.8)
3. Internal defensiveness (items 2.9 – 2.11)
4. Futurity (items 2.12-2.14)
5. Aggressiveness (items 2.15-2.17)
6. External defensiveness (items 2.18-2.21)
7. Analysis (items 2.22-2.24)
8. Innovativeness (items 2.25-2.27).

3) Cost of implementation (Kumar et al., 2003), first order latent variable measured through:

- 3.5 (Cost of consultants)
- 3.6 (Training costs)
- 3.7 (Retraining)
- 3.8 (Additional hardware capacities)
- 3.9 (Actual cost compared to the budgeted one).

4) Time of implementation (Kumar et al., 2003) first order latent variable measured through:

- 3.1 (Estimated work volume)
- 3.2 (BPR)
- 3.3 (Initial project schedule)
- 3.4 (Actual duration of the implementation).

5) Business justification for implementation (Mabert et al., 2000), first order latent variable measured through items:

- 4.3 (communication with suppliers and customers)
- 4.4 (gain competitive advantage)
- 4.5 (link global activities)
- 4.7 (keep up with competitors)
- 4.9 (restructuring of the organization).

6) Technological justification (Mabert et al., 2000), first order latent variable measured through items:

- 4.1 (replace legacy systems)
- 4.2 (simplification and standardization of systems)
- 4.6 (solution to Y2K problem)
- 4.8 (upgrade the new system).

7) Business process, first order latent variable measured through items:

- 5.1 (decentralization of finance and control tasks)
- 5.2 (decentralization of responsibilities within organization)
- 5.3 (real-time follow-up of business)
- 5.4 (easy follow-up of business).

8) Internal process efficiency, first order latent variable measured through items:

- 6.1 (increased accuracy of sales data)
- 6.2 (better resource management)
- 6.3 (better monitoring of inventory levels)
- 6.4 (increased invoicing flexibility)
- 6.5 (economies of scale)
- 6.6 (automation of cost control of operations)
- 6.7 (improved management of cost centers)
- 6.8 (tasks monitoring)
- 6.9 (improvement in cash management)
- 6.10 (improvement in accounts receivables management)
- 6.11 (accurate calculation of selling prices).

Customer benefits, first order latent variable measured through items:

- 6.12 (improved customer service)
- 6.13 (focus on customer value-added activities)
- 6.14 (better monitoring of due payments)
- 6.15 (more accurate customer invoices).

Financial benefits, first order latent variable measured through items:

- 6.16 (lower headcount costs)
- 6.17 (lower selling, general and administrative costs)
- 6.18 (higher inventory turnover)
- 6.19 (maintenance of profit margins).



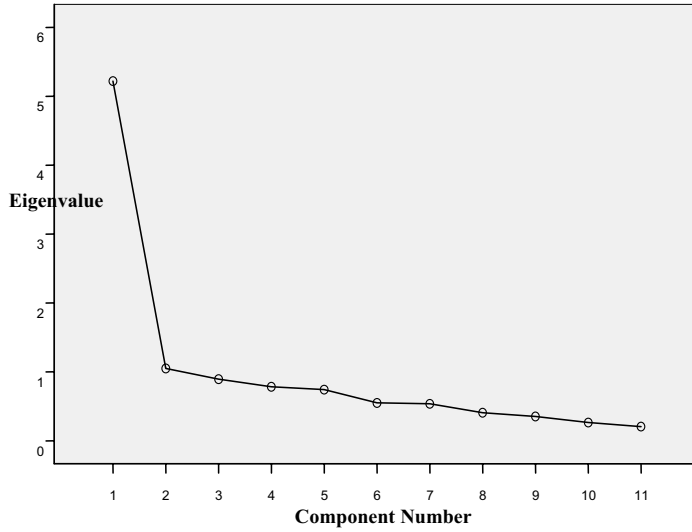
**APPENDIX 3 T-STATISTICS OF PATHS COEFFICIENTS**

	Strategic alignment	Business strategy	ERP strategy	ERP project success	Time	Cost	Motivation	Business driven	Technological driven	Process changes	Internal efficiency benefits	Customer benefits	Financial benefits
Strategic alignment	0.000	5.823	17.163	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Business strategy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ERP strategy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ERP project success	2.352	0.000	0.000	0.000	0.000	0.000	0.103	0.000	0.000	0.000	0.000	0.000	0.000
Time	0.000	0.000	0.000	81.575	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cost	0.000	0.000	0.000	48.618	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Motivation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	15.340	5.008	0.000	0.000	0.000	0.000
Business driven	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Technological driven	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Process changes	0.000	0.000	0.000	2.274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Internal efficiency benefits	0.000	0.000	0.000	0.150	0.000	0.000	0.000	0.000	0.000	13.590	0.000	0.000	0.000
Customer benefits	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.549	0.000	0.000
Financial benefits	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.507	0.000	0.000

**APPENDIX 4 SCREEPLOTS OF EXPLORATORY FACTOR ANALYSIS  
FOR “INTERNAL EFFICIENCY BENEFITS” AND “CUSTOMER BENEFITS”**

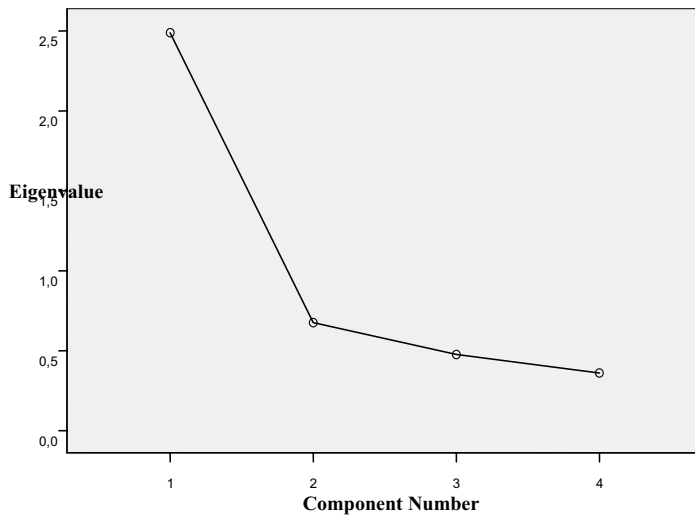
“Internal efficiency benefits” construct

Scree Plot

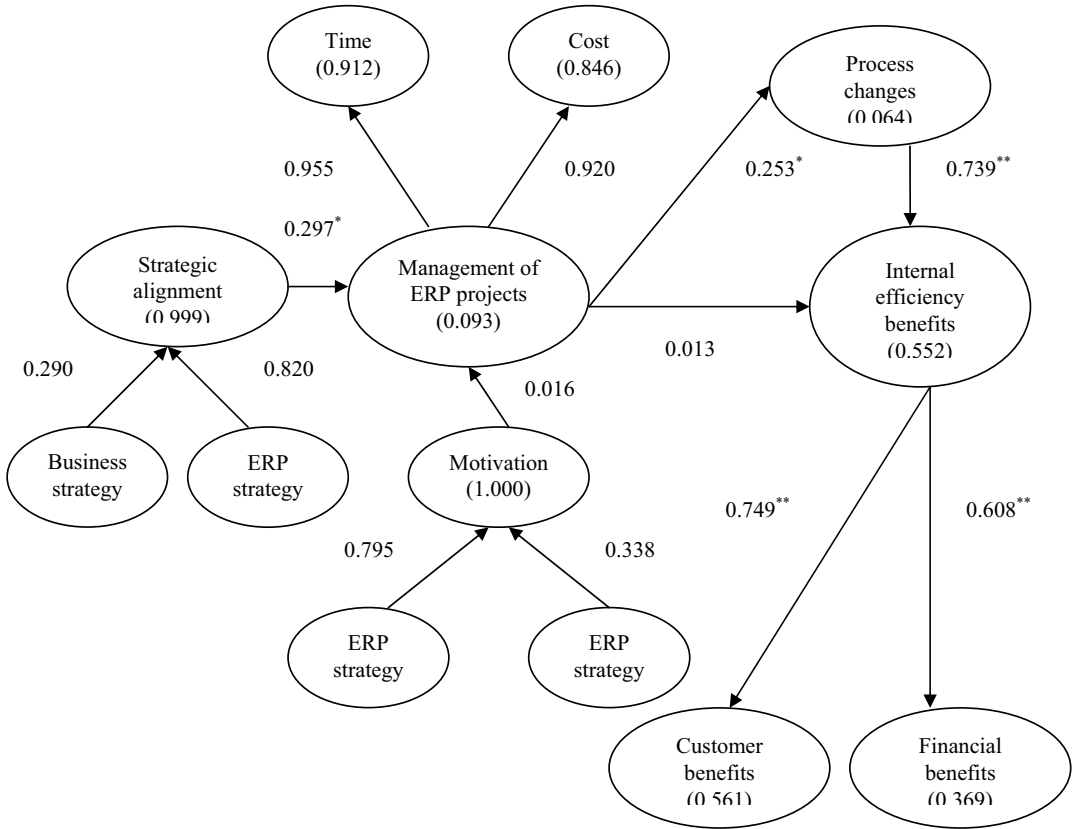


“Customer benefits” construct

Scree Plot



APPENDIX 5 STRUCTURAL MODEL



\*\* significant at 0.001  
 \* significant at 0.01

## REFERENCES

- Agarwal R., Karahanna E., (2000) "Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage", *MIS Quarterly*, Vol. 24, No. 4, pp. 665-694.
- Basoglu N., Daim T., Kerimoglu O., (2007) "Organizational adoption of enterprise resource planning systems: A conceptual framework", *Journal of High Technology Management Research*, doi:<http://dx.doi.org/10.1016/j.hitech.2007.03.005>.
- Beard J.W., Sumner M., (2004) "Seeking strategic advantage in the post-net era: viewing ERP systems from the resource-based perspective", *Journal of Strategic Information Systems*, Vol. 13, pp.129-150.
- Bingi P., Sharma M.K., Godla J.K., (1999) "Critical Issues Affecting an ERP Implementation", *Information Systems Management*, Vol. 16, Issue 3, pp.7-15.
- Björkman I., Forsgren M., (2000) "Nordic International Business Research – A Review of Its Development", *International Studies of Management and Organizations*, Vol. 30, No. 1, pp. 6-25.
- Bollen K., Lennox R., (1991) "Conventional wisdom on measurement: A structural equation perspective", *Psychological Bulletin*, Vol. 110, Issue 2, pp.305-314.
- Boulianne E., (2007) "Revisiting fit between AIS design and performance with the analyzer strategic type", *International Journal of Accounting Information Systems*, Vol. 8, pp.1-16.
- Boulianne E., (2007) "The Weighting Effect of Balanced Scorecard Dimensions on Performance Evaluation", 30th Annual Congress European Accounting Association, 25-27 April 2007, pp.219.
- Bruin E., Lykkegaard B., (2007) "Western European ERP Applications, Forecast and Analysis, 2007-2011" (<http://www.idc.com/getdoc.jsp?containerId=LC01P>) Accessed on 27.05.2007.
- Brynjolfsson E., Hitt L., (1996) "Paradox lost? Firm-level evidence on the returns to information systems spending", *Management Science*, Vol. 42, Issue 4, pp.541-560.
- Brynjolfsson E., Hitt L.M., (2000) "Beyond computation: information technology, organizational transformation and business performance", *Journal of Economic Perspectives*, Vol. 14, No.4, pp.23-48.

- Byrd T.A., Lewis B.R., Bryan R.W., (2006) "The leveraging influence of strategic alignment on IT investment: An empirical examination", *Information & Management*, Vol. 43, pp.308-321.
- Chan Y., Huff S. (1993) "Strategic Information Systems Alignment", *Business Quarterly*, London Autumn, Vol. 58, Issue 1, pp.51-56.
- Chan Y.E., Huff S.L., Barclay D.W., Copeland D.G., (1997) "Business Strategic Orientation, Information Systems Strategic Orientation, and Strategic Alignment", *Information Systems Research*, Vol. 8, No.2, pp.125-150.
- Chan Y.E., Huff S.L., Copeland D.G., (1998) "Assessing realized information systems strategy", *Journal of Strategic Information Systems*, Vol. 6, pp. 273-298.
- Chand D., Hachey G., Hunton J., Owosho V., Vasudevan S., (2005) "A balanced scorecard based framework for assessing the strategic impacts of ERP systems", *Computers in Industry*, Vol. 56, pp.558-572.
- Chenhall R.H., (2005) "Integrative strategic performance measurement systems, strategic alignment of manufacturing, learning and strategic outcomes: an exploratory study", *Accounting, Organizations and Society*, Vol. 30, pp. 395-422.
- Chenhall R.H., Moers F., (2007) "The Issue of Endogeneity within Theory-Based, Quantitative Management Accounting Research", *European Accounting Review*, Vol. 16, No. 1, pp.173-195.
- Chin W.W., (1998) "The Partial Least Squares Approach to Structural Equation Modelling," in *Modern Methods for Business Research*, George A. Marcoulides (ed.), Mahwah, New Jersey: Lawrence Erlbaum Associates, pp.295-336.
- Chin W.W., (2000a) *Partial Least Squares for Researchers: An overview and presentation of recent advances using PLS approach*. Available: <http://disc-nt.cba.uh.edu/chin/indx.html>.
- Chin W.W., (2000b) *Frequently asked questions – Partial least squares & PLS-Graph*. Home page. [On-line]. Available: <http://disc-nt.cba.uh.edu/chin/plsfaq/plsfaq.htm>.
- Coleman P., Papp R., (2006) "Strategic Alignment: Analysis of Perspectives", *Proceedings of the 2006 Southern Association for Information Systems Conference*, pp. 242-250.

- Dehning B., Richardson V.J. (2002) "Returns on Investments in Information Technology: A research Synthesis", *Journal of Information Systems*, Vol. 6, No.1, pp. 7-30.
- Dehning B., Richardson V.J., Zmud R.W., (2005) "The value relevance of announcements of transformational information technology investments", *MIS Quarterly*, Vol. 27, No. 4, pp.637-656.
- Duh R.R., Chow C.W., Hueiling C., (2006) "Strategy, IT applications for planning and control, and firm performance: The impact of impediments to IT implementation", *Information & Management*, Vol. 43, pp.939-949.
- Floyd S.W., Wooldridge B., (1990) "Path Analysis of the Relationship between Competitive Strategy, Information Technology, and Financial Performance", *Journal of Management Information Systems*, Vol. 7, No. 1, pp.47-64.
- Fornell C., Larcker D.F., (1981) "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18, No. 1, pp. 39-50.
- Kearns G.S., Lederer A.L., (2004) "The impact of industry contextual factors on IT focus and the use of IT for competitive advantage", *Information & Management*, Vol. 41, pp. 899-919.
- Kotha S., Swamidass P.M., (2000) "Strategy, advanced manufacturing technology, and performance: Empirical evidence from U.S. manufacturing firms", *Journal of Operations Management*, Vol. 18, Issue 3, pp.257-277.
- Kumar V., Maheshwari B., Kumar U., (2003) "An investigation of critical management issues in ERP implementation: empirical evidence from Canadian organizations", *Technovation*, Vol. 23, pp.793-807.
- Henderson J.C., Venkatraman N., (1991) "Understanding Strategic Alignment", *Business Quarterly*, Vol. 55, Issue 3, pp.72-78.
- Henderson J.C., Venkatraman, N., (1993) "Strategic alignment: Leveraging information technology for transforming organizations", *IBM Systems Journal*, Vol. 32, No. 1, pp.4-16.
- Hitt L.M., Wu D.J., Zhou X., (2002) "Investment in Enterprise Resource Planning: Business Impact and Productivity Measures", *Journal of Management Information Systems*, Vol. 19, No. 1, pp. 71-98.

- Hoque Z., James W., (2000) "Linking Balanced Scorecard Measures to Size and Market Factors: Impact on Organizational Performance", *Journal of Management Accounting Research*, Vol. 12, pp.1-17.
- Hong K-K., Kim Y-G., (2002) "The critical success factors for ERP implementation: an organizational fit perspective", *Information & Management*, Vol. 40, pp. 25-40.
- Hulland J., (1999) "Use of Partial Least Squares (PLS) in Strategic Management Research: a Review of Four Recent Studies", *Strategic Management Journal*, Vol. 20, pp. 195-204.
- Hunton, JE, Lippincott, B, Reck, JL., (2003) "Enterprise Resource Planning Systems: Comparing Firm Performance of Adopters and Nonadopters", *International Journal of Accounting Information Systems*, Vol 4, pp165-184.
- Ittner C.D., Larcker D.F., (1998) "Innovations in Performance Measurement: Trends and research Implications", *Journal of Management Accounting Research*, Vol. 10, pp.205-238.
- Larcker D.F., Rusticus T.O., (2007) "Endogeneity and Empirical Accounting Research", *European Accounting Review*, Vol. 16, No.1, pp.207-215.
- Laukkanen S., Sarpola S., and Hallikainen P., (2007) "Enterprise size matters: objectives and constraints of ERP adoption", *Journal of Enterprise Information Management*, Vol. 20, No. 3, pp.319-334.
- Law C.C.H., Ngai E.W.T., (2007) "ERP system adoption: An exploratory study of the organizational factors and impacts of ERP success", *Information & Management*, Vol. 44, pp. 418-432.
- Li M., Ye R., (1999) "Information technology and firm performance: Linking with environmental, strategic and managerial contexts", *Information & Management*, Vol. 35, pp. 43-51.
- Lin W.T., Shao, B.B.M., (2006) "The business value of information technology and inputs substitution: The productivity paradox revisited", *Decision Support Systems*, Vol. 42, pp. 493-507.
- Lucas Jr. H.C., Walton E.J., Ginzberg MJ., (1988) "Implementing Packaged Software", *MIS Quarterly*, Vol. 12, No. 4, pp.537-539.
- Luftman J., Brier T., (1999) "Achieving and sustaining business-IT alignment", *California Management Review*, Vol. 42, Issue 1, pp.109-122.

- Mabert V.A., Soni A., Venkataramanan M.A., (2000) "Enterprise Resource Planning Survey of US Manufacturing Firms", *Production and Inventory Management Journal*, Vol. 41, No.2, pp.52-58.
- Markus M.L., Axline S., Petrie D., and Tanis C., (2000) "Learning from adopters" experiences with ERP: problems encountered and success achieved", *Journal of Information Technology*, Vol. 15, pp.245-265.
- Melville N., Gurbaxani V., Kraemer K. (2007) "The productivity impact of information technology across competitive regimes: The role of industry concentration and dynamism", *Decision Support Systems*, Vol. 43, pp.229-242.
- Mintzberg H., (1978) "Patterns in strategy formation", *Management Science*, Vol. 24, No. 9, pp. 934-948.
- Mintzberg H., Waters J.A., (1982) "Tracking strategy in an entrepreneurial firm", *Academy of Management Journal*, Vol. 25, pp.465-499.
- Newman M., Westrup C. (2005) "Making ERPs work: accountants and the introduction of ERP systems", *European Journal of Information Systems*, Vol. 14, pp. 258-272.
- Nicolaou A.I., (2004) "Firm Performance Effects in Relation to the Implementation and Use of Enterprise Resource Planning Systems", *Journal of Information Systems*, Vol. 18, No.2, pp.79-105.
- Nicolaou A.I, Battacharya S., (2006) "Organizational performance effects of ERP systems usage: The impact of post-implementation changes", *International Journal of Accounting Information Systems*, Vol. 7, No.1, pp.18-35.
- Pallant J., (2007): *SPSS survival manual: a step by step guide to data analysis using SPSS for Windows*, 3rd ed. Buckingham: Open University Press.
- Pankratz H., (1991) "Strategic Alignment: Managing for Synergy", *Business Quarterly* (1986-1998), Vol.55, No.3. pp.66.
- Papp R., (1999) "Business-IT alignment: productivity paradox payoff?", *Industrial Management + Data Systems*, Vol. 99, Iss. 8, pp.367-374.
- Parr A., Shanks G., (2000) "A model of ERP project implementation", *Journal of Information Technology*, Vol. 15, No. 4, pp. 289-303.
- Rogelberg S.G., Stanton J.M., (2007) "Introduction: Understanding and Dealing with Organizational Survey Nonresponse", *Organizational Research Methods*, Vol. 10, No. 2, pp.195-209.



- Sheu C., Chae B., Yang C-L., (2004) "National difference and ERP implementation: issues and challenges", *Omega*, Vol. 32, pp. 361-371.
- Simons R., (1987) "Accounting control systems and business strategy: an empirical analysis", *Accounting, Organizations and Society*, Vol. 12, No. 4, pp.357-374.
- Stratopoulos T., Dehning B., (2000) "Does successful investment in information technology solve the productivity paradox?", *Information & Management*, Vol. 38, pp.103-117.
- Soh C., Kien S.S., Tay-Yap J., (2000) "Cultural fits and misfits: Is ERP a universal solution?", *Communications of the ACM*, Vol. 43, No. 4, pp. 47-51.
- Somers T.M., Nelson K.G., (2003) "The impact of strategy and integration mechanisms on enterprise system value: Empirical evidence from manufacturing firms", *European Journal of Operational Research*, Vol. 146, pp.315-338.
- Sumner M., (2000) "Risk factors in enterprise-wide ERP projects", *Journal of Information Technology*, Vol. 15, pp. 317-327.
- Van der Stede W., Young S., Chen C., (2005) "Assessing the quality of evidence in empirical management accounting research: the case of survey studies", *Accounting, Organization and Society*, Vol. 30, No. 7-8, pp. 655-684.
- Van Lent L., (2007) "Endogeneity in Management Accounting Research: A Comment", *European Accounting Review*, Vol. 16, No.1, pp.197-205.
- Velcu O., (2005) "Impact of the Quality of ERP Implementations on Business Value", *Electronic Journal of Information Systems Evaluation*, Vol. 8, No. 3, pp.229-238, available online at [www.ejise.com](http://www.ejise.com).
- Velcu O., (2007) "Exploring the effects of ERP systems on organizational performance – Evidence from Finnish companies", *Journal of Industrial Management and Data Systems*, Vol. 107, No.9, pp. 1316-1334.
- Venkatraman N. (1989) "Strategic Orientation of Business Enterprises: the Construct, Dimensionality, and Measurement", *Management Science*, Vol. 35, No.8, pp. 942-962.
- Viswesvaran C., Barrick M., Ones D.S., (1993) "How definite are conclusions based on survey data: estimating robustness to nonresponse", *Personnel Psychology*, Vol. 46, Issue 3, pp.551-567.

- Voordijk H., Van Leuven A., Laan A., (2003) "Enterprise Resource Planning in a large construction firm: implementation analysis", *Construction Management and Economics*, Vol. 21, Issue 5, pp.511-521.
- Waarts E., Van Everdingen Y., (2005) "The Influence of National Culture on the Adoption Status of Innovations: An Empirical Study of Firms across Europe", *European Management Journal*, Vol.23, No.6, pp.601-610.
- Werner S., Praxedes M., Kim H-G., (2007) "The Reporting of Nonresponse Analyses in Survey Research", *Organizational Research Methods*, Vol. 10, No. 2, pp.287-295.
- Willcocks L., Sykes R., (2000) "The role of the IT function", *Communications of the ACM*, Vol. 41, No. 4, pp.32-39.

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