

The effects of ERP-implementations on the non-financial performance of small and medium-sized enterprises in the Netherlands

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Abstract: In this paper we try to assess the impact of ERP-implementations on the development of non-financial organizational performance, as described by Shang and Seddon (2002) and Eckartz et al. (2009). We assess this impact for Dutch small and medium-sized enterprises, using a small but unique dataset. Several aspects of the performance of organizations are compared before and after the introduction of an ERP-system, taking into account a three-year period, and controlling for several influential factors (like organizational size, financial health and sectoral differences). We conclude that by and large, organizational performance increased significantly more for organizations that implemented an ERP-system in the last three years than for organizations that did not implement such a system. We also conclude that organizations that implemented an ERP-system at most three years ago did not have significantly lower non-financial performance than organizations that did not implement such a system. Additional analyses suggest that we would oversell our results if we would claim that ERP-systems are the main or sole source of the effects found. Nevertheless, although limited to Dutch SMEs, our results contradict some of the views expressed in the ERP-literature.

Keywords: ERP systems, organizational performance, organizational benefits, non-financial performance, SME, surveys

1. Introduction

Ever since their introduction in the 1990s, Enterprise Resource Planning (ERP) systems have been widely used by organizations wishing to work with integrated information systems in the hopes to increase their market agility (Grabski and Leech 2007; Keller 1999). Many researchers have tried to assess the impact of the introduction of ERP- systems on organizational conduct, often focusing on a system's performance effects. Examples include Hunton *et al.* (2003), Kallunki *et al.* (2011), Liu *et al.* (2008), Poston and Grabski (2001), Nicolaou (2004) and Nicolaou and Bhattacharya (2006). One of the main questions in this type of research seems to be whether the (chiefly) financial performance of organizations adopting an ERP-system has deteriorated or improved during the post-implementation period.

The implementation of an ERP-system in an organization is often accompanied by substantial changes in organizational structure and ways of working (Bernroider 2008; Grabski and Leech 2007; Kallunki *et al.* 2011). Such implementations seem to be set apart by their complexity, and more specifically, by the difficulties involved in implementing large-scale changes in an organization together with a transition to new systems, whilst legacy systems may be in place (Kumar *et al.* 2002; Jones *et al.* 2006). Eckartz *et al.* (2009) even state that ERP-systems have a "(...) decisive impact on almost all aspects of an organization" (p2). Partly, the impact of these effects seems to be influenced by whether or not an ERP-system is tailored to fit an organization before it is implemented (Hong and Kim 2002; Kumar *et al.* 2002).

In general, organizations (and consultancy firms alike) seem to think that the introduction of an ERP-system allows for more efficiency in organizational work, and therefore, for better (financial) performance vis-à-vis non-adopting organizations, because of the fact that best practices are embraced (Bernroider 2008; Davenport 1998; Sneller 2010). It is also expected that in conjunction to this, ERP-implementations invoke more reliable information recording and exchanges in an organization (Shang and Seddon 2002). However, is the situation always that simple?

Markus and Tanis (2000) developed a framework to describe the 'typical' phases involved in the adoption and implementation of an ERP-system. After a chartering phase, comprising the decisions leading to the approval of the implementation of a specific system, the communication in the organization about this, and the system's funding, a project phase is entered, in which a system is set up and executed in one or more organizational (business) units. This ultimately results in its rollout and start-up across the organization ('going live'). Thereafter, a shakedown phase is witnessed, which takes up the period of time between the aforementioned 'go live' date and the moment that user acceptance has occurred, bugs have been fixed, system training has been accommodated, and a system has been 'fine-tuned' to fit an organization. Finally, Markus and Tanis discern an onward and upward phase. This phase generally occurs between 1-3 years after a system's 'go live' date, and covers the period from 'normal operations' until a system is replaced completely by another system or is upgraded. Alas, all of these phases are fraught with problems that can affect an organization's performance. For instance, Kumar *et al.* (2002) found that in many Canadian governmental organizations, project schedules tended to be revised as organizations underestimated the amount of work involved in implementing an ERP-system, inadequate training in the new system occurred, and difficulties in assuring the quality of the data entered in the system were paramount. Other studies have reported similar problems: implementation costs may rise exponentially, employees may refuse to work with the new system, and data integration processes between new and old (legacy) systems may be more troublesome than expected (Botta-Genoulaz and Millet 2005; Hunton *et al.* 2003; Ross and Vitale 2000; Nicolaou 2004; Scott 1999; Sneller 2010). It may therefore not come as a surprise that more than 70% of ERP-introductions do not reach their intended effects, and may even be regarded as complete failures (Al-Mashari *et al.* 2006; Buckhout *et al.* 1999; Hong and Kim 2002; Stefanou 2001).

In this paper we will look at organizations that implemented an ERP-system between one and three years ago, and compare their self-assessed organizational benefits with a set of comparable organizations that did not implement or have such systems in the same period. The period of three years has been chosen for Nicolaou and Bhattacharya (*ibid.*) concluded that organizations adopting an ERP-system needed at least two years to generate positive financial performance. The authors term this the "... lag-led re-emergence of performance gains ..." (*ibid.* p20) (see also Wah 2000). Contrary to their research, however, we decide to look at non-financial organizational performance (Shang and Seddon 2002), this being an area where so far little research seems to have been done (Eckartz *et al.* 2009). On top of this, we follow up on Esteves and Bohorquez's (2007) call for more research on the benefits of ERP-implementations in small and medium-sized enterprises, this being the market where ERP-systems are nowadays implemented most often (Adam and O'Doherty 2003).

This paper will proceed as follows. We start by setting out the types of benefits that may be expected from an ERP-system in section 2.. Thereafter, in section 3.1, our research approach and method will be discussed. The main results will be presented in section 3.2. Finally, in section 4, we will put forward the conclusions that we think can be distilled from this research and discuss some of its drawbacks. We will also point out what we see as viable avenues for further research.

2. ERP benefits

In this study we define an ERP-system as a business support system that maintains the data needed for various business functions such as manufacturing, financials and supply chain management in a single database, so that transactions only need to be processed once (Kumar and van Hillegersberg 2000).

Eckartz *et al.* (2009) present the results of an extensive literature review on enterprise system (ES) performance, with particular reference to ERP-systems. They aim to determine all benefits that may be achieved during and after an ES-implementation, both tangible and intangible. Their analysis results in what they call a '3-dimensional benefit framework'. It is largely based on a similar classification of benefits from Shang and Seddon (2002). The three dimensions Eckartz *et al.* (2009) distinguish are:

- Operational, managerial and strategic benefits (Anthony 1965; Shang and Seddon 2002);
- Process, customer, financial and innovation benefits, following the four perspectives of the balanced scorecard (Kaplan and Norton 1993). Also included is a fifth perspective to assess employee resistance or willingness to change (Eckartz *et al.* 2009);

- Benefits falling into IT infrastructure and organizational categories (Shang and Seddon 2002). These are often intangible and hard to identify (such as organizational learning and improvement in communications), and are, consequently, not researched very much (Eckartz *et al.* 2009).

Eckartz *et al.* explicitly ask researchers to validate their framework in a variety of ways, among others by determining how the various dimensions and categories of ES-related benefits impact on one another. Our own goal with their framework is, however, more modest. We wish to examine (non-financial) organizational performance, which Eckartz *et al.* call 'organizational benefits'. We will only try to validate this particular aspect of their framework, as these benefits apparently have not been researched as often as more tangible ES-benefits (see also Hunton *et al.* 2003; Nicolaou and Bhattacharya 2006). According to Shang and Seddon (2002), organizational benefits "... arise when the use of an ES benefits an organization in terms of focus, cohesion, learning and execution of its chosen strategies" (p279). They go on to argue that the potential organizational benefits of ES-implementations evolve around the following issues, which will all be taken along in this study:

- Changing work patterns with shifted focus: the harmonization of interdepartmental processes and interdisciplinary matters
- Facilitating business learning and broadening of employee skills: greater possibilities to enhance employee learning
- Employee empowerment: more pro-active, perhaps even entrepreneurial, employee behavior and involvement in business management
- Building common visions: departments work as a unit, and not as separate entities, sustaining a shared image on organizational work across different levels of the organization
- Shifting work focus: concentration on core work
- Increased employee morale and satisfaction: increased work efficiency and (more) content users, who are provided with better quality service.

We will focus on ERP-systems as a particularization of ES-systems, which is not uncommon in the ES-related literature (Shang and Seddon *ibid.*). There are many articles trying to assess the performance effects of ERP-system introductions in an organization (Hunton *et al.* 2003, Kallunki *et al.* 2011; Liu *et al.* 2008; Nicolaou 2004; Nicolaou and Bhattacharya 2006; Poston and Grabski 2001). Although the focus of these papers is chiefly on financial performance (Kallunki *et al.* 2011 is one of the few exceptions), the way in which these authors conceptualized their research is also followed here, even though we focus on specific non-financial benefits: the six dimensions of organizational benefits described by Shang and Seddon (2002).

Nicolaou and Bhattacharya (2006) report that changes in ERP-systems often offset implementation issues that at first, negatively affect the long-term financial performance of organizations. The sooner adaptations are made, the better performance may develop. Adapting a system too late may result in a deterioration of financial performance. Following Nicolaou (2004), they also find that an, at least, two year time lag may be useful to assess the performance impact of ERP-systems, as this lag seems to be necessary for positive differential financial performance in adopting vis-à-vis non-adopting organizations to start materializing. Kallunki *et al.* (2011) obtain similar results in their exploration of the effects of ERP-implementations on both the financial and non-financial performance of 70 Finnish business-units. They conclude that ERP-systems can improve both the financial and non-financial performance of business-units, chiefly in the long run (three years or more). Using specific forms of management control can help to achieve this.

Taken together, this leads to the first hypothesis we would like to test in this study:

H1: *Organizational benefits are significantly larger for organizations that have implemented an ERP-system in the last three years than for organizations that did not implement or have such a system.*

The financial performance effects of ERP-implementations in Chinese chemical firms were assessed by Liu *et al.* (2008). They find no significant performance improvement during the implementation period and during the first three years after implementation. At first, a decline in performance is witnessed, which is in line with the Markus and Tanis (2000) framework and previous studies by Nicolaou and Bhattacharya (2006) among others. However, a slight performance improvement in the

third year after implementation occurs, which may indicate that the financial benefits of ERP-implementations may only manifest themselves after more extensive ERP-use.

The impact of ERP-system adoption on the financial performance of over 60 organizations that were matched, on the basis of their 2-digit SIC-code as well as their size, with organizations that had not adopted such a system, was the focus of a study conducted by Hunton *et al.* (2003). Although the financial performance of ERP-adopting organizations was generally better over a three year period than for non-adopters, no improvement in the financial performance of adopting organizations could be witnessed before and after the implementation of an ERP-system. Nevertheless, the financial performance of non-adopters decreased over time.

These particular outcomes lead up to the following hypothesis that will be tested in this study:

- **H2:** Organizations that implemented an ERP-system in the last three years had significantly better organizational benefits three years ago than organizations that did not implement or have such a system (Hunton *et al.* 2003).

Esteves and Bohorquez (2007) stress the importance of more research on the benefits of ERP-implementations in small and medium-sized enterprises. This call is followed up on here. We will compare differences in organizational benefits for Dutch small and medium-sized enterprises. Bernroider and Tang (2003), albeit indirectly, suggest that although many studies have been conducted on ERP-implementation effects in Europe, few studies have been conducted in the Netherlands. As ERP-systems as such have been said to have their roots in Europe (Pairat and Jungthirapanich 2005), the lack of focus on this country is striking. It will be 'redeemed' here.

We will now discuss our research approach. We will start with setting out our research method, after which a description of the main research findings will follow.

3. Research approach

3.1 Method

The data used to test H1 and H2 have been obtained via a self-developed survey that was almost entirely based on validated concepts taken from the ERP-related literature (Berchet and Habchi 2005; Bradley 2008; Eckartz *et al.* 2009; Grabski and Leech 2007; Hong and Kim 2002; Hunton *et al.* 2003; Shang and Seddon 2002; Soja and Poliwoda-Pękosz 2009; Vluggen 2006). The survey was developed to assess the performance and circumstances faced by a variety of Dutch firms during the 2007-2009 period. Two surveys were constructed: one for organizations that had implemented an ERP-system in the last three years (and had no such system before), and a similar survey for organizations that did not have an ERP-system - the main difference being that the latter survey came without the questions on ERP.

As part of the preparation for their master of science thesis, part-time master of science students in accountancy from the university that the authors of this paper stem from were asked to select and approach top-level managers who were knowledgeable about an organization's primary processes (CFOs, CIOs, etc.) in four organizations: two organizations with and two organizations without an ERP-system. They received the, for them, appropriate survey. The data were collected in November and December 2010, and were returned both on paper and in a pre-prepared Excel-sheet. As names and contact persons of the organizations that had been approached had to be handed in as well, we had the possibility to check whether the organizations in question had indeed been approached, and an appropriate interviewee had been selected. Several checks were carried out to safeguard that the data had been entered correctly in Excel (for instance, by checking several surveys in their entirety or by checking specific variables across surveys)¹. The survey questions relevant to this study can be found in Appendix 1. Forty organizations in our sample were SMEs (according to EC guideline 2003/361/EC²) and completed the survey they had been given. The data of these organizations will be used in our analyses. The aim is to create matched pairs of organizations based on their size, whose organizational benefits can subsequently be compared as stated in H1 and H2. We will correct the matching procedure for sectoral effects and possible other factors related to an organization's size. Like in the Hunton *et al.* (2003) study, sectoral effects will be taken into account by looking at an

¹Both surveys can be obtained from the corresponding author on request.

² Refer to http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/index_en.htm for details.

organization's 2-digit SIC-code (see also Barber and Lyon 1996). Size is expressed in this study as the natural logarithm of the sales of an organization, which is one of the ways in which Hunton *et al.* (2003) operationalized this item.

However, contrary to the Barber and Lyon (1996) and Hunton *et al.* (2003) studies, we believe that organizational size is dependent on a number of other factors, the influence of which has to be purged before matching can occur. To accomplish this, two regressions will be run. We first run the following regression for organizations that had implemented an ERP-system in the last three years:

$$\text{LOGMSALES} = \beta_0 + \beta_1 \text{FINHEALTH}_t + \beta_2 \text{PEU}_t + \beta_3 \text{GOLIVE} + \epsilon_t$$

where³:

LOGMSALES = the natural logarithm of the mean of organizational sales for the 2007-2009 period (our size measure);

FINHEALTH = financial health of an organization;

PEU = perceived environmental uncertainty;

GOLIVE = dummy indicating whether the 'go live' date of a system occurred in 2007 ('0'), 2008 ('1'), or 2009 ('2').

The reason for including the 'go live' date of a system has been set out in the previous section: it generally takes time before the fruits of an ERP-implementation can be reaped (Markus and Tanis 2000; Nicolaou and Bhattacharya 2006). The PEU variable has been incorporated to accommodate effects occurring in the environment of an organization. The operationalization of this variable has been taken from Vluggen (2006). Cronbach's alpha will be calculated to substantiate the operationalization chosen.

The financial health variable tries to put the respondents' view on whether they thought their organization was in a healthy financial state. This was a single-item measure. We assert that an organization's financial health can affect the benefits ultimately obtained from an ERP-system (Berchet and Habchi 2005; Hunton *et al.* 2003). We also feel that the recent financial crisis, which occurred in the period of study, exacerbates the importance to include such a variable.

A similar, second regression will be run for organizations without an ERP-system, without the 'go live' variable.

The standardized residuals of these two regressions will subsequently be used to match organizations. Thus, the residuals constitute our corrected size measure. Barber and Lyon (1996) assert that when organizations are matched within the same 2-digit SIC-code, viable matches are possible. As stated, this conforms to the correction for sectoral effects proposed by Hunton *et al.* (2003). Of course, a perfect match in terms of standardized residuals will be highly unlikely. Organizations, at best, will have roughly similar residuals. Barber and Lyon (1996) therefore decide to use a 90%-110% range of the matching variable to carry out their matching. They say that as long as the values of the matching variable are between 90%-110% of one another, a 'good' match can be made. They also propose several 'alternative rules' to extend the possibilities of a match when the abovementioned match cannot be made when using 2-digit SIC-codes. The following rule proved to be the most promising in their study on organizational performance:

"First, we attempt to match ... within the 90%-110% filter, using all firms in the same one-digit SIC code. If we still find no ... match, then we try to match ... within the 90%-110% filter using all firms without regard to SIC code. If we still find no ... match, our third step is to use the firm... closest to the firm in question, without regard to SIC code" (Barber and Lyon, 1996, p370).

Following Hunton *et al.* (2003), we will apply the same alternative rule here, even though organizational size is our matching variable (instead of organizational performance).

The statistical test that in the Barber and Lyon (*ibid.*) study yielded the most statistical power is the non-parametric Wilcoxon test (Hair *et al.* 2010). Its application led to consistently more powerful

³For details, refer to Appendix I.

results than (in)dependent sample Student *t*-tests. This happens to be the same test used by Hunton *et al.*(2003). It can accommodate very small sample sizes (with typically even less than ten observations) and still have substantial statistical power (Noether 1987). Therefore, we will apply it as well to test for differences in organizational benefits between the matched firms.

The six dimensions of organizational benefits distilled by Shang and Seddon (2002) are linked with ten aspects in our survey (see Appendix I for details). Respondents were asked to indicate how they judged the performance of their organization on these ten aspects, both currently and three years ago. A Likert 1-7 scale was employed to assess this (Grabski and Leech 2007). A low score on this scale indicates poor performance on a particular aspect, whereas a high score indicates very good performance. Cronbach's alpha will be used to substantiate the operationalization chosen.

3.2 Results

All ten aspects we used to operationalize Shang and Sheddon's (2002) organizational benefits concept could be grouped together. For the current data, Cronbach's alpha was 0.770. For the data from three years ago it was 0.836. Both values are larger than the commonly used threshold of 0.70 (Nunnally 1978).

A Cronbach's alpha analysis was also performed to see whether the six items discerned by Vluggen (2006) to capture PEU could be grouped together. Alas, Cronbach's alpha was only 0.653. Although below the 0.70 threshold, the value of 0.653 is deemed acceptable for exploratory studies, and was therefore satisfactory for our purposes (Nunnally 1978). Deletion of items within the construct would not have yielded a larger Cronbach's alpha value.

In the regression analyses, multicollinearity was considered by checking pairwise Spearman rank corrections for all explanatory variables. No problems were noted, for both regressions. The highest bivariate correlation was between FINHEALTH and PEU for organizations with an ERP-system (-0.183). No correlation was significant at the 5% level of significance.

By and large, the regression results of the two regressions for LOGMSALES were not impressive, as can be seen in Table 1, panel A and B. In panel A it is shown that the regression for ERP-related organizations had an R^2 of 0.027 (with 21 observations), with no statistically significant variables at either the 1%, 5% or 10% level of significance, except for the constant term. Both LOGMSALES and the standardized residuals of the regression were normally distributed on the basis of a Kolmogorov-Smirnov test at all of the aforementioned levels of significance, with *p*-values equal to 0.877 and 0.898 respectively (Hair *et al.* 2010). As shown in Table 1, panel B, roughly the same conclusions held for the regression for the group of non-ERP adopting organizations (with 19 observations). This regression yielded an R^2 of 0.058, with only the constant term being significant at the 1%, 5% and 10% level of significance. *P*-values of the Kolmogorov-Smirnov test for the LOGMSALES variable and the standardized residuals were 0.612 and 0.543 respectively, suggesting normal distributions in both cases. Visual inspection of predicted and standardized residuals suggested that homoscedasticity was present in both regressions (see also Hair *et al. ibid.*). Two Glejser tests were carried out to substantiate this conclusion (Gujarati and Porter 2008). In this test, the absolute values of the residuals of a regression become the dependent variable in a new regression, using all of the explanatory variables of the original regression. Heteroscedasticity may be present when one or more coefficients are significant in the new regression model. This was not the case in either of the two regressions carried out here. This corroborated our visual impression that the residuals of both regressions were homoscedastic.

Table 1: Regression results for LOGMSALES for organizations with (panel A) and without (panel B) an ERP-system.

Panel A			
Variable	Coefficient	t-statistic	(p-value)
Constant	16.765	18.857	(.000)
FINHEALTH	.056	.512	(.615)
PEU	-.026	-.169	(.868)
GOLIVE	-.047	-.320	(.753)
F-statistic for model (p-value): .158 (0.923); R ² : .027			
Panel B			
Variable	Coefficient	t-statistic	(p-value)
Constant	17.558	27.679	(.000)
FINHEALTH	-.066	-.746	(.467)
PEU	-.091	-.588	(.565)
F-statistic for model (p-value): .488 (0.622); R ² : .058			

Table 2 depicts the sectors in which the 21 sample organizations with and 19 sample organizations without an ERP-system operated, according to the respondents. This gives us some insight into the number of viable matches that can be made to assess H1 and H2.

Table 2: Sample overview of ERP- and non-ERP adopting organizations per SIC-code

SIC-code	Total number of organizations	Number of ERP-adopting organizations	Number of non-ERP adopting organizations
20	1	0	1
25	2	1	1
26	1	0	1
28	7	5	2
29	2	1	1
31	1	1	0
35	2	2	0
45	5	1	4
50	1	0	1
52	1	0	1
60	2	0	2
65	3	2	1
70	3	0	3
71	1	1	0
72	3	3	0
74	2	2	0
85	2	1	1
93	1	1	0
Total	40	21	19

From Table 2, it is immediately clear that even when including 1-digit SIC-codes in our analysis, not all organizations can be matched based solely on the sector in which they operate, for the mostly dissimilar number of observations (standardized residuals) per sector (see also Barber and Lyon 1996).

For instance, there are five organizations in the dataset with SIC-code 28 (producers of metal products) among the organizations with an ERP-system, but only two among the non-adopting organizations. Therefore, at best, two organizations can be matched for this particular sector at the 2-digit SIC-code level. Even when the possibilities for matching are extended following Barber and Lyon's alternative rule, we can only viably match 15 of the 19 organizations that could in principle have been matched, as we deem the difference between standardized residuals to be too large for the remaining four organizations (differences were more than 100%, and in two cases even more than 300 and 1000%). This we find a shortcoming of Barber and Lyon's alternative rule: it encourages researchers to keep on matching cases until there are none left in the database. In the end, this may mean linking too dissimilar organizations, but still calling such links a 'match'. This we believe is misleading, and is something we try to circumvent here.

Two Wilcoxon paired-sample tests were conducted to assess H1 and H2. The results of these tests have been summarized in Table 3. We could not reject H1 at either the 5% or 10% level of significance, but we could at the 1% level of significance. H2 could not be reject at either the 1%, 5% or 10% level of significance (*p*-values were 0.030 and 0.670 respectively). Thus, before the implementation of an ERP-system, organizational benefits were not significantly larger for organizations that implemented such a system than for organizations that did not implement or have such systems, but there is some indication that ERP-adopting organizations outperformed non-adopting organizations after the implementation (and within three years), even though the latter result is not particularly strong, judging from the corresponding *p*-value of 0.030. We believe that the number of observations in our sample did not affect this outcome, as Wilcoxon tests have been shown to have sufficient power in case of small samples (Barber and Lyon 1996;Noether 1987).

Table 3: Wilcoxon test results for H1 and H2.

<i>Wilcoxon test</i>	<i>p-value</i>	<i>Mean (median) organizational benefits for matched organizations</i>
<i>Difference in organizational benefits of matched organizations (2009)</i>	<i>.030</i>	<i>ERP-adopting organizations (2009): 5.093 (5.100)</i>
<i>Difference in organizational benefits of matched organizations (2007)</i>	<i>.670</i>	<i>ERP-adopting organizations (2007): 4.353 (4.500)</i>
		<i>Non-adopting organizations (2009): 4.673 (4.500)</i>
		<i>Non-adopting organizations (2007): 4.220 (4.200)</i>

In the following section, we will discuss our results against the background of the extant literature.

4. Discussion and conclusions

Our results partly corroborate the results in the ERP-literature, but they contradict others. For instance, all of the SMEs that implemented an ERP-system in the last three years needed less than three years for organizational benefits to start materializing. This is in line with Nicolaou (2004) and Nicolaou and Bhattacharya (2006), who suggested a period of two years for this to happen, but not with Kallunki *et al.* (2011) and Liu *et al.* (2008), who found a period of at least three years more likely. However, the aforementioned studies do not focus on SMEs. Perhaps the relatively less intricate organizational structure of many SMEs as compared to large multinational companies may be a reason for this different outcome. However, the fact that ERP-adopting organizations tend to outperform non-adopting organizations, sometime after a system's adaptation, and perhaps only for a limited period of time, is something that has been mentioned in the ERP-literature before (Bernroider 2008; Davenport 1998; Sneller 2010).

One might wonder if the ERP-adopting and non-adopting firms in our sample underwent statistically significant increases or decreases in organizational benefits over the last three years themselves. This could provide additional information on our likely acceptance of H1 and rejection of H2. Two other Wilcoxon paired-sample tests were carried out to assess this, using our entire sample of 21 ERP-adopting and 19 non-ERP adopting firms. As indicated in Table 4, in both cases, we rejected the null hypothesis that no changes in organizational benefits occurred in the 2007-2009 period at the 1%, 5% and 10% level of significance (p -values was 0.001 for both tests). Thus, by and large, both ERP-adopting and non-adopting firms had significant changes in organizational benefits in three years' time - the changes being positive in both cases⁴. Although organizational benefits were slightly less for non-ERP adopting firms than for adopting firms both three years ago and now, they increased by almost the same amount in the intervening period. Still, changes were sufficiently different for H1 to be accepted. This suggests that other factors affected both adopting and non-adopting organizations' performance between 2007-2009 considerably, rather than or in addition to just the implementation of an ERP-system. Although such systems ostensibly had some impact on the performance of adopting firms vis-à-vis non-adopting firms, other factors must have influenced our results as well, judging from the latter two tests. Thinking that ERP-implementations are the main culprit of this result may thus be too far-fetched.

Table 4: Wilcoxon test results for additional analyses.

<i>Wilcoxon test</i>	<i>p-value</i>	<i>Mean (median) organizational benefits for all organizations⁵</i>
<i>Difference in organizational benefits of ERP-adopting organizations (2007-2009)</i>	<i>.001</i>	<i>ERP-adopting organizations (2009): 4.871 (4.800)</i> <i>ERP-adopting organizations (2007): 4.286 (4.200)</i>
<i>Difference in organizational benefits of non-adopting organizations (2007-2009)</i>	<i>.001</i>	<i>Non-adopting organizations (2009): 4.853 (4.700)</i> <i>Non-adopting organizations (2007): 4.316</i>

⁴As can be seen in Table 4, for all ERP-adopting firms, the mean (median) level of organizational benefits rose from 4.286 (4.200) to 4.871 (4.800) while for non-adopting firms it rose from 4.316 (4.200) to 4.853 (4.700).

⁵Note that in Table 3, mean and median organizational benefits for the 15 matched organizations are presented, whereas in Table 4, all ERP and non-ERP adopting organizations in our sample are taken along.

Acknowledging that there are many factors influencing an organization's performance apart from an ERP-system, the question arises how these factors might be disentangled to assess their individual impact. Unfortunately, this may be extremely difficult, no matter which theoretical frameworks are adopted or research methods are applied. Think for example of the effects of management team changes on organizational performance, or the empathy that is felt for a consultant who helped an organization during an ERP-implementation, which makes that some employees continue to put in extra hours to make the system a success. How can such effects be set apart from the effects caused by an ERP-system by itself, when examining an organization's day-to-day business? All of these effects are obviously interrelated, often intricately so (Scapens 2006). On top of this, organizations can be seen as constellations of human and non-human actors, each with a specific past, and with their own set of rules and routines that have developed over time, which may be difficult to control and change (Boudreau and Robey 2005). How can such organizations be compared with others, so that reliable, general statements about the effects of ERP-systems on organizational conduct can be made (see also Argyris 1964)? Many of these aspects are overlooked when organizations are treated as 'black boxes', as is commonly done in much of the ERP-related literature on financial performance effects (see also Grabski *et al.* 2011). Some claim that the fact that this has not often been done has resulted in a highly influential ERP-rhetoric: ERP-systems are supposed to be beneficial for organizations when they are implemented 'correctly' and are used throughout an organization without difficulty. This is what these systems 'simply' are made to do, given their focus on 'best practices' (Lang and Wagner 2006).

An alternative view on the relation between ERP-implementations and organizational performance has been provided by Ahrens and Chapman (2007), Hopwood (1987) and Scapens (2006) among others. These authors claim that employees develop shared understandings of accounting practices (like those evolving around an ERP-system) in organizations, and organizational processes as a whole, *in situ*, jointly with fellow employees. Employees base their efforts on behalf of the organization on these understandings. Employee efforts, on their turn, can affect such understandings and the way in which they are shared. In terms of ERP-systems, this would imply that the performance effects of the latter's introduction and use at least partially depend on how such systems are perceived in an organization by employees, and how their opinion about these systems changes over time. All this is overlooked in the perspective we have taken here, and therefore warrants further study.

Nevertheless, we assert that there is clearly added value in this paper. It lies in the fact that as of yet, not much empirically supported research seems to be available for Dutch SMEs (Bernroider and Tang 2003). We admit that generalizable results cannot be claimed on the basis of this study. Still, valuable insights into some of the effects that ERP-implementations might (not) realize in specific settings when looking at non-financial performance benefits have been generated. Further research, using larger samples, and also, perhaps, taking into account other factors like the presence of specific integrating mechanisms that might help in realizing the alleged integration benefits of ERP-systems (Grabski and Leech 2007; Kallunki *et al.* 2011; Kumar *et al.* 2002), could yield further important insights into an, in our view, under-researched area in the ERP-literature.

References

- Adam, F. and O'Doherty, P. (2003). "ERP projects: good or bad for SME's?" In: Shanks, G., Seddon, P. and Willcocks, L. (Eds.), *Second-wave enterprise resource planning; implementing for effectiveness*, Cambridge: Cambridge University Press, pp275-298.
- Ahrens, T. and Chapman, C.S. (2007). "Management accounting as practice". *Accounting, Organizations and Society*, Vol.32, No. 1, pp1-27.
- Al-Mashari, M., Zairi, M. and Okazawa, K. (2006). "Enterprise resource planning (ERP) implementation: a useful road map". *International Journal of Management and Enterprise Development*, Vol. 3, No.1/2, pp169-180.
- Anthony, R.N. (1965). *Planning and control systems: a framework for analysis*. Cambridge: Harvard Business School Publications.
- Argyris, C. (1964). *Integrating the individual and the organization*. New York: John Wiley & Sons.
- Barber, B.M. and Lyon, J.D. (1996). "Detecting abnormal operating performance: the empirical power and specification of test statistics". *Journal of Finance & Economics*, Vol. 41, No. 3, pp359-399.
- Berchet, C. and Habchi, G. (2005). "The implementation and deployment of an ERP system: an industrial case study". *Computers in Industry*, Vol. 56, No. 6, pp588-605.

- Bernroider, E.W.N. (2008). "IT governance for enterprise resource planning supported by the DeLone–McLean model of information systems success". *Information & Management*, Vol. 48, No. 5, pp257-269.
- and Tang, N (2003). "Einführungsentscheidung, Bewertung und Auswahl von betriebswirtschaftlicher Standardsoftware (ERP-Systemen) in KMUs", *Diskussionspapiere zum Tätigkeitsfeld Informationsverarbeitung und Informationswirtschaft (Working Papers on Information Processing and Information Management*, No. 03/2003, Wirtschaftsuniversität Wien, Vienna, Austria.
- Botta-Genoulaz, V. and Millet, P-A. (2005). "A classification for better use of ERP systems". *Computers in Industry*, Vol. 56, No. 6, pp573-587.
- Boudreau, M.C. and Robey, D (2005). "Enacting integrated information technology: a human agency perspective". *Organization Science*, Vol. 16, No. 1, pp3-18.
- Bradley, J. (2008). "Management based critical success factors in the implementation of enterprise resource planning systems". *International Journal of Accounting Information Systems*, Vol. 8, No. 3, pp175-200.
- Buckhout, S., Frey, E., and Nemec, Jr., J. (1999). "Making ERP succeed: turning fear into promise". *Journal of Strategy and Business*, Vol.15, No. 1, pp60-72.
- Davenport, T.H. (1998). "Putting the enterprise into the enterprise system". *Harvard Business Review*, Vol. 76, No. 4, pp121-131 (July/August).
- Eckartz, S., Daneva, M., Wieringa R., van Hillegersberg, J. (2009). "A conceptual framework for ERP benefit classification: a literature review". *Technical Report TR-CTIT-09-04, Centre for Telematics and Information Technology, University of Twente, Enschede, the Netherlands (ISSN 1381-3625)*.
- Esteves, J. and Bohorquez, V. (2007). "An updated ERP systems annotated bibliography: 2001–2005". *Communications of the Association for Information Systems*, Vol. 19, Art. 18, pp386-446.
- Grabski, S.V. and Leech, S.A. (2007). "Complementary controls and ERP implementation success". *International Journal of Accounting Information Systems*, Vol. 8, No. 1, pp17-39.
- Grabski, S.V., Leech, S.A. and Schmidt, P.J. (2011). "A review of ERP research: a future agenda for accounting information systems". *Journal of Information Systems*, Vol. 25, No. 1, pp37-78.
- Gujarati, D. and Porter, D. (2008). *Basic econometrics* (5th edition). New York: McGraw-Hill/Irwin.
- Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010). *Multivariate data analysis; a global perspective* (7th edition). New Jersey: Prentice Hall.
- Hong, K. and Kim, Y. (2002). "The critical success factors for ERP implementation: an organizational fit perspective". *Information & Management*, Vol. 40, No. 1, pp25-40.
- Hopwood, A.G. (1987). "The archaeology of accounting systems". *Accounting, Organizations and Society*, Vol. 12, No. 3, pp207-234.
- Hunton, J., Lippincott, B. and Reck, J. (2003). "Enterprise resource planning systems: comparing firm performance of adopters and nonadopters". *International Journal of Accounting Information Systems*, Vol. 4, No. 3, pp165-184.
- Jones, M.C., Cline, M. and Ryan, S. (2006). "Exploring knowledge sharing in ERP implementation: an organizational culture framework". *Decision Support Systems*, Vol. 41, No. 2, pp411-434.
- Kallunki, J-P., Laitinen, E.K. and Silvola, H. (2011). "Impact of enterprise resource planning systems on management control systems and firm performance". *International Journal of Accounting Information Systems*, Vol. 12, No. 1, pp20-39.
- Kaplan, R.S., and Norton, D.P. (1993). "Putting the balanced scorecard to work". *Harvard Business Review*, Vol. 71, No. 5, pp134-147.
- Keller, E.L. (1999). "Lessons learned". *Manufacturing Systems*, Vol. 17 No. 11, pp44-50.
- Kumar K. and van Hillegersberg, J. (2000). "Enterprise resource planning experiences and evolution". *Communications of the ACM*, Vol. 43, No. 3, pp22-26.
- Maheshwari, B. and Kumar, U. (2002). "ERP systems implementation: best practices in Canadian government organizations". *Government Information Quarterly*, Vol. 19, No. 2, pp147-172.
- Light, B. and Wagner, E.L. (2006). "Integration in ERP environments: rhetoric, realities and organisational possibilities". *New Technology, Work and Employment*, Vol. 21, No. 3, pp215-228.
- Liu, L., Miao, R. and Li, C. (2008). "The impacts of enterprise resource planning systems on firm performance: an empirical analysis of Chinese chemical firms". *IFIP International Federation for Information Processing*, Vol. 254/2008, pp579-587.
- Markus, M.L. and Tanis, C. (2000). "The enterprise systems experience – from adoption to success". In: Zmud, R.W. (Ed.), *Framing the domains of IT research: glimpsing the future through the past*, Cincinnati: Pinnaflex Educational Resources, pp173-207.
- 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, pp79-105.
- and Bhattacharya, 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, pp18-35.
- Noether, G.E. (1987). "Sample size determination for some common nonparametric tests". *Journal of the American Statistical Association*, Vol. 82, No. 398, pp645-647.
- Nunnally, J.C. (1978). *Psychometric theory* (2nd edition). New York: McGraw-Hill.
- Pairat, R. and Jungthirapanich, C. (2005). "A chronological review of ERP research: an analysis of ERP inception, evolution, and direction". *Proceedings of the IEEE International Engineering Management Conference*, Vol. 1, pp288-292.

Poston, R. and Grabski, S. (2001). "Financial impacts of enterprise resource planning implementations". *International Journal of Accounting Information Systems*, Vol. 2, No. 4, pp271-294.

Ross, J.W. and Vitale, M.R. (2000). "The ERP revolution: surviving vs. thriving". *Information System Frontiers*, Vol. 2 No. 2, pp233 -241.

Scapens, R.W. (2006). "Understanding management accounting practices: a personal journey". *British Accounting Review*, Vol. 38, No. 1, pp1-30.

Scott, J. (1999). *The FoxMeyer Drugs' bankruptcy: was it a failure of ERP?* In: Leitheiser, R. (Ed.), *Proceedings of the fifth American conference on information systems*. Milwaukee: Association for Information Systems, pp223-225.

Shang, S. and Seddon, P. (2002). "Assessing and managing the benefits of enterprise systems: the business manager's perspective". *Information Systems Journal*, Vol. 12, No. 4, pp271-299.

Sneller, L. (2010). *Does ERP add company value? A study for the Netherlands and the United Kingdom*. Alblasterdam: Drukkerij HAVEKA.

Soja, P. and Paliwoda-Pekosz, G. (2009). "What are real problems in enterprise system adoption?". *Industrial Management & Data Systems*, Vol. 109, No. 5, pp610-627.

Stefanou, C.J. (2001). "A framework for the ex-ante evaluation of ERP software". *European Journal of Information Systems*, Vol. 10, No. 4, pp204-215.

Vluggen, M. (2006). *Enterprise resource planning systems: an empirical study of adoption and effects*. PhD dissertation, Maastricht: Universiteit Maastricht.

Wah, L. (2000). "Give ERP a chance". *Management Review*, Vol. 89, No. 3, pp20-24.

Appendix 1: Relevant survey questions

Organizational benefits [Eckartz et al. 2009; Shang and Seddon 2002]

Could you tell us how your organization **currently** performs/does on the following aspects? Please use the scale below⁶.

(1= very poorly; 2= quite poorly; 3= somewhat below expectations; 4= as expected; 5= somewhat better than expected; 6= quite well; 7= very well; 8= don't know)

Current performance	very poorly very well							don't know
	1	2	3	4	5	6	7	
1. Internal communication								
2. Standardization of work processes								
3. Quality of internal reports								
4. The degree to which work activities and decision power have been relegated to other employees than managers								
5. Flexibility of work processes								
6. The size of budgets available for internal and external courses								
7. Building a common, organization-wide vision								
8. Focus on core tasks								
9. Employee satisfaction								
10. Mutual behaviour of employees								

Financial health [Berchet and Habchi 2005; Hunton et al. 2003]

How far do you agree with the following statement: "I work in a financially healthy organization"?

completely disagree	substantially disagree	disagree somewhat	agree somewhat	substantially agree	completely agree	don't know
1	2	3	4	5	6	7

Perceived environmental uncertainty [Vluggen 2006]

⁶ This question was repeated to assess the situation in an organization three years ago.

Below you can find several statements that are presented as opposite pairs. All statements concern the market(s) and environment(s) your organization operates in. Could you please tell us how far these statements currently reflect the situation your organization faces?

1.	the marketing strategy of our organization is hardly ever changed to fulfill customer needs	1	2	3	4	5	6	the marketing strategy of our organization is changed very often to fulfill customer needs	don't know
2.	our line of products and services stays very much the same over time	1	2	3	4	5	6	our line of products and services changes very quickly over time	don't know
3.	it is relatively easy to guess what our competitors are doing	1	2	3	4	5	6	our competitors are highly unpredictable	don't know
4.	it is relatively easy to determine what our customers want	1	2	3	4	5	6	it is extremely difficult to determine what our customers want	don't know
5.	we continuously have to anticipate changes in our environment in order for our organization to survive	1	2	3	4	5	6	we hardly ever have to anticipate changes in our environment in order for our organization to survive	don't know
6.	our production technology is stable	1	2	3	4	5	6	our production technology changes very rapidly	don't know

Go live' date [Markus and Tanis 2000]

According to our information, an ERP-system has been implemented in your organization somewhere during the last three years. Below you can find several question about this system, that we kindly request you to answer.

<p>1. What was the 'go live' date of the ERP-system?</p> <p><i>The 'go live' date is the moment in time all users in your organization were allowed to work with the system for the very first time.</i></p>	dd/mm/yy
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