Impact of enterprise resource planning systems on management control systems and firm performance

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ABSTRACT

In this study, we extend existing research on enterprise resource planning systems by exploring the effects of enterprise system adoption on subsequent non-financial and financial performance of a firm. Specifically, we investigate the role of formal and informal management control systems as mechanisms which mediate the effect of enterprise resource planning systems adoption on firm performance. Our empirical analyses are based on survey data drawn from 70 Finnish business units. Overall, our findings demonstrate that formal types of management control systems act as intervening variables mediating the positive lagged effect between enterprise systems adoption and non-financial performance. Informal types of management control systems, however, do not show similar mediating effects. We also predict and find a significant relationship between non-financial and financial firm performance. These results are important because the evidence on the joint roles of enterprise systems and management control system on improving the firm performance is very limited in prior literature. Our results show that the use of enterprise systems results in improved firm performance in the long run, and that more formal than informal types of management controls help firms achieve future performance goals.

1. Introduction

In the last ten years, enterprise resource planning systems (ERPS) have become popular in mid-sized and large firms throughout the world. Prior to this, each function within an organization had its own

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information system operating separately from the information systems of the other organizational functions (Rom and Rohde, 2007). ERPSs are organization-wide and integrated information systems that can be used to manage and coordinate all the resources, information, and functions of a business from shared data stores. As ERPSs are intended to integrate all corporate information into one central database, they allow all information to be retrieved from many different organizational positions and to make any organization object visible (Dechow and Mouritsen, 2005).

Since ERPSs render all corporate information visible and financial information accessible not solely to accountants, this poses challenges for managerial reporting and control. ERPSs change the role of management accounting by providing management with easy and fast access to relevant and real-time operational data needed in decision-making and management control. The main purpose of management control systems (MCS) is to monitor decisions throughout the organization and to guide employee behavior in desirable ways in order to increase the chances that an organization's objectives, including organizational performance, will be achieved (e.g. Bhimani et al., 2008). MCS can be defined as a tool designed to assist the manager's decision-making consisting of both formal and informal forms of controls (Chenhall, 2003). Formal control consists of contractual obligations and formal organizational mechanisms and can be subdivided into outcome and behavior control mechanisms; informal or social control, on the other hand, relates to informal cultures and systems influencing members and is essentially based on mechanisms inducing self-regulation (Ouchi, 1979). Earlier studies show that ERPSs result in changes in MCS due to increased centralization of system coordination and homogenization of control practices (Granlund and Malmi, 2002). Chapman and Kihn (2009) suggest that formal MCS, and notably budgeting, mediates the effect of ERPS on performance. Granlund (2007) suggests that information technology (IT) may have many notable effects on management control practice, although some of them are realized unintentionally. These studies show only a moderate effect of ERPS on management accounting practices. However, a number of studies suggest that ERPSs drive a role change of accountants from "bean counters" to business analysts (e.g. Granlund and Malmi, 2002; Scapens and Jazayeri, 2003). As ERPSs are organization-wide information systems, they require support from management and employees in order to be successfully adopted. When ERPS are used in tandem with an efficient portfolio of controls, they may achieve an organization's objectives and lead to improvements in performance.

When assessing the potential effects of ERPSs, it is important to make a distinction between financial and non-financial performance effects. Financial performance refers to the ability to generate profits or profitability assessed by financial measures such as the return on investment ratio (ROI). Non-financial performance refers to organizational effectiveness and efficiency assessed by non-financial measures such as manufacturing lead time, labor efficiency variance and number of customer complains. The potential non-financial benefits of ERPSs include productivity and quality improvements in key business areas such as product reliability, customer service, and knowledge management (Hunton et al., 2003). ERPSs are expected to result in a better designed information system, which in turn increases the organizational efficiency and the effectiveness of attaining desired organizational outcomes (Nicolaou, 2004b). However, the relationship between improvements in efficiency, effectiveness and the financial performance of the firm is empirically unclear (Kaplan, 1990; Fisher, 1992). Furthermore, the recent empirical evidence on the effects of ERPSs on organizational performance is contradictory; the existing literature shows statistically that those organizations which implemented ERPS a few years ago nowadays perform either better (e.g. Hunton et al., 2003; Nicolaou, 2004a; Nicolaou and Bhattacharya, 2006, 2008; Wier et al., 2007) or worse than the firms which have not implemented ERPS (Poston and Grabski, 2001). These contradictory results may be due to the time lag between the initial ERPS adoption and its desired effects on performance. To illustrate, Nicolaou (2004a) has shown that it takes at least two years before ERPS adopters begin to achieve positive financial performance.

The studies discussed above typically do not examine the role of MCSs in achieving desired firm performance. In spite of its obvious importance, research on the relationship between ERPSs and MCSs is still in its infancy (e.g. Granlund, 2007; Nicolaou, 2008). This issue has mainly been addressed by case studies describing either ERPS as an implementation process (e.g. Rose and Kraemmerkaard, 2006) or then the effects of ERPS adoption on management accounting and the accounting profession (e.g. Granlund and Malmi, 2002) and on the centralization of organizations (e.g. Quattrone and Hopper, 2005) without considering potential effects on perceived performance. In essence, a broader and more generalizable view of the interrelation between MCSs and ERPSs is still lacking (e.g. Chapman, 2005; Chapman and Kihn, 2009;

Dechow and Mouritsen, 2005; Rom and Rohde, 2007). In addition, recent calls for research on enterprise systems have raised the issue of enhancing the validity of studies in this area and examining issues of enterprise systems adoption and management control in organizations (e.g. Arnold, 2006; Granlund, Mouritsen and Vaassen, 2010; Sutton, 2006).

In this study, we explore the effects of ERPS adoption on the subsequent non-financial and financial performance of the firm, and whether the formal and informal MCSs mediate these effects. We examine both non-financial and financial performance in order to gain a comprehensive view of the organization's performance (Ittner and Larcker, 2003). Since ERPSs are a long-term strategic investment and their implementation is a lengthy process influencing the organization as a whole, the effect of ERPS on future performance needs to be investigated over an adoption process/period of several years. Our study contributes to the ERPS and MCS literature in two main respects. First, it expands the studies on the use of ERPSs (e.g. Hunton et al., 2003; Nicolaou, 2004a; Nicolaou and Bhattacharya, 2006, 2008; Wier and Hunton, 2007) by providing evidence on the effect of ERPS adoption on the future performance of the business unit when the effect of other MCSs as mediating variables is controlled for. In fact, we show that, when taking this time lag into account, the effect on financial performance is achieved through non-financial performance (e.g. Velcu, 2007). Second, our paper extends the work of Chapman (2005) and Chapman and Kihn (2009) by exploring the role of formal and informal MCSs in addition to budgeting as mediating variables of ERPS in improving performance.

Our empirical analyses are based on survey data drawn from 70 Finnish business units in 2007. The main results of our empirical analyses can be summarized as follows. First, we find a significant path from ERPS to formal controls, which is then linked to non-financial performance. It is noteworthy that no direct significant effect of ERPS on non-financial performance is observed, although these variables are strongly correlated in univariate analysis. Therefore, the significant correlation between ERPS and non-financial performance is perfectly mediated by formal controls. Informal controls seem not to have a mediating effect. In addition, our results also show that non-financial performance is positively associated with the financial performance of the firm. In sum, the result of the path model indicates that formal controls act as intervening variables mediating the positive lagged effect between ERPS and non-financial performance.

The remainder of the paper is organized into four sections. In Section 2 we review the relevant literature and develop our research hypotheses. We describe the survey data and research method in Section 3 and report descriptive statistics and the results of preliminary data analyses. In Section 4, we report the empirical results including the corresponding robustness tests and present concluding remarks in Section 5.

2. Literature review and hypotheses development

In this section, we develop a path model based on the literature. First, we expect that ERPSs have a direct positive influence on the use of both formal and informal MCSs. Second, we assume that formal and informal MCSs mediate the positive influence of ERPSs on both non-financial and financial performance. It is also proposed that ERPSs may have a direct influence on non-financial and financial performance, and that non-financial performance may have an effect on financial performance. Fig. 1 presents our hypothesized path model, which includes the constructs and their relationships. The set of hypotheses states that formal and informal MCSs act as intervening (mediating or process) variables (mediator) between ERPS (initial variable) and financial and non-financial performance (outcome). In order to substantiate this view, we develop detailed hypotheses by drawing on the earlier literature and MCS theory. Moreover, research on management accounting systems as systems of management control is emphasized.

2.1. Direct influence of ERPS on performance

ERPS investments are intended to improve organizational efficiency and effectiveness (non-financial performance) and ultimately financial performance. Financial performance refers to the profitability of the firm or business unit, which can be measured by financial measures such as return on investment ratio. Non-financial performance in turn covers areas such as product reliability, customer service, knowledge management and other performance areas that are likely to affect the ultimate profitability of the firm. Thus, non-financial performance measures bridge gaps left by financial accounting to complete the picture of the organization's performance (Ittner and Larcker, 2003). In the last decade many organizations have
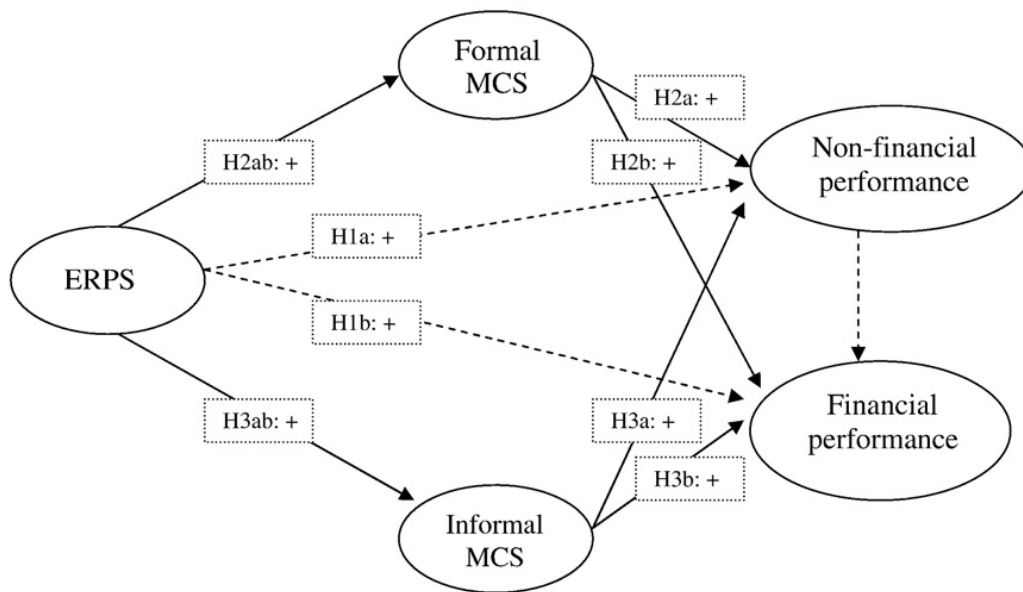
Note: We expect the effects of Hypotheses H1a and H1b to non-significant, given the expected mediating influence of formal and informal controls. The link between non-financial and financial performance is not formally hypothesized.

Fig. 1. Hypothesized path model.

adopted performance measurement frameworks covering both financial and non-financial performance such as Kaplan and Norton's Balanced Scorecard (BSC). In general, ERPSs are expected to result in a more efficient information system contributing to the non-financial efficiency with which organizational functions are carried out and eventually to the financial performance of the firm (Nicolaou, 2004b).

2.1.1. Effect on non-financial performance

ERPS can be expected to have a direct effect on the non-financial performance of a firm. Empirical studies show that several benefits for operational efficiency can be achieved when implementing ERPS. Shang and Seddon (2002) propose a framework for assessing ERP benefits at five levels: operational (e.g. the automation of business processes), managerial (e.g. better planning and management of organizational resources), strategic (e.g. the ability of the ERPS to support business growth and competitive advantage), IT infrastructural (e.g. savings on IT costs), and organizational (e.g. organizational learning and staff empowerment). The use of ERPS may result in production and quality improvements in key business areas, such as product reliability, customer service, and knowledge management (Hunton et al., 2003). The use of financial modules of ERPS may improve performance, for example, through accelerated reporting cycles and expanded information capabilities (O'Leary, 2000; Wier et al., 2007).

2.1.2. Effect on financial performance

ERPSs are likely to directly improve the financial performance of the firm because of the lower IT infrastructure costs (Shang and Seddon, 2002). However, the evidence of this direct effect is generally mixed and often the effect is indirect through non-financial performance. However, Velcu (2007) shows in a field study that ERPSs have many direct effects not only on non-financial performance but also on financial performance. She reports that ERPS implementations may enable more accurate selling prices, leading to better profit margin maintenance. The number of mistakes in invoiced prices may diminish and lead to improvements in revenue. Business initiative ERPS implementations may enable economies of scale, which avoid the generation of additional headcount costs and selling, general, and administrative costs. This is partly due to structural changes concurrent with the system implementation.

In early 1990 researchers could find no significant positive relationship between IT investments and financial performance. This is referred to as the productivity paradox. Since then, the evidence has been

mixed. Hayes et al. (2001) found a positive effect of ERPSs on performance by showing significantly higher stock returns upon the announcement of ERPS implementations, whereas Poston and Grabski (2001) found no effect on financial performance. Moreover, Hunton et al. (2003) found that non-ERPS adopters experience deteriorating performance, while ERPS adopters do not. Comparing the long-term differences in performance between ERPS adopters and non-adopters, Nicolaou (2004a) reported that it takes at least two years after the ERPS adoption before adopters show a better performance than non-adopters. Nicolaou and Bhattacharya (2006) also reported that the timing and nature of ERPS transformation have a significant bearing on the effect of ERPS on performance; early enhancements (during the year of completion or in the following year) in the form of either add-ons or upgrades differ positively and significantly while late enhancements (at least two years after system completion) and both early and late abandonments appear to demonstrate differential performance deterioration. Nicolaou and Bhattacharya (2008) subsequently found that early post-implementation activities such as project planning, strategic definition and process integration have a positive financial performance differential effect on firms' incremental ROI, return on sales ratio (ROS), the cost of goods sold over sales ratio, and the employee efficiency ratio. Kobelsky et al. (2008) found that IT investment also increases the volatility of future earnings but that this impact is heavily contingent upon three firm level contextual factors; sales growth has a decidedly positive effect on the relationship between IT and earnings volatility while firm size and unrelated diversification have a markedly negative moderating impact on earnings volatility. These findings may partly explain the discrepancy in the results obtained by Poston and Grabski (2001).

Based on the above discussion, ERPSs adoption is expected to have direct effects on both non-financial and financial performance. The following two research hypotheses are therefore advanced:

H1a. More extensive use of ERPS will have a positive direct effect on non-financial performance.

H1b. More extensive use of ERPS will have a positive direct effect on financial performance.

2.2. MCSs mediating the influence of ERPS on performance

According to Anthony (1965), organizational processes comprise three levels — strategic planning, management control and operational control. Even though much of ERPS success has been in facilitating operational coordination across functional departments, successful implementation of ERPS should also benefit strategic planning and management control. Thus, ERPS may lead to improvement in organizational performance only when it is built within efficient MCSs to control reengineered business processes. MCS is a system which gathers and uses information to evaluate the performance of different organizational resources – human, physical, financial and also of the organization as a whole – considering the organizational strategies. The main purpose of MCS is to is to provide information useful for decision-making, planning and evaluation (Merchant and Otley, 2006), so as to control decisions throughout the organization and guide behavior in desirable ways in order to help organizations achieve their objectives (e.g. Anthony and Govindarajan, 2007; Bhimani et al., 2008). MCS comprises multiple control systems that are interdependent and work together to form an efficient control package to improve organizational performance (Otley, 1980; Abernethy and Chua, 1996; Malmi and Brown, 2008). A mix or package of MCSs consists of both formal and informal controls that are expected to converge towards an efficient portfolio of controls. Overall, MCS is a general system by which managers influence other members of the organization to implement the organization's strategies (Anthony and Govindarajan, 2007). According to the definition of MCS and the purpose of ERPS, ERPS itself can be seen as an umbrella for a formal management control system aiming to improve organizational performance jointly with other controls including more organic forms. The literature also suggests that ERPS can be seen as a massive management control system package integrating various accounting and non-accounting control systems (Granlund, 2007).

One might expect that the mere existence of ERPS as a technical software system does not improve organizational performance, while optimal organizational performance could be achieved jointly using ERPS with informal communication i.e. more organic controls. Overall, earlier studies show the effect of the extent of use in both formal controls and informal controls (organic processes) on organizational performance (Chenhall and Morris, 1995). Moreover, in entrepreneurial firms performance was significantly and simultaneously associated with the extent of both control types but in conservative firms no such association

was found. Simons (2000) in his levers of control framework (LOC) argues that four formal and informal control systems (beliefs, boundary, diagnostic, and interactive systems) work together to improve the performance of a firm through organizational learning and the efficient use of management expertise. Widener (2007) examined the LOC framework and reported that the use of control systems has a positive effect on firm performance, although there is a cost. While earlier studies suggest that the best organizational performance can be achieved by using both informal and formal controls concurrently, we expect that both forms of MCSs also help ERPS to achieve improved organizational performance.

The implementation of ERPS may yield a number of managerial benefits in MCSs due to better planning and control (Shang and Seddon, 2002; Chapman, 2005). In this way, ERPSs can fulfill the dream of many management controllers through remote and instantaneous control with real-time information (Quattrone and Hopper, 2005). Granlund (2007) argues that most of the accountants in his study perceived IT as the most important single driver of recent developments in managerial accounting. Prior studies, however, show that even if the potential of ERPSs to develop MCSs is considerable, firms often want to retain their existing MCSs (Rom and Rohde, 2007). Scapens and Jazayeri (2003) in a case study showed that MCSs did not change significantly despite the implementation of ERPS, because the plant managers wanted what they had before. It has also been reported that management support is essential in order to carry out a successful ERPS implementation process (e.g. Rom and Rohde, 2007; Rose and Kraemmerkaard, 2006). In their field study, Granlund and Malmi (2002) obtained the same results as they found that the existing principles of MCSs were simply transferred to the ERPS. These studies show that the MCSs used by the firms prior to ERPS implementation have not so far changed. In addition, new and more sophisticated MCSs have not been adopted due to the use of ERPS (Granlund and Malmi, 2002; Scapens and Jazayeri, 2003). Granlund and Malmi (2002) argue that one reason for the limited influence may be the time lag between ERPS implementation and its effects on MCSs. However, they conducted their study around the turn of the millennium, when ERPSs were relatively new and complex systems, and this may have affected their results. One possible explanation for the time lags is that it may be too risky to change basic operations and management control systems simultaneously (Granlund and Malmi, 2002; Quattrone and Hopper, 2005). Granlund and Malmi (2002) also report that the reason for ERPS adopters not using the new technology in their attempts to develop management accounting may well be economic considerations i.e. system complexity and lack of resources.

More recent studies have identified significant impacts of ERPSs on MCSs (Rom and Rohde, 2007). Spathis and Constantinides (2004) found in their survey that the responding firms had increased the use of non-financial performance measures and profitability analyses when ERPSs were implemented. Quattrone and Hopper (2005) showed in two cases that ERPS may have a significant effect on MCS. In their cases, ERPSs were not a vehicle for radical change in MCSs, but were restricted to incrementally improving prevailing practices. ERPS information reproduced the iterative and cumulative reporting of transactions in existing accounting controls. The first case firm used ERPS to preserve gaps between geographical and functional areas, and the center and the periphery. Rather than re-defining relations between hierarchical levels, functional areas, and operational activities, ERPS reinforced the status quo. The second case demonstrates how the same ERPS (SAP) produced a different outcome. The case firm reduced distances between segments to enact the ERP philosophy of integration based on real-time control. However, control suffered because the reorganization of processes and structures failed to match responsibilities to accountability. Thus it is a strategic decision whether ERPSs are used to centralize management control on top management or to decentralize power to demonstrate more visible MCSs throughout the organization. Dechow and Mouritsen (2005) reported that ERPS may enable control through financial and non-financial representations because it distinguishes between accounting and logistics information. They argue that management control in an ERPS environment is not a property of the accounting function but a collective issue, where local control issues in different parts of the organization are used to create notions of global management. ERPSs therefore create a platform for the more extensive use of both formal and informal controls. Recently, Chapman and Kihn (2009) have shown that as information systems integration enables budgeting systems, formal MCSs are associated with perceived information system success.

2.2.1. Relationship between non-financial and financial performance

Velcu (2007) showed that the respondents in her study were able to report a number of operational benefits from ERPS implementation but were unable to make quantitative assessments of the impact of ERPSs

on financial performance because of uncertainty about other structural changes occurring concurrently with the system implementation. However, the respondents conceded that they expected indirect financial impacts either at the cost or income level i.e. better monitoring of inventory levels led to higher inventory turnover, reducing the need for working capital while more accurate selling prices had an indirect effect on profit margins. Chapman and Kihn (2009) report a direct association between information system integration and perceived system success, but not between integration and other aspects of performance i.e. traditional non-financial and financial performance measures. They suggest that ERPSs can be very useful for management even if the system does not directly enhance the firm's financial performance.

Although there is often a causal link between non-financial and financial performance, is difficult to identify this empirically. Fisher (1992) studied non-financial measures at five high technology manufacturing plants and concluded that one of the crucial difficulties of the non-financial system was the inability to quantify the degree of improvement in the non-financial measurements. He concludes that the connection between improvements in the non-financial operational measures and profits was unclear. However, some evidence shows that the use of non-financial performance measures improves firms' financial performance. For instance, Said et al. (2003) report that ERPS adoption, compared to non-adoption, improves both short-term and long-term stock returns and long-term return on assets (ROA) when non-financial performance indicators are included in executive remuneration contracts. Wier et al. (2007) report similar results. Brown and Vessey (2003) suggest that top management support involving project planning and project execution is crucial to long-term post-implementation success. These findings are consistent with agency theory, suggesting that when non-financial performance indicators become part of the managerial reward system, managers are motivated to implement information processes, procedures, systems and metrics (both formal and informal MCSs) that are focused on non-financial performance. In sum, the literature discussed above suggests that both ERPS and MCSs are related to both financial and non-financial performance and illustrate that non-financial performance may ultimately lead to financial performance. As a result, the following research hypotheses are advanced:

H2a. More extensive use of formal controls mediates the positive direct effect of ERPS on the non-financial performance of the firm.

H2b. More extensive use of formal controls mediates the positive direct effect of ERPS on the financial performance of the firm.

H3a. More extensive use of informal controls mediates the positive direct effect of ERPS on the non-financial performance of the firm.

H3b. More extensive use of informal controls mediates the positive direct effect of ERPS on the financial performance of the firm.

3. Data and research design

3.1. Sample

The data used in the study were collected by questionnaire. The survey was conducted in November 2007 by e-mailing questionnaires to 1000 randomly selected chief financial officers (CFOs) or business controllers in the business units of large Finnish companies. E-mail addresses were obtained from a business education company maintaining a large contact information database of Finnish firms. The e-mail included a covering letter explaining the purpose of the research and a link to the web site where respondents could complete the questionnaire anonymously. A reminder was e-mailed two weeks later. All in all, out of the 1000 people contacted we received responses from 96 different business units, giving a response rate of 9.6%. Moreover, 81 of the respondents were business controllers while only 15 of the respondents were CFOs. This response rate is relatively low, most likely due to the following two reasons. First, the questionnaire was about the use of ERPS, and, thus, potential respondents in firms not using ERPS did not respond to the questionnaire. Second, the detailed questions require respondents to remember detailed information on the firm over a relatively long period of time. To illustrate, six respondents reported that they were not able to answer such specific and practical questions.

Table 1
Age, size and growth of the sample firms.

	Mean	Media	Std. deviation	Minimum	Maximum
Age	44	25	44	1	207
Total number of employees	759	200	1656	3	10,000
Number of employees in the finance department	13	7	18	1	100
Net sales in 2006 (1000€)	162,186	36,969	520,871	26	4,100,000
Growth of net sales in 2006 (%)	22	10	102	−30	855
Net profit of net sales (%) 2004	7.6	5.0	10.3	−26	41
Net profit of net sales (%) 2005	6.5	5.6	8.4	−14	37
Net profit of net sales (%) 2006	6.4	4.6	8.9	−15	33

The table presents the mean, median, standard deviation, minimum and maximum values of age, size and growth variables of the sample firms.

As with earlier surveys exploring the use of MCSs and performance, respondents were asked to respond to a series of questions in a way that best described the situation in their business units. In our study, sampling at the business unit level is especially important because of the modular nature of ERPS. Specifically, different modules of ERPS may have been adopted in different business units within a large company or adoption processes may be at different stages in several business units. All the questions address the business unit level except in companies having only one unit, when the answers refer to the organization as a whole. The business units are of different sizes and they operate in various industries, because we wanted to test our hypotheses regarding the impact of ERPS on MCSs and the performance of the units so that the results could be generalized to firms of different sizes and operating in different industries. Tables 1 and 2 report the summary statistics of the sample units.

As Van der Stede et al. (2005) suggest, response bias tests are needed to ensure that the sample is representative. We tested the potential effect of response bias on our results by comparing the mean values of the survey items of the first 20% of responses received to the mean values of variables of the last 20% of responses received. There were no significant differences, which would support that there was no response bias.

3.2. Measures

The questionnaire included items measuring the extent of the use of ERPS, formal and informal controls and the performance of the firm. The questionnaire was designed to use survey items used in earlier studies so as to reduce response error, in case respondents did not fully understand the questions (e.g. Dillman, 1999; Van der Stede et al., 2005). In this section, we describe the survey items in detail. Table 3 provides the details of the questions used to measure constructs in the study.

3.2.1. The extent of ERPS

We improve the variable measuring the extent of ERPS use on the basis of the earlier literature providing different variables to measure ERPS.[3] As Granlund and Malmi (2002) and Quattrone and Hopper (2005) point out, ERPS projects appear to be inconsistent across organizations. Thus, we do not agree with the assumption according to which it is ideal to implement all available modules and features of the ERPS. Organizations differ in their structures and needs and therefore not all organizations necessarily need all modules.[4] In this study, we defined ERPSs as modules at business unit level. The term 'module' is used in

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[3] The literature abounds in investigations of the implementation of ERPS using more or less simple variables to measure the use of ERPS. A zero-one dummy variable has been used to represent whether the firm has or has not adopted ERPS (e.g. Hunton et al., 2003). A variable 'successful adoption of ERPS' has been used to investigate the extent to which a company has implemented the full capability of ERPS and redesigned its business processes commensurate with the ERPS concept (Markus and Robey, 1998; O'Leary, 2000; Grabski and Leech, 2007). A more sophisticated 'ERP impact score', which is very close to our variable, has been used to describe the extent to which the company has implemented all the available modules and features of ERPS and the extent to which the company has redesigned it business processes to best utilize the ERPS (Wier and Hunton, 2007; Brazel and Dang, 2008).

[4] We recognize that business units that have adopted only one or two modules of a specific ERPS cannot necessarily be considered to apply an integrated information system. In such a case, an organizational need has led to more limited information system, and our construct of ERPS should be interpreted in this context.

Table 2
Summary statistics of the sample units.

	N
Panel A: industry of the business unit	
Energy	5
Materials	19
Industrials	31
Consumer discretionary	14
Consumer staples	4
Health care	5
Financials	3
Information technology	3
Telecommunication services	7
Utilities	2
No response	3
Total	96
Panel B: Independence of the business unit	
Independent company which does not belong to a group of companies	3
Independent company which belongs to a group of companies	16
Dependent company which belongs to a group of companies	38
Parent company of a group of companies	37
No response	2
Total	96
Panel C: Nature of operations in the business unit	
Manufacturing unit	51
Service unit	29
Trade	15
No response	1
Total	96

Table 2 describes summary statistics of our sample of 96 firms. In our final empirical analyses, only complete responses (70 firms of total 96) can be included in a path model.

this study while some vendors use the terms 'solution', 'function' or 'segment', which would be equally appropriate. As Granlund (2007) suggests, there is little theoretical point in studying a specific software package. Thus, SAP R/3 was used as a starting point and then modules were modified such that respondents could answer even if their organization used some other software. In addition, existing ERPS measures and descriptions were used as a reference when creating a new ERPS measure (Dowlatshahi, 2005). Our ERPS variable measures the extent of ERPS usage in terms of the type of module adopted, on a Likert scale which measures the lagged effect of ERPS usage. The actual measurement is shown in Table 3, where it inquires as to the extent to which a business unit has integrated specific operating sectors into ERPS. A response scale is constructed to measure the lagged extent of implementation on an one to six Likert scale, as follows: 'have not adopted nor considered adopting', 'currently considering adoption', 'currently implementing', already adopted less than a year ago', 'adopted 1–3 years ago' or 'adopted more than 3 years ago'. Thus, units which have already integrated ERPS into their operations are assigned a higher score and vice versa. As shown in Table 3, we apply this measurement over a number of twelve different operating sectors or modules so as to construct a final measure of ERPS adoption which incorporates the extent to which a business unit has integrated specific operating sectors into ERPS. The ERPS construct that is formed thus incorporates the weight assigned to each type of operating sector or module as well as the lagged effect of ERPS adoption.

To the best of the authors' knowledge, this is the first time that this type of ERPS variable has been created in the management control system literature to measure the impact of ERPS. Therefore, pilot testing was especially important to validate the new construct. Pilot tests were undertaken with groups of financial directors and controllers having experience of various ERPS software packages. Two researchers in an SAP research center in Germany and one SAP consultant in Finland helped us to develop the question on ERPS. In addition, several scholars helped us to refine the design of the survey from the statistical point of view. In general, we received some advice on survey design and formulation to make the survey more explicit and easier to respond to.

Table 3
Measurement items, PLS loadings, composite reliability and AVEs.

Original question	Measurement
ERPS	
Q1a. When did your business unit introduce ERPS for the first time?	Year:_____
Q1b. To what extent are the following operating sectors (segments, modules) integrated to your ERP system?	6-point Likert scale:
	(1) Not adopted or considered
	(2) We are considering adopting an ERPS
	(3) Implementation of the process is currently ongoing
	(4) ERPS was adopted less than 1 year ago
	(5) ERPS was adopted 1–3 years ago
	(6) ERPS was adopted more than 3 years ago
	Loadings
1.1 Budgeting and planning	
1.2 Business intelligence and analytics	
1.3 Performance evaluation	
1.4 Sales and marketing	0.790
1.5 Customer relationship management (CRM)	
1.6 E-commerce applications	
1.7 Procurement	0.834
1.8 Inventory management	0.925
1.9 Supply chain management (SCM)	
1.10 Manufacturing and product management	0.727
1.11 Service and maintenance	
1.12 Human resource management (HRM)	0.628
Composite reliability	0.889
AVE	0.620
Q2. As of today, what proportion of the final planned implementation process has been completed?	(0–100%) 90% on average
Formal controls	
Q3. To what extent does your business unit use the following?	7-point Likert scale:
	(1) Not used at all to
	(7) Used to a great extent
	Loadings
3.1 Standard costs and the analysis of cost variances	0.799
3.2 Marginal or incremental costing in 'make or by' or pricing decisions	
3.3 Flexible or activity level budgeting	
3.4 Activity based costing	
3.5 Internal auditing	
3.6 Performance or operational auditing by outside auditors	
3.7 Use of internal rate of return/present value in evaluating investments	
3.8 Statistical quality control of production	0.870
3.9 Inventory control and production scheduling by means of operations research techniques	0.786
3.10 Systematic evaluation of managerial and senior staff personnel	
Composite reliability	0.859
Ave	0.671
Informal controls	
Q4. To what extent are the following controls used in your business unit?	7-point Likert scale:
	(1) Not used at all to
	(7) Used to a great extent
	Loadings
4.1 An emphasis on consensus-seeking, staff participative decision making	0.682
4.2 An emphasis on adaptation without concern for past practice	
4.3 Open channels of communication and free flow of information	0.835
4.4 An emphasis on initiative, and adaptation to the local situation rather than specialization and top level co-ordination	0.615
4.5 Easy informal access to senior managers	0.725

Table 3 (continued)

Original question	Measurement
ERPS	
4.6 Managers encouraged to develop new ideas even if they fall outside the individual's area of responsibility	0.722
Informal controls	
4.7 Tolerance of manager's mistakes, learning and sharing lessons learnt from them	0.743
4.8 Managers share information with colleagues	0.762
4.9 Fast reaction to take advantage of unexpected opportunities	
4.10 Current corporate culture encourages informal signaling of potential problems	0.779
Composite reliability	0.903
Ave	0.541
Performance	
Q5. In comparison with the industry average, how would you describe the performance of your business unit in terms of the following indicators?	7-point Likert scale: (1) Low to (7) High or (0) Do not know Loadings
Non-financial performance	
5.1 Materials efficiency variance	0.743
5.2 Ratio of good output to total output at each production process	0.678
5.3 Manufacturing lead time	0.762
5.4 Rate of material scrap loss	0.838
5.5 Labor efficiency variance	0.749
5.6 Number of new patents	
5.7 Number of new products launches	
5.8 Time-to-market new products	
5.9 Employee satisfaction	
5.10 Personnel development	
5.11 Workplace relations	
5.12 Employee health and safety	
5.13 Increase in market share	
5.14 Customer response time	0.622
5.15 On-time delivery	
5.16 Number of customer complains	0.717
5.17 Number of warranty claims	0.702
5.18 Customer satisfaction	
5.19 Percentage of shipments returned due to poor quality	0.684
5.20 Number of overdue deliveries	
5.21 Customer retention	
5.22 Acquisition of new customers	
Composite reliability	0.908
Ave	0.524
Financial performance	
6.1 Operating income	0.811
6.2 Sales growth rate	0.747
6.3 Return on investment (ROI)	0.863
6.4 Return on assets (ROA)	0.838
6.5 Operating return on assets (OIA)	0.848
6.6 Cash flow from operation	0.728
6.7 Cost of goods sold divided by sales (CGSS)	0.640
6.8 Selling, general and administrative expenses over sales (SGAS)	
Composite reliability	0.918
AVE	0.617
Characteristics of your business unit (profit centre)	
Q6. What is the total number of units (e.g. profit centers) in your organization (please provide a specific number)?	(In numbers)
Q7. Independence of your business unit	
	An independent company which does not belong to a group of companies An independent company which belongs to a group of companies

Table 3 (*continued*)

Original question	Measurement
ERPS	
Characteristics of your business unit (profit centre)	
Q7. Independence of your business unit	A dependent company which belongs to a group of companies
	A parent company of a group of companies
Q8. Year of foundation	(Year)
Q9. Total number of employees in 2006	(In numbers)
Q10. Number of employees in finance department	(In numbers)
Q11. Net sales in 2006 (1000 €)	(In Euros)
Q12. Growth of net sales in 2006	(%)
Q13. Net profit of net sales in 2006, 2005 and in 2004	(%)
Q14. Industry	
	Energy
	Materials
	Industrials
	Consumer Discretionary
	Consumer durables
	Health care
	Financials
	Information technology
	Telecommunication services
	Utilities
Q15. Our business unit is mainly	
	Manufacturing unit
	Service unit
	Trade

Respondents are asked to answer the questions by choosing the option that best describes their business unit. If the respondent is a representative of a whole company without separate business units, (s)he is asked to choose the option that best describes her/his company. The items *in italics* have lower than 0.60 loadings from their respective constructs and are thus deleted from the final PLS model.

3.2.2. The use of MCSs

The variables of formal and informal controls were adopted from Chenhall and Morris (1995) and Khandwalla (1972). Items used to measure the use of formal controls were use of accounting practices such as standard costs, budgeting, process controls, activity based costing, formal financial decision tools and systematic evaluations of personnel. Informal controls included items covering more open communication such as informal access to managers, emphasis on consensus and tolerance of errors. For MCS instruments we used seven-point Likert scales ranging from (1) 'Not used at all' to (7) 'Used to a great extent'. Note that these instruments measure the extent to which a business unit uses specific MCSs in general, whereas the instruments described in Section 3.2.1 measure the extent to which a business unit has integrated specific operating sectors into ERPS.

3.2.3. Performance measures

A combination of existing instruments was used to measure the performance of the business unit (Hoque et al., 2001; Hoque, 2005; Nicolaou, 2004a; Nicolaou and Bhattacharya, 2006; Govindarajan, 1984; 1988). The measure of performance captures both the financial and non-financial performance of the business unit compared to the industry average on a seven-point Likert scale ranging from (1) 'Low' to (7) 'High'. In addition, the respondents had an alternative (0) 'Do not know'.

3.3. Use of ERPS

We also collected data on the year of implementation and degree of completion of ERPS projects that were already started (see questions number 1a and 2 in Table 3). Our data show that the business units introduced ERPS at very different times, the earliest adoption being in 1989 and the most recent in 2007. The most common year of adoption was 2000. Our data also indicate that the implementation process is generally nearing its end because the average proportion of final planned implementation is 90%. Table 4 provides information about the extent to which different operating sectors are integrated into the ERPS.

Table 4
Integration of operating sectors in the ERP system.

Operating sector	Not adopted or considered	We consider adopting an ERPS	Implementation process is currently ongoing	Subtotal 1	ERPS was adopted less than 1 year ago	ERPS was adopted 1–2 years ago	ERPS was adopted more than 3 years ago	Subtotal 2	Total (N)
Sales and marketing	25	8	8	**41**	2	7	42	**51**	94
Customer relationship management (CRM)	41	14	10	**65**	3	4	14	**21**	87
E-commerce applications	47	15	9	**71**	2	4	6	**12**	85
Procurement	18	6	6	**30**	7	6	47	**60**	93
Inventory management	20	5	3	**28**	6	9	47	**62**	93
Supply chain management (SCM)	53	8	3	**64**	2	1	13	**16**	82
Manufacturing and product management	33	3	4	**40**	5	5	36	**46**	90
Service and maintenance	46	10	6	**62**	2	4	17	**23**	88
Human resource management (HRM)	49	7	6	**62**	4	7	16	**27**	89
Budgeting and planning	34	13	12	**59**	2	6	24	**32**	93
Business intelligence and analytics	38	12	11	**61**	2	2	20	**24**	89
Performance evaluation	46	14	10	**70**	1	3	10	**14**	87

The columns in Table 4 show the numbers of responses in each of the items. Subtotal 1 describes the total number of sample firms who has not yet adopted the particular operating sector of ERPS. Subtotal 2 shows the total number of sample firms who have finished the implementation of a particular operating sector of ERPS. Total (N) in the last column shows the total number of responses to that item.

The options range from "not adopted or considered" to "ERPS is already in use" on a six-point Likert scale.[5] If the respondent reported ERPS already in use in the particular operating sector, further options were given to specify how long ago the ERPS was implemented. Overall, our data show that operational modules are more often integrated into ERPS than the financial modules. The descriptive statistics in Table 4 show that firms do not aim to adopt all the available modules and features of the ERPS because the respondents have already accomplished 90% of the final planned implementation. Thus, a sole indicator about the number of modules integrated into ERPS may not necessarily be associated with the successful adoption of ERPS (cf. Markus and Robey, 1998; O'Leary, 2000; Grabski and Leech, 2007); this supports our measurement of the ERPS construct which considers both the extent and scope of ERPS adoption.

3.4. Measurement model

We illustrate the main idea of a structural equation model in our study according to Baron and Kenny (1986) (see also Fig. 1). They claim that if the mediation model is correctly specified, the mediation can be tested by the correlation analysis in four steps. When these steps are applied to the present model and

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[5] In addition to the six-point Likert scale, we double checked the effect of ERPS adoption using a continuous variable of the use of ERPS. In our questionnaire, we asked "When did your business unit introduce ERPS for the first time?" and used the time frame as a control variable. However, our results remain the same.

variables, they can be expressed as follows: first, PERFORMANCE is explained by ERPS. This step establishes that there is indeed an effect of the initial variable on the outcome that may be mediated. Second, MCS is explained by ERPS. This step shows that the initial variable correlates with the mediator. Third, PERFORMANCE is explained by MCS and ERPS (and control variables). This step shows that the mediator affects the outcome variable. It is not sufficient to correlate the mediator with the outcome because this correlation may be due to the fact that they are both caused by the initial variable. The initial variable must therefore be controlled for in establishing the effect of the mediator on the outcome. Fourth, to establish that MCS perfectly mediates the ERPS and PERFORMANCE relationship, the effect of ERPS on PERFORMANCE controlling for MCS should be zero. The effects in both steps 3 and 4 are estimated in the same regression equation. If all four of these steps are fulfilled then the data are consistent with the hypothesis that MCS perfectly mediates the ERPS and PERFORMANCE relationship. If the first three steps are met but step 4 is not, then partial mediation is indicated. The steps are stated in terms of zero and nonzero coefficients, not purely in terms of statistical significance.

We empirically test our structural equation model using the multivariate statistical method Partial Least Squares (PLS) as it is particularly well suited to small sample size studies when the data contain several dependent variables and a large set of independent variables (Wold, 1985). PLS defines a set of latent vectors that performs a simultaneous decomposition of the matrix of independent variables and the matrix of dependent variables with the constraint that these latent vectors explain as much as possible of the covariance between the dependent and independent variables. PLS provides the measurement model that specifies the relations between the original variables and the constructs they represent. It also provides estimates and diagnostics of the structural model specifying the relations among constructs.

A PLS model should be analyzed and interpreted in two stages (e.g. Hulland, 1999). Specifically, the reliability and validity of the measurement model should first be assessed. The resulting structural model should then be interpreted. To assess construct validity, we examine the multi-item variables within the measurement model of a PLS. We delete items with fewer than 0.60 loadings from their respective constructs. We re-estimate the PLS model without the deleted items. In the resulting final model, the loadings on the remaining items are all significant at the $p < 0.01$ level. Table 3 also reports the results of the analysis of construct validity. Loadings for items remaining within constructs after deletion of those with scores lower than 0.60 are reported in the right hand column.[6]

We assess the internal reliability of the PLS model using the composite reliability statistic. The composite reliability reported in Table 3 indicates high reliability with scores in excess of 0.70 for all constructs. Fornell and Larcker (1981) suggest that the discriminatory validity of the measurement model should be examined by testing the extent to which a construct shares more variance with its own measures than it shares with other constructs. Therefore, we report the average variance extracted (AVE)[7] in Table 3 and the square root of AVEs in the diagonal of panel B of Table 5. Correlations between constructs reported in the off-diagonal in panel B of Table 5 can be compared to the square root of AVEs reported in the diagonal in the panel B of Table 5. All correlations based on the correlations reported in Table 5 are clearly below the square root of AVEs. This attests to the satisfactory discriminatory validity of the measurement model.

3.5. Control variables

We test robustness of the results by including in the path model several control variables (non-tabulated). Specifically, we include in the path model firm size measured by the logarithm of net sales as well as by the number of employees, firm age in years, the degree of competition and past profitability, but none of these variables were significantly associated with ERPS adoption. We only find one difference in the distributions of the sample characteristics summarized in Table 1. ERPS users (ERPS variable; values 4–6 on the Likert scale) are mature firms while ERPS adopters (ERPS variable; values 2–3 on the Likert scale)

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[6] For financial and non-financial performance, some items with loadings greater than 0.60 in the initial measurement model had loadings less than 0.60 in the final measurement model. In order to ensure high construct validity we also delete these items in the final model.

[7] AVE for non-financial performance is relatively low most likely because of several missing values in the original data. In our questionnaire, the respondents probably had too many similar non-financial performance measures from which to choose the ones they used in their organization and thus, did not respond to all points in this particular question. Thus, factor loading for this variable is low, many points are deleted in the final model and finally, AVE is relatively low. The larger sample size and complete data may alleviate the problem.

Table 5
Correlations from PLS model between different constructs.

Panel A: descriptive statistics of the constructs					
	Mean	Median	Std.	Ave	Cronbach's alpha
ERPS	0.000	0.271	1.000	0.620	0.829
Formal controls	0.000	− 0.006	1.000	0.671	0.769
Informal controls	0.000	− 0.003	1.000	0.541	0.890
Non-financial performance	0.000	0.250	1.000	0.524	0.847
Financial performance	0.000	0.207	1.000	0.617	0.886

Panel B: correlations from PLS model between constructs (square root of Ave as diagonal values)					
	ERPS	Formal controls	Informal controls	Non-financial performance	Financial performance
ERPS	0.787	0.538***	0.281***	0.224***	0.228***
Formal controls		0.819	0.286***	0.330***	0.170***
Informal controls			0.736	0.153**	0.200***
Non-financial performance				0.724	0.342***
Financial performance					0.785

Notes:
***, ** and * indicate significant at 1%, 5%, 10% respectively.
The square root of Ave is used as the values of the diagonal.

are relatively young firms. This illustrates a natural development of organizational life-cycle indicating that young firms are more willing to implement ERPS — maybe because their information systems are still in the early stage of development. However, firm size itself does not influence the adoption of ERPS. In sum, our findings of the original path model remain unchanged even after controlling for the effects of the control variables.

4. Structural model results

Table 5 reports the correlation coefficients between the constructs included in our path model. The correlation coefficients reported in Table 5 are all significant indicating that the more extensive use of ERPS is positively associated with the financial and non-financial performance of the firm as well as the use of formal and informal controls. Moreover, there are significantly positive correlations between informal and formal controls and the firm performance.

The final results for hypotheses testing are presented in Table 6 and illustrated in Fig. 2. Table 6 reports the PLS structural model results. The final path model is estimated on 70 business units which reported complete data.[8] Specifically, Table 6 shows the structural relations among the constructs including their estimated path coefficients, their significance levels, and percent of variance explained (R^2 values). Our model explains 14% in the variance of non-financial performance and 18% of the variance in financial performance. We use the bootstrapping re-sampling method (using 200 samples) to obtain the confidence intervals to assess the significance of the estimated path coefficients. Fig. 2 summarizes significant associations in the path model.

The results reported in Table 6 and Fig. 2 show that, within the path model, ERPSs are positively related to the use of formal controls ($t = 6.631$, $p = 0.000$) and to the use of informal controls ($t = 2.491$, $p = 0.015$) indicating that ERPS act as antecedents to formal and informal controls. More importantly, there is a significantly positive path also from formal controls to non-financial performance ($t = 2.096$, $p = 0,040$), while the path from ERPSs to the financial performance is insignificant. These findings support **H2a**, i.e. the more extensive use of formal controls mediates the positive direct effect of ERPSs on the non-financial performance of the firm. We do not find, however, support for the other stated hypotheses on the mediating role of formal and informal controls. As for the other results reported in Table 6 and Fig. 2, we find a significant path also from

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[8] Our final path model consists of data from only 70 business units even though our initial sample included survey responses from 96 business units because only complete responses can be included in a path model. PLS excludes observations with any missing independent variables (including all classification variables) from the analysis, and computes no predictions for such observations (see, e.g. Wold, 1985).

Table 6
PLS structural model results ($N = 70$).

Independent variables:	Dependent variables			
	Formal controls	Informal controls	Non-financial performance	Financial performance
ERPS	**0.550*****	**0.299****	0.076	0.133
Formal controls	–	–	**0.284****	−0.085
Informal controls	–	–	0.094	0.135
Non-financial performance	–	–		**0.354****
R^2	0.30	0.09	0.14	0.18

Notes:
***, ** and * indicate significant at 1%, 5%, 10% respectively.

non-financial performance to financial performance ($t = 2.165$, $p = 0.034$) indicating that non-financial performance mediates the direct effect of formal controls on financial performance.

In sum, our findings support **H2a** that formal MCSs act as intervening variable mediating the positive direct effect between ERPS and non-financial performance. The mediation effects also satisfy the Sobel test ($z = 1.809$; two-tailed $p < .07$) supporting the view that formal control perfectly mediates the influence of an ERPS on non-financial firm performance. Formal controls, which are mainly accounting controls, can be useful in helping managers to develop a rational approach to planning and control, and in helping organizations to achieve better organizational performance.

5. Discussion and conclusions

In this paper, our aim was to explore whether the formal and informal controls used by the firm mediate the positive effect of ERPS on the future performance of the firm. As ERPSs are expected to lead to productivity and quality improvements (Hunton et al., 2003) and to better designed information systems (Arnold, 2006), firms should be able to translate the benefits of ERPSs into better financial and non-financial performance (e.g. Hunton et al., 2003; Nicolaou, 2004a; Nicolaou and Bhattacharya, 2006, 2008; Velcu, 2007; Wier et al., 2007). In addition, the management accounting literature suggests that this can be done through the more extensive use of MCSs (Chapman, 2005; Chapman and Kihn, 2009). Relying on these
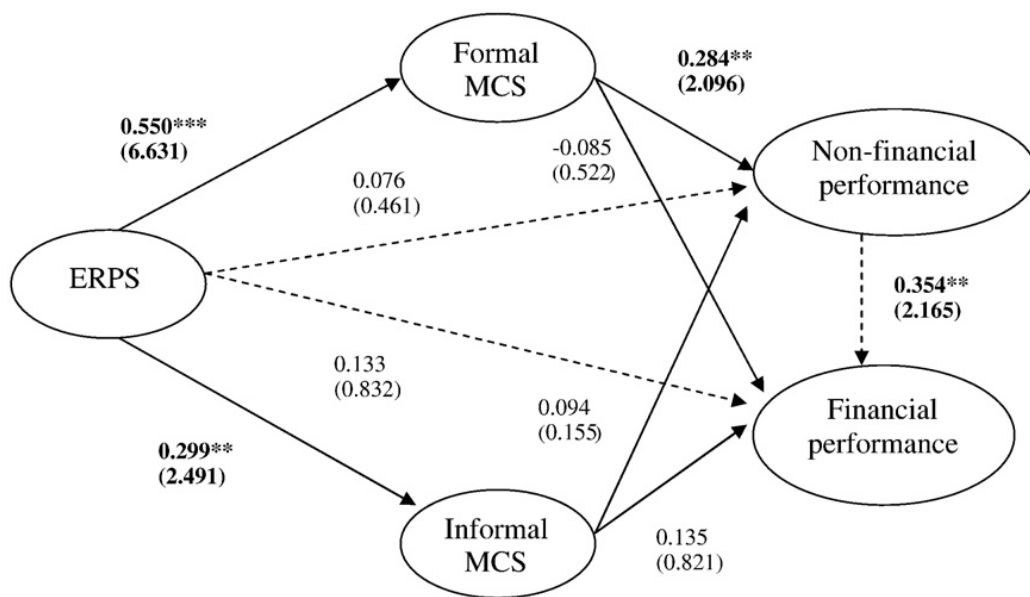
Notes: ***, ** and * indicate significant at 1%, 5%, 10% respectively.

Fig.2. Results of estimating PLS regressions.

arguments we develop a path model which we then test empirically using survey data from 70 business units of Finnish firms.

In the path model reported in Fig. 2 we find a significant path from ERPS to formal controls which are then linked to non-financial performance. It is noteworthy that there is no direct significant association between ERPS and the non-financial performance, although this correlation was significant in Table 5. In other words, the significant association between ERPS and future non-financial performance is fully mediated by formal controls supporting our hypothesis (**H2a**) that formal controls mediate the positive lagged effect of ERPS on non-financial performance. In addition, our results also show that non-financial performance is positively related to the financial performance of the firm. However, we do not find support for the hypotheses (H3a and H3b) that informal controls mediate the effect of ERPS on the future non-financial and financial performance.

Our study contributes to the existing literature in two main respects. First, we confirm the earlier results regarding the effects of ERPS (e.g. Hunton et al., 2003; Nicolaou, 2004a; Nicolaou and Bhattacharya, 2006, 2008; Wier et al., 2007) by providing evidence on the effect of the adoption of ERPS on the future performance of the business unit when controlling for the effect of other MCSs as mediating variables. Our findings show that formal controls help ERPS first to improve subsequent non-financial performance in terms of improved operational efficiency and then enhance the final performance. Our findings also support Velcu's (2007) results that ERPS adopters may report a number of operational benefits from ERPS implementation but are unable to make quantitative assessments of the impact of ERPS on financial performance.

Second, we extend the work of Chapman (2005) and Chapman and Kihn (2009) by arguing that formal MCSs as mediating variables help ERPS to achieve better organizational performance. Chapman and Kihn (2009) reported a direct association between information system integration and perceived system success, but not between information system and other aspects of performance i.e. traditional non-financial and financial performance measures. They show that enabling budgeting as formal MCS is associated with perceived information system success and suggest that ERPSs can be very useful to management even if the system does not directly enhance the firm's financial performance. One reason for their results may be the absence of a time lag between ERPS implementation and its performance effect. Since ERPS is a long-term strategic investment and its implementation is a lengthy process influencing the organization as a whole, the lagged effect of ERPS on MCS needs to be investigated over an adoption period of several years. By taking into account this time lag, we extend the work of Chapman and Kihn (2009) by claiming that formal MCSs fully mediate the lagged effect of ERPS adoption on organizational performance. However, our findings indicate that formal MCSs initially improve non-financial performance, which then improves financial performance. These findings corroborate the results of earlier studies according to which the use of ERPS enables and encourages the use of MCSs (e.g. Shang and Seddon, 2002; Chapman, 2005; Chapman and Kihn, 2009).

One reason for the crucial role of formal MCSs, which are mainly accounting controls, may be the limited integration of financial modules into ERPSs in our sample firms. The descriptive statistics in Table 4 show that a minority of sample firms have integrated financial modules (covering both financial and management accounting functions) while in some firms the implementation process is currently ongoing. The majority of the sample firms still have separate formal/accounting controls that are not merely integrated into the organization-wide ERPSs. In this way formal controls would be complementary to the financial module of ERPS in promoting improved financial performance. Granlund and Malmi (2002) also argue that financial modules have seldom been adopted. They also report that new MCSs were not created in their case firms due to ERPS adoption. If the organization already has existing principles, it may be too risky to change logistic practices and control systems simultaneously but this may also be a consequence of economic considerations i.e. system complexity and lack of resources (Granlund and Malmi, 2002; Quattrone and Hopper, 2005). The age distribution of our sample firms also supports this view. Our sample firms are relatively mature organizations (see Table 1 and discussion on control variables earlier). Our additional analyses indicate that older organizations seldom implement financial modules while young firms often do so — possibly because they do not currently have formal accounting controls.

Contrary to our hypotheses (H3a and H3b) informal controls do not seem to mediate the effect of ERPS on organizational performance. In the contingency literature the association of informal controls and performance is usually explained by arguing that informal controls provide scope for performance measurement by ensuring sufficient flexibility in decision-making and communications to adapt to

changing circumstances (Chenhall and Morris, 1995; Simons, 2000). Possibly the fact that ERPSs themselves rapidly provide the real-time data needed in decision-making and performance measurement reduces the need for informal controls. Yet formal controls are useful in helping managers to develop a rational approach to planning and control, and in helping organizations to achieve better organizational performance, as suggested in the earlier contingency literature (e.g. Chenhall and Morris, 1995; Widener, 2007). Moreover, informal controls and own solutions can be used to remedy the possible problems arising from ERPSs (Dechow and Mouritsen, 2005).

It has also been speculated that ERPSs supplant, or at least limit, the scope and applicability of local and informal control systems (Chapman and Chua, 2003). This can be compared to a more general tendency in multinational organizations to standardize ERPS and control systems globally. While this is justified in terms of consistency, accuracy and cost savings, it may pose a threat to the quality of local decision support (Scapens and Jazayeri, 2003). In cases where the specific local information needs are not fully met by the global ERPS, additional software and spreadsheet models will be needed. This supports our findings such that formal controls are needed simply to achieve performance, especially if financial modules are not integrated into ERPS. It could be argued that our findings may reflect the fact that in many large companies using ERPS the control and reporting processes are centralized on headquarters (see, e.g. Granlund, 2007). This means that in order to get a local report (in this study a unit-based report) report, line managers need formal (accounting) controls to construct the desired reports. Even though our survey is conducted on business unit level, most of the business units in our sample are independent companies. Thus the explanation used in earlier case studies does not ultimately apply to our findings. In light of the statistical significances found in this study, we can only speculate – more or less – about the reasons why informal controls are of little importance compared to formal controls in mediating the effect of ERPS on firm performance. This research therefore opens up opportunities for future research by taking a qualitative approach and to look beyond the causality and further examine the relationship found in the survey and to explore the role of informal controls which is relatively difficult and challenging to measure.

Several limitations must be conceded when drawing conclusions on the findings of this study. The sample size is relatively small, consisting of only 96 business units and the final structural equation model includes responses from 70 business units. Thus generalization of the role of ERPS cannot be made without considerable caution. Even though the analyses of this study include the necessary conditions for the proof of causal relationships, a larger sample size would yield robust results. To illustrate, as a consequence of several alternative questions, limited sample size and many missing values, for example average variance extracted (AVE) for non-financial performance is relatively low. We also concede that although the respondents are among the top executives of the firm, they may be unfamiliar with all the details of the information needed when responding to some of the survey items. However, such a bias (if any) in our constructs inhibits finding statistically significant results. As generalization always includes uncertainty in quantitative research, it is reasonable to question whether the overall hypothesis of a causal relationship between ERPS and ultimate financial performance is plausible. To illustrate, financial performance may be affected by simultaneous ongoing development projects regarding quality, processes and, human resources or influenced by mergers and acquisitions or economic situation, for example. In our study, as also in earlier studies (e.g. Hunton et al., 2003; Nicolaou, 2004a; Nicolaou and Bhattacharya, 2006, 2008; Wier et al., 2007), the authors have naturally tried to control for other variables potentially affecting the result. However, it is empirically impossible to include a huge number of variables in one model. We also need to acknowledge a limitation caused by measuring the variables in our model. For example, it could be questioned whether the ERPS variable represents integrated information systems if only some modules are adopted. Thus further studies could lead to the refinement of many of the variables used in the study and investigate the performance implications using a broader set of MCS measures or other factors likely to influence per-formance. It would also be interesting to examine if the mediating effect of MCSs persists in different cultural settings. Notwithstanding these limitations, our findings suggest that the use of formal controls mediates the direct effect of ERPS on the non-financial performance of the firm. Our results thus support the view presented by Chapman and Kihn (2009), who suggest that management may be highly satisfied with the usefulness of ERPS in enhancing non-financial performance even if ERPSs do not directly improve the firm's financial performance. We also provide statistical support for Velcu (2007), who found an association in her field study but could not generalize her findings. Finally, we confirm the finding of Nicolaou (2004a) showing that there is a lagged effect of ERPS on performance even if the role of MCSs is controlled for.

Acknowledgements

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