Drivers of change in management accounting practices in an ERP environment

Benita M. Gullkvist[1]

Abstract

This study contributes to contemporary research on changes in management accounting (MA) practices by examining the effect of changes in data quality, information quality and management accountants' tasks on accounting efficiency and effectiveness, and indirectly on management accounting change after the implementation of an Enterprise Resource Planning (ERP) system. Data was collected through an online survey questionnaire distributed to Finnish companies. Overall, the results of the PLS tests (n=70) provide significant support for the proposed model. Consistent with previous studies, time since ERP adoption appears to be a significant determinant of MA change, but the findings of this study also suggest that late adopters, that is, firms adopting an ERP system more recently, perceive greater changes in MA than early adopters. Further, the results indicate that global ERP implementations and use of business intelligence (BI) tools significantly relate to changes in MA practices. The implications of these results for practice and future research are discussed.

Keywords: Management accounting, ERP, BI, change, survey

JEL Classification: M10, M15, M40

1. Introduction

Enterprise resource planning (ERP) systems have become popular in medium-sized and large firms all around the world over the last twenty years. ERPs are organization-wide and integrated information systems that enable organizations to manage and coordinate all their information, resources and functions from shared databases. As ERPs are used to integrate all corporate information into one central database, they allow information to be retrieved from many different organizational functions and assist in providing visible objects for organizations (Dechow and Mouritsen, 2005; Kallunki et al., 2011).

Despite the wide use of ERPs in current business operations, knowledge of their effect on management accounting (MA) is rather scarce (Sutton, 2006; Vakalfotis et al., 2011). Nevertheless, it is important to examine examples of well-functioning relationships

[1] Hanken School of Economics, P.O.BOX 287, FI-65101 VAASA, Finland; benita.gullkvist@hanken.fi

between ERP use and MA, as ERP systems are supposed to provide an easy and rapid access to operational data, and the role of MA is to convey such data into a managerially relevant and usable form (e.g. Cooper and Kaplan, 1998). Arnold and Sutton (1998) also argue that it is common practice for accounting logic to be reviewed and possibly changed when organizations carry out major scale changes on information systems. Furthermore, scholars (Hunton, 2002; Sutton, 2006) maintain that ERP systems would have an influence on all areas of accounting. Findings from the existing early studies on the impact of ERP on MA indicate, however, that ERP systems have had only a limited impact on MA practices (Fahy and Lynch, 1999; Granlund and Malmi, 2002; Scapens and Jazayeri, 2003). Booth et al. (2000) argue that one main reason for the low impact is that ERP systems are effective in transaction processing, but less effective in reporting and decision support. However, organizations continue to commit substantial business investment to ERP systems, so it is increasingly important to understand the extent to which ERP systems affect MA practices (Sutton, 2000, 2006; Rom and Rohde, 2006; Granlund, 2011).

This study aims to examine the impact of ERP systems on MA change by investigating the effect of changes in data quality, information quality and management accountants' roles and tasks on accounting efficiency and effectiveness, and through that on the change in MA practices, measured as changes in MA techniques. Data from an online survey questionnaire among Finnish large and medium-sized enterprises is used to test hypotheses. The results indicate significant support for the proposed model explaining approximately 52 per cent of variance in changes in MA practices.

Consistent with previous studies, time since ERP adoption appears to be a significant determinant of MA change, but the findings of this study also suggest that late adopters, that is, firms adopting an ERP system more recently, perceive greater changes in MA than early adopters. Further, the results indicate that global ERP implementations and use of business intelligence (BI) tools significantly relate to changes in MA practices. The implications of these results for practice and future research are discussed.

The remainder of this article is organized as follows. The next section provides a literature review of relevant previous studies, the research model and the hypotheses. Section three describes the research method and data collection. Section four presents some details about the MA techniques and the findings of the PLS analysis. The final section provides the conclusions and suggestions for future research.

2. Theory and Hypothesis Development

It has been suggested that an organization's effectiveness largely depends on the effectiveness of its sub-systems, including the accounting function (Kondalkar, 2009). To date, a rather limited number of empirical studies have investigated the relationship between information technology and management accounting using quantitative or qualitative research approaches. Vakalfotis et al. (2011) provide an overview of previous studies on ERP systems, and argue that the majority of previous empirical studies tend to focus on describing changes in MA practices and the role of management accountants resulting from

ERP implementation rather than on analysing and understanding those changes. Granlund and Malmi (2002) developed a theoretical model for the impact of ERP systems on MA and accountants. They propose both direct and indirect effects of ERP systems on management accountants and MA. Direct effects will occur when the implementation of an ERP system directly changes reporting practices, for example. Indirect effects are changes in MA resulting from changes in management practice and/or business processes, initiated by the ERP implementation. Rom (2008) presented a theoretical model to illustrate the relationship between integrated information systems and MA. The Rom (2008) model divides MA into four parts i) tasks, ii) techniques, iii) organization of MA, and iv) behaviour, use and user perceptions.

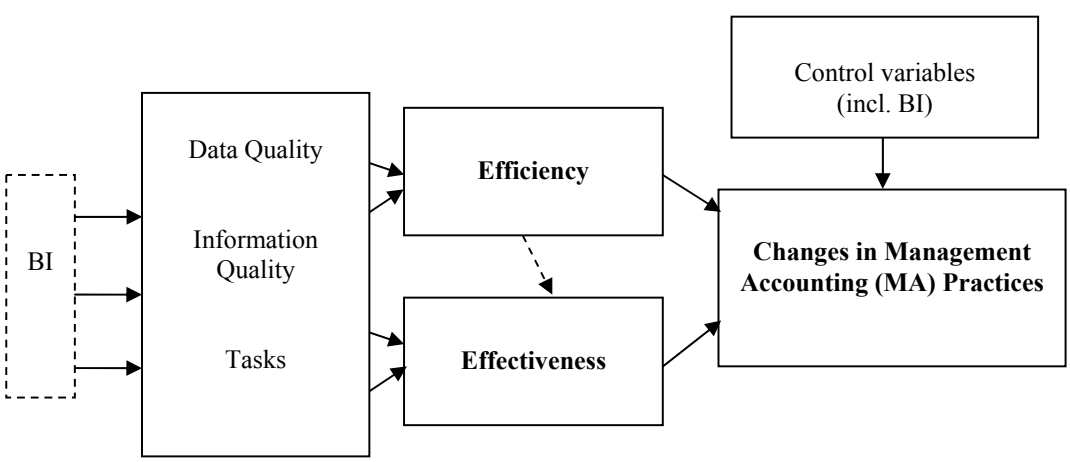
Prior research on the organizational level maintains that information systems, such as ERP systems, are implemented within an organization to improve effectiveness and efficiency (e.g. Davenport, 1998; Adam and O'Doherty, 2003; Hevner et al., 2004). Effectiveness implies the degree to which predetermined goals are met, whereas efficiency refers to the economical manner in which goal-oriented operations are conducted, usually measured as an input/output ratio (e.g. Kondalkar, 2009). Efficiency and effectiveness have also been seen in prior studies as measures of system success (e.g., Smithson and Hirschheim, 1998). To what extent those goals are achieved will, however, depend on several factors such as the capabilities of the information system (IS) and characteristics of the organization; its work systems, its people and its development and implementation methodologies (Silver et al., 1995). For example, the IS success model, developed by DeLone and McLean (1992), and considered one of the prominent instances of successful theory development alongside the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Evermann and Tate, 2009), illustrates that the effects of information technology on the overall organization may depend on the effects on the individual user, the system use, the underlying quality of the system and the quality of the information in the system. Thus, DeLone and McLean (1992) regard IS success as a multifaceted construct including quality measures (system and information quality), attitudinal outcomes (use and satisfaction), and performance-related outcomes (individual and organizational effects).

The DeLone and McLean model (1992; 2003) has gained widespread acceptance as an IS success model (e.g. Tsai et al., 2011), but it has also been criticized for its weak theory in applying *IS use* as one of the key variables of the model (Seddon, 1997; Rai et al., 2002; Bradley et al., 2006). Bradley et al. (2006) argued that is not the use of the information system itself but the impact of the IS use on organizations that is important and represents a success measure. Therefore, this study uses MA impact (measured as efficiency and effectiveness) as an ERP success measure to represent outcomes from ERP use on MA. Further, the DeLone and McLean model has been criticized for focusing too much on the quality of the information technology and system, indicating that only the technology characteristics determine the overall impact. Scapens and Jazayeri (2003), in identifying the *drivers* of MA change through a longitudinal case study, emphasized four characteristics of the SAP software in question –integration, standardization, routinization and centralization – but also noted that the system apparently changed the work of the management accountants.

Therefore, given that the implementation of an ERP system often is accompanied by major changes in ways of working (Grabski and Leech, 2007; Kallunki et al; 2011) to improve efficiency in organizational work (Seddon, 1997; Bernroider, 2008), it is suggested that task-related aspects (that are considered to relate to individual users) should be included in the research model as an independent rather than as an outcome (dependent) variable. Drawing on the above theoretical reasoning, the DeLone and McLean (1992; 2003) model is used as a reference model and underlying theory in this study, however, it is modified to fit the current setting with the construct *Tasks* as an independent variable. In summary, this study considers efficiency and effectiveness as intermediate variables between the independent variables (data quality, information quality, tasks) and the dependent variable (changes in MA practices).

Previous research has considered time elapsed since ERP implementation crucial when studying the effect of the ERP implementation on accounting. It has been argued that a longer period of use will help organizations develop their expertise with the system more effectively and generate business benefits. Granlund and Malmi (2002) argued that some features, such as analytic tools (BI tools), were not included in the early ERP implementations, which could have slowed down the adoption of new MA techniques. Nicolaou and Bhattacharya (2006) maintain that due to the problems and performance drop after the implementation, positive financial performance should not be expected until after a period of at least two years has passed since adoption. Rom (2008) used the period since adoption as a control variable in his study of relationships between integrated information systems and MA, something that will also be tested here.

Figure 1: Theoretical model depicting the influence of changes in data and information quality as well as the accountants' tasks through administrative efficiency and effectiveness on changes in management accounting practices
Model 1 (main model): BI tools as a control variable to changes in MA practices
Model 2: BI tools as an antecedent to data quality, information quality and tasks



Furthermore, although Scapens and Jazayeri (2003) found in their study that the implementation of the SAP software in a European division of a large US multinational company did not lead to the adoption of more advanced MA techniques, this was considered the ultimate goal because previous research maintain that technological changes require fundamental changes to performance measures and methods (e.g., Drury and Tayles, 1995). Scholars (Scapens and Jazayeri, 2003; Rom and Rohde, 2006) argue, however, that despite the lack of adoption of new MA techniques, the ERP system would increase the users' knowledge about these new techniques, which is seen as a starting point for further development. Likewise, in this study the ultimate goal of the implementation of an ERP system is proposed to be fundamental improvements or changes in MA techniques, achieved through a successful ERP implementation as indicated by improved efficiency and effectiveness of MA practices. It is also proposed that achieving efficient and effective MA practices will, however, be contingent upon technology characteristics and MA tasks. Positive relationships are hypothesized to exist between all variables in the model. The variables are modified to the current context based on previous studies in this area. The research model, as illustrated in Figure 1, is controlled for firm- and technology-related characteristics

The research model proposes using unidirectional, rather than bi-directional, paths between the constructs (see Figure 1). DeLone and McLean (2003) suggest in their model that the association between IS use and the net benefits (effects) of the system may be complicated, as the benefits may arise from system use, but positive or negative feedback loops may influence and reinforce subsequent use. While acknowledging that a bi-directional relationship is in this study highly likely between *efficiency/effectiveness* and *change in MA practices* and also between *technology characteristics*, *MA tasks* and *efficiency/effectiveness*, prior studies seem to consider and support a one-way direction. Scholars (Davenport, 1998; Granlund and Malmi, 2002) argue that it is more likely that the ERP system will have an effect on MA practices than vice versa, as the configuration of the ERP system is difficult to change after implementation. Therefore, linear one-way links are adopted in this study, but noted as a limitation of the study. The research model and the proposed relationships will next be discussed in more detail.

It has been argued that IT resources create economic value by increasing operational efficiencies and creating competitive advantage (Melville et al., 2004; Rai et al., 2006). Although the organizational impact of IT/IS has been measured in a number of ways in previous studies (Gorla et al., 2010), research within MA regards efficiency and effectiveness as two main key indicators in assessing and measuring the performance of organizations related to accounting practices and information technology. As stated, one of the key areas and aims of ERP implementation is to achieve increased efficiency and effectiveness of the organization and accounting function. In this study, efficiency and effectiveness are used as mediators to investigate changes in MA techniques. Laitinen (2002) presented two dimensions, cost and quality, in the measurement of the performance of activities. Those dimensions have been modified and used as the dimensions to measure the efficiency of

MA after the adoption of ERP. Thus, the items used relate to the cost of the MA department and the quality of MA work.

Nicolaou (2000) defined the effectiveness of accounting information systems based on the perceptions of decision-makers of whether the output information available to them through transaction processing, management reporting, and budgeting systems meets their requirements for organizational control. He also emphasized the importance of ongoing monitoring as an indicator of effective accounting and internal control systems. Nicolaou's study suggests that effectiveness can be evaluated using indicators like: i) Reports (e.g. daily or weekly reports) are provided frequently, systematically and regularly; ii) Accounting information systems provide information useful for the ongoing monitoring of decisions and actions. These indicators were modified and used as instruments to measure effectiveness in this study.

Regarding the research model of this study it is proposed that increased efficiency and effectiveness in accounting practices will facilitate (in the sense of providing time and resources for) the improvement and development of MA practices and thus trigger a change from existing practice. Thus, it is proposed that an increase in accounting efficiency and effectiveness will positively influence changes in MA practices, here measured as changes in MA techniques. This is stated in the following two hypotheses:

***H1**: There is a positive relationship between efficiency and changes in MA practices*

***H2**: There is a positive relationship between effectiveness and changes in MA practices*

Data quality was defined by Park and Kusiak (2005) as the measure of the agreement between the data views presented by ERP and that same data in the real world. Data quality has been considered essential to information quality, as poor data quality results in poor information quality. Poor data quality, and hence poor information quality, has adverse effects on organizations at the operational, tactical and strategic levels (Redman, 1998). Among others, Sangster et al. (2009) reported that successfully implemented ERP systems have automated data collection and improved information quality, which is in line with prior research indicating that ERP systems are effective in terms of information processing.

Ballou and Pazer (1985) identified four dimensions of data quality: data accuracy, data timeliness, completeness and consistency. Data accuracy means that the recorded data conforms to the actual value, data completeness implies that all data for a certain variable is recorded and data consistency that the representation of the data value is the same in all cases. These dimensions (with the exception of data timeliness) were included as measurement items in this study. It is proposed that positive changes in data quality will positively affect the efficiency and effectiveness of the accounting function and practices.

***H3a:** There is a positive relationship between changes in data quality and efficiency*

***H3b**: There is a positive relationship between changes in data quality and effectiveness*

Further, information provided by an IS system that does not meet its end users' needs is likely to incur heavy maintenance costs and disrupt the operations of the organization, also resulting in high costs to the organization (Swanson, 1997). Therefore, it is argued that high *information quality* (i.e. accurate, complete, and relevant information) leads to better cost control and increased organizational efficiency (i.e. increased profit margin, increased decision making efficiency) (Gorla et al., 2010). In addition, inaccurate or incomplete information may cause job dissatisfaction and the quality of decision making can be negatively affected by irrelevant information. Spathis (2006) reported that information management in ERP systems rated among the most highly rated accounting benefits derived from the implementation of ERP systems. The following benefits were stated by respondents: increased flexibility in information generation, increased integration of applications, improved quality of reports, quicker issuing of reports, improved decisions based on timely and reliable accounting information, and speedier end of year accounting procedures. Their study further found, in contrast to some other prior studies, a significant relationship between ERP systems, reporting and decision making. In addition, Granlund and Malmi (2002) argued for greater accuracy of reports and improved information as a result of ERP implementation in their explorative study. Scapens and Jazayeri (2003) emphasized that the availability of information from an SAP system improved and that information was more up-to-date. Drawing on the above prior studies it is proposed here that the ERP system will affect the quality of information, which in turn will have an effect on the efficiency and the effectiveness of the accounting function. This is stated in the following hypotheses:

***H4a**: There is a positive relationship between changes in information quality and efficiency*

***H4b**: There is a positive relationship between changes in information quality and effectiveness*

Scapens and Jazayeri (2003) recorded the following four changes in the work of management accountants: the elimination of routine jobs leading to a reduction in size of the accounting function; increased accounting knowledge requirements for line managers; more forward-looking information provided by the ERP, enabling them to produce better forecasts; and a broader knowledge of the business required of management accountants, as they were far more involved in the management team. Similarly, Sangster et al. (2009) found that ERP implementation results in changes in the *tasks* of the management accountants. It was also concluded that when the ERP implementation was successful, management accountants had more time for other activities and their role became more enriching. Drawing on these studies, the proposal made here is that a change in the tasks and roles of management accountants will positively affect the efficiency and effectiveness of management accounting in the company, which will provide slack time for development and to implement changes to MA practices. This is stated as follows:

***H5a**: There is a positive relationship between tasks and efficiency*

***H5b:** There is a positive relationship between tasks and effectiveness*

Control variables

Previous studies have also found that demographic characteristics of the firm, such as industry, age and audit firm may explain variations in research findings. Therefore, some firm and ERP demographics were selected as control variables in this study. There might of course be numerous characteristics, acting alone or in combination with other characteristics and events, that affect MA change. One control variable in this study is ERP success, which has been found in previous studies to affect ERP implementation significantly (Sangster et al., 2009). Also ERP scope, that is, the extent of the implemented system, has been found to have an effect on the impact of the system and benefits gained (e.g., Nicolaou, 2003), and is therefore controlled for. Previous research also suggests that major development work might take place after the ERP system has been in use for some time (e.g., Granlund and Malmi, 2002), indicating that additional and more advanced features of the ERP might be adopted at a later stage of the implementation (e.g. Markus et al., 2000; Spathis and Ananiadis, 2005). Consequently, time elapsed since adoption is considered a vital control variable.

Furthermore, scholars have argued that many organizations fail to retrieve all the information they want from their ERP systems and need BI tools (Rom and Rohde, 2006). BI tools are BI software products deployed in an organization (Wieder et al., 2012) to add value to the large data infrastructure investments (e.g., ERP systems) made by firms and believed to have the potential to help a firm access the substantial value locked up in its data resources (Burns, 2005). BI techniques include the activities of decision support systems, querying and reporting, online analytical processing (OLAP), statistical analysis, text mining, data mining and visualization. BI tools provide a business with the ability to analyse business information in order to support and improve management decision making across a broad range of business activities. Chou et al. (2005) claim that the BI tools, compared to the ERP systems, provide better access to data, greater functionality in analyzing data and that the tools are implemented to enhance the performance of the ERP systems. Further, BI tools are considered critical in helping an organization to adapt to change and improve its performance (Watson and Wixom, 2007).

While scholars generally agree on the importance of BI tools, only a few empirical studies have examined the effect of the BI tools on performance (Elbashir et al., 2008) or organizational decision-making (Davenport, 2010). Further, it is not clear how to examine the effect. Wieder et al. (2012) maintain that BI success or quality should be measured around the quality or quality increase of provided data and the quality or quality increase of decisions made in the organization. Rom (2008), however, examines the relationship between the BI tools and MA tasks. To examine the effect of BI tools on MA, this study

tests two models: 1) the use of BI tools as a control variable on MA change (main model, Model 1) and 2) the use of BI tools as an antecedent to changes in data quality, information quality and MA tasks (alternative model, Model 2). The first model implies that BI tools may not be fully integrated with the ERP system but technically separate systems; thus the overall effect may be visible as a change in the MA techniques. The second alternative model assumes integration between the ERP system and BI tools so that the use of the BI tools can be associated with the changes in data quality, information quality and MA tasks.

3. Research Methodology

3.1 Survey and data

Survey data collected through a web-based form was used to test the hypotheses. Hyvönen (2003) argued that small-sized Finnish companies would not have integrated information systems with an analysis-oriented component and systematic MA systems. Therefore, large and medium-sized Finnish companies were targeted. The European Commission (EC, 2011) defines medium-sized enterprises as follows: the number of employees of a medium-sized company is less than 250 but greater than 50; and the turnover is greater than 10 million euro but less than 60 million euro. Using size as a selection criterion, the selected companies can be regarded as medium-sized and large companies. As there was no data available specifically recording whether firms had adopted ERP systems, random sampling was used. To account for the risk that responding firms would not have implemented ERP systems, two questions were included that controlled for time since ERP implementation and scope. Email addresses of CFOs, Finance Managers, Business Controllers and equivalent job positions were collected from Profinder B2B, a database including information about executives and senior management of Finnish companies. This respondent group was chosen as it was expected that the respondents would have knowledge of the effect of ERP systems on MA and the possible changes in MA practice. A total of 1845 companies and 2168 contact emails fulfilled the selection criteria. As the contacts had to be manually collected from the database, the sample was limited to 1300 contact emails and one from each company.

Following Dillman's Tailored Design Method (2000) in the design and administration of the questionnaire, the survey instrument was pre-tested by a group of academics and practitioners and distributed after minor changes by email with a covering letter explaining the aim of the study and response practice. Whenever possible multiple item indicators based on prior studies were used to measure dependent and independent variables. The indicators are listed in Appendix 1. Most control variables were measured as dummy variables.

Table 1: Descriptive statistics on the sample

n = 70	Mean	Median	Std. Deviation	Minimum	Maximum
Industry	1.90	1.00	1.11	0	4.00
Firm_listed	1.30	1.00	0.46	1.00	2.00
Aud_firm	2.90	3.00	0.98	1.00	5.00
Firm_Age	28.94	20.00	25.15	3.00	102.00
ERP_time	10.06	10.000	7.53	0.50	21.00
ERP_inst.	1.27	1.00	0.64	0	2.00
BI_exist	1.64	2.00	0.48	1.00	2.00
ERP_Succ	4.29	4.00	1.56	1.00	7.00
DataQ	4.57	4.667	1.49	1.00	7.00
InfoQ	4.15	3.750	1.58	1.00	7.00
Task	3.92	3.750	1.84	1.00	7.00
Ecy	4.03	3.833	1.73	1.00	7.00
Efs	4.20	4.333	1.75	1.00	7.00

Minimum value 0 indicates missing values
Industry 1= Manufacturing, 2=Trade, 3=Services, 4 = Other
Firm_listed indicates public listing of firm or group 1=No, 2 = Yes
Aud_firm (Auditing firm), 1= Deloitte & Touche, 2 = Ernst & Young, 3 = KPMG, 4 = PwC, 5 = Other
Firm_Age indicates age of firm since establishment, in years
ERP_time indicates time since ERP implementation, in years
ERP_inst indicates scope of implementation, 1 = global, 2 = local
BI_exist measures whether the firm uses BI tools, 1 =no, 2 =yes
ERP_success measures perceived success of ERP implementation, scale 1-7 (1=not at all, 7=to extremely great extent)

The participants were given two weeks to complete the online questionnaire, before two reminders were sent. In the end, 80 responses were collected rendering a response rate of 5.3 per cent. There might be several reasons for the low response rate, but it was noted that some email addresses were incorrect and returned by the system; and a considerable number of approaches generated 'out of office' replies, although care was taken when selecting the time of the distribution. Moreover, some companies use spam filters to avoid receiving this type of email. Thus, it is possible that not all targeted respondents were in fact reached. Finally, among the eighty responses received, six were unusable owing to the firms not having adopted an ERP system, and four responses were incomplete. Therefore, only 70 usable responses were received. The low response rate indicates that care should be taken when using and analysing the data.

The responding companies represent the following different industries: manufacturing (51%), trade (13%), service (26%) and other (10%). The respondents were: CFOs (67%),

business controllers (30%) and chief financial accountants (3%). While the respondents may appear to operate at different hierarchical levels within the organizations, and thus might perceive things differently, a *t*-test indicated no significant differences in mean between the respondent groups CFOs and controllers/accountants. One explanation for this may be that all respondents, despite variations in title, operate on a managerial level, something that could be expected because of the choice of database used to source the email addresses. The average time since ERP implementation was approximately 10 years, but varied from six months to over 20 years. The time the firm had been established varied from 3 to 104 years with a mean of about 29 years. The average turnover was EUR 107 985 000 and the sample included both publicly listed and non-listed companies. All Big4 audit firms were represented. More details on the descriptive data may be found in Table 1.

3.2 New MA techniques and BI tools

Although it is recognized that organizations may have other motives for ERP implementation, the responses of this study indicate that the organization to some extent implemented new MA techniques − new to the organization − after the ERP implementation. The instrument used was adopted from previous studies (Waldron, 2007; Rom 2008). Table 2 illustrates that the most commonly adopted MA technique (61.4%) after the ERP implementation is key performance indicators (KPIs) but also MA techniques such as comparative analysis, customer satisfaction surveys, activity-based costing, target costing and the balance scorecard appear to have increased, although to a lesser extent. A further analysis shows that 12 respondents had adopted one new technique, eight respondents marked two new techniques, 14 respondents reported three new techniques and 18

Table 2: Adoption of new MA techniques

	No. of firms adopting new MA techniques	In percentage
Activity-based costing	14	20,00%
The balanced scorecard	14	20,00%
Comparative analysis (benchmarking)	20	28,57%
Customer satisfaction surveys	19	27,14%
Key Performance Indicators	43	61,43%
Non-financial key performance indicators	18	25,71%
Target Costing	17	24,29%
Life-cycle costing	5	7,14%
Other	4	5,71%

respondents reported four or five new techniques of the proposed list; only 18 respondents (25.7%) had not adopted anything. A more detailed analysis on mean values, conducted by splitting the sample into two groups based on the time since ERP implementation, indicates that on average the organizations have adopted 2.51 new MA techniques three or more years after implementation compared to 0.55 techniques within the first three years (*t*-test, $p < 0.001$). In contrast, late adopters (time since implementation 0-3 years) perceive greater changes in the MA techniques compared to early adopters (time since implementation over 3 years) (*t*-test, $p < 0.001$). Moreover, organizations that have a global ERP installation perceive greater changes in MA techniques and have implemented more MA techniques compared to those pursuing a local ERP installation (*t*-tests, $p < 0.05$).

In addition, 45 organizations (64.3%) reported the use of a BI tool. Organizations using BI tools perceive significantly greater changes in their MA techniques than organizations not using BI tools (*t*-test, $p < 0.01$). In contrast to the ERP implementation, early adopters of BI tools perceive greater changes in the MA techniques compared to late adopters (*t*-test, $p < 0.05$).

4. Results

The research model of this study was tested with the path analytic modelling technique of partial least squares (PLS), using Smart PLS (version 2-M3) (Ringle et al., 2005). PLS estimates the structural model using an iterative OLS regression-like procedure, but does not aim for the optimization of the model, nor does it report on the fit of the whole model (see Chin, 1998). All constructs were modelled using reflective indicators. Our analysis follows the typical two-stage approach (Barclay et al., 1995) where first the reliability and validity of the measurement model is assessed, and then the structural model is assessed.

4.1 Measurement Model

The factor loadings of each item met or exceeded the criteria of 0.6 (Hulland, 1999) as is shown in Table 3. Moreover, the reliability of each variable, assessed using Fornell and Larcker's (1981) measure of composite reliability (CR), is above 0.80, which demonstrates acceptable reliability (Nunnally, 1978). Third, convergent and discriminant validity of each construct, assessed by examining the average variance extracted (AVE) statistics, shows that the AVEs for all constructs are above 0.60, which demonstrates good convergent validity (Chin, 1998; Hair et al., 2010).

Table 3: Estimation of the measurement model parameters

	Original Sample	Sample Mean	Standard Deviation	T Statistics	AVE	CR
Data quality					0.831	0.937
DQ1	0.894	0.894	0.042	21.300		
DQ2	0.957	0.957	0.010	93.291		
DQ3	0.883	0.884	0.038	23.396		
Information quality					0.783	0.935
IQ1	0.925	0.925	0.015	62.747		
IQ2	0.886	0.884	0.025	35.756		
IQ3	0.907	0.908	0.018	49.894		
IQ4	0.818	0.816	0.035	23.484		
MA Tasks					0.863	0.962
T1	0.945	0.947	0.010	94.430		
T2	0.942	0.943	0.012	78.596		
T3	0.923	0.922	0.026	34.874		
T4	0.905	0.903	0.025	36.450		
Efficiency					0.729	0.889
Ecy1	0.767	0.766	0.069	11.099		
Ecy2	0.898	0.897	0.021	42.366		
Ecy3	0.890	0.891	0.028	31.536		
Effectiveness					0.770	0.909
Efs1	0.821	0.820	0.045	18.006		
Efs2	0.908	0.909	0.031	29.674		
Efs3	0.901	0.902	0.028	31.999		
MA_Impact						
C2	1	1	0			
Control Variables						
ERP_Success	1	1	0			
ERP_Scope	1	1	0			
ERP_time	1	1	0			
Firm_Age	1	1	0			
Industry	1	1	0			
Aud_firm	1	1	0			
BI_exist	1	1	0			

Assessing discriminant validity taking into account model parameters and measurement errors, shows that the square roots (diagonal, in bold) of the AVEs are greater than the respective correlations between constructs for all variables bar one (Table 4). Furthermore, although some correlations between the independent variables and dependent variables appear high, no bivariate correlation exceeds the value of 0.9 (Hair et al., 2010), thus providing little indication of multicollinearity. Table 4 is incorporated in Appendix 2.

In addition, cross-loadings were examined to test discriminant validity on the item level. As expected, the loadings of a certain item with its associated construct were all higher on their associated constructs compared to their cross-loadings. These test data results are, however, not included here. In summary, it was concluded that all scales behaved reliably, demonstrated satisfactory convergent and discriminant validity and exhibited adequate psychometric properties.

4.2 Structural Model

The second step in the PLS analysis is the estimation of the specified structural equations, which in this study is done by assessing the size and significance of path coefficients, R-squared (R^2), and Stone-Geisser-Criterion Q-squared (Q^2). R-squared is used to evaluate the PLS model (Chin, 1998). As PLS makes no distributional assumptions, a bootstrapping process (500 samples with replacement) was used to evaluate the statistical significance of each path coefficient (Chin, 1998). Table 5 (main model) and Table 6 (alternative model) present the structural models including the standardized betas and statistical significance as well as outlining the results of the hypothesis testing.

Hypothesis 1 proposed a positive relationship between efficiency and MA_Impact. This hypothesis is rejected by the results as showing a negative, significant association (-0.176, $p < 0.05$). Hypothesis 2 proposed and confirmed a positive relationship between effectiveness and MA_Impact (0.360, $p < 0.01$) and the hypothesis is supported. Hypotheses 3a and 3b proposed a positive relationship between DataQ and efficiency and effectiveness respectively. The results indicate a positive association, but one significant only for effectiveness (0.205, $p < 0.05$). Hypotheses 4a and 4b posited that improvements in InfoQ would positively affect efficiency and effectiveness. The path coefficient shows a significant positive association 0.601 ($p < 0.001$) for efficiency and 0.422 ($p < 0.01$) for effectiveness respectively. Both hypotheses are thus supported. Hypotheses 5a and 5b posited that changes in management accountants' tasks (MA_tasks) would be related to efficiency and effectiveness. The path coefficient shows a positive association (0.293, $p < 0.01$) which supports efficiency, and 0.218 ($p < 0.05$) for effectiveness respectively. Both hypotheses are thus supported. Moreover, the control variables ERP_Success (0.371, $p < 0.01$), ERP_scope (-0.207, $p < 0.01$), ERP_time (-0.084, $p < 0.05$) and BI_use (0.200, $p < 0.01$) appear to significantly and directly affect MA_Impact. The control variables firm age, industry or audit firm are not significant. The main model explains approximately 52 per cent of the variance in MA impact.

Table 5: Structural Model Results (main model, n = 70)

Independent Variables	Dependent Variable			Test of Hypothesis
	MA_Impact			
Efficiency	-0.176**			H1 rejected
Effectiveness	0.360***			H2 supported
		Efficiency	**Effectiveness**	
DataQ		0.085	0.205**	H3a rej., H3b supp.
InfoQ		0.601***	0.422***	H4a,b supported
MA Tasks		0.293***	0.218*	H5a,b supported
Efficiency			0.124*	
Control Variables				
ERP_Success	0.371**			
BI_use	0.200**			
ERP_scope	-0,207**			
ERP_time	-0.084*			
Firm_Age	0.042			
Industry	-0.021			
Aud_firm	-0.009			
Q^2	0.000	0,088	0.214	
R^2	0.523	0.802	0.771	

Path coefficient and (t-value) reported above
*p<0.05; ** p<0.01 *** p<0.001 (one-tailed tests)

Table 6: Structural Model Results (alternative model, n = 70)

Independent Variables	Dependent Variable					
	MA_Impact					
Efficiency	-0.203**					
Effectiveness	0.387***					
		Efficiency	**Effectiveness**			
DataQ		0.084	0.205**			
InfoQ		0.602***	0.423***			
MA Tasks		0.292***	0.217*			
Efficiency			0.124*			
				DataQ	**InfoQ**	**Tasks**
BI use				0.274**	0.070	0.240**
Control Variables						
ERP_Success	0.418**					
ERP_scope	-0,187**					
ERP_time	-0.044					
Firm_Age	0.062*					
Industry	0.019					
Aud_firm	0.029					
Q^2	0.001	0,088	0.214	0.062	0.004	0.050
R^2	0.488	0.802	0.771	0.075	0,005	0.057

Path coefficient and (t-value) reported above, *p<0.05; ** p<0.01 *** p<0.001 (one-tailed tests)

The alternative model (Table 6) tests for BI tools as an antecedent variable to the independent variables data quality, information quality and MA tasks. Everything else is identical to the main model and no hypotheses were stated. The results indicate significant positive relationships between the use of BI tools and DataQ (0.274, p <0.01), and BI tools and MA_tasks (0.240, p <0.01) respectively, but not between BI tools and InfoQ. Besides previous control variables also firm age (0.062, p <0.05) is significant in the alternative model, which explains approximately 49 per cent of the variance in MA impact.

The predictive validity of the parameter estimates could be assessed on a cross-validated redundancy index or a Stone–Geisser Q^2-test (Geisser, 1974; Stone, 1974). As PLS models lack an index for goodness of fit statistics, Tenenhaus et al. (2005) argue that, besides the reliability and validity of constructs and the significance of variance explained, positive Q^2s for all constructs provide sufficient evidence of model fit. The Q^2 results (Table 6), which are above zero, suggest that the model has some predictive relevance.

5. Discussion and Conclusions

This study examines factors that drive change in MA practices, and more specifically whether changes in data quality, information quality, and management accountants' tasks owing to use of an ERP system will have a positive effect on MA practices through improved efficiency and effectiveness. A path model was developed based on previous research, and tested using structural equation modelling with PLS with a sample gathered from 70 Finnish ERP adopters. The research model explains approximately 52 per cent of the variance in management accounting impact, approximately 80 per cent of the variance in efficiency, and approximately 77 per cent of the variance in effectiveness.

This study contributes to accounting literature in numerous ways. It found support for the assertion that increased information quality (InfoQ) enhances both accounting efficiency and effectiveness. The importance of InfoQ in developing and changing MA practices appears to be indirect, in that it is mediated by efficiency and effectiveness. This result would be important to consider when developing and improving MA practices in a company, and it draws attention to the company's internal organization and management. Further, DataQ is merely seen as improving effectiveness, and not as having any significant effect on efficiency. Moreover, the results confirm the importance of implementing changes to the tasks of the management accountants in order to improve effectiveness and efficiency, and indirectly to change MA practices. Somewhat surprisingly though, the results indicate a significant negative relationship between efficiency and changes in MA practices. Thus, enhanced efficiency would not promote changes in MA practices, rather the opposite. While no explanation for this is available in the data, it could indicate that changes in MA techniques do not emerge through improvements in efficiency. In summary, this study contributes by empirically testing and verifying the relationships between various factors related to both data/information quality and accountants' tasks on efficiency and effectiveness and indirectly on change in MA practices. This type of holistic model on these relationships, one empirically tested with survey data in an accounting setting, does not appear to have been examined before, and this study responds to calls for papers that test the IS success model in various contexts (Rai et al., 2002; Petter et al., 2008).

Further, the empirical findings demonstrate a statistically significant influence of a successful ERP implementation as having a direct effect on changes in MA practices. While Sangster et al. (2009) identified increased data quality, improved decision-making and changes in accountants tasks under successful ERP implementations, this study adds to those findings by emphasizing change in MA techniques as associated with successful ERP implementation.

Consistent with reasoning in prior research (Granlund and Malmi, 2002), the results of this study indicate that time since ERP adoption is a significant determinant of changes in MA techniques, but also that the majority of the changes occur within eight years after ERP implementation. Further, late ERP adopters perceive greater changes in MA techniques than early adopters. One possible explanation could be that late adopters perceive the changes as greater because of the short time since ERP implementation. Another explanation could be

that newer software versions include features and functionality that were missing from their predecessors, and which could be driving the changes already at the ERP implementation stage. Some respondents maintained in an open question in the questionnaire that change in MA techniques occurred simultaneously with the ERP implementation, not afterwards. Furthermore, the findings indicate that the scope of installation, local or global, is a significant determinant of changes in MA techniques. This is an important finding, as many organizations in recent years have pursued global ERP implementation. As many previous studies on the attributes of MA change have been conducted at an early stage of ERP implementation and early in the first decade of the century, this study offers an update, and also indicates that change may occur over time.

Another interesting finding is that the use of a BI tool may significantly affect change in MA practices either directly or indirectly as an antecedent of data quality and accountants' tasks. This seems to be a novel result. While this study confirms the findings of Wieder et al. (2012) regarding the significant relationship between BI tools and data quality, it also indicates that the effects of BI tools could be difficult to measure as those may relate to various issues. There may be several explanations for it, one being that the level of integration between the BI tools and the ERP system may differ and influence how the BI tools associate with changes in MA practices. It appears, however, that the ERP system needs additional tools to generate value and facilitate changes in MA practices. Future research should explore the effects of BI tools in more detail in order to better understand how the BI tools would best benefit the accountants' tasks and accounting function overall.

Moreover, an understanding of what drives MA changes in an ERP environment is believed to be important to practitioners, to firms, but also to the research community, as the body of research on changes in MA practices is still rather limited. An enhanced understanding of the effects of ERP systems on MA practices is of major importance within the accounting profession. In practice, factors affecting change in MA practices would be important to consider in the planning, development and management of MA practices in times of change.

It is, however, necessary to recognize some limitations of this study. First, data was obtained at a single point in time, which makes it difficult to infer causality. In future studies, it might be useful to explore the model over a longer period, for example using a longitudinal case study approach. Second, this study suffers from the usual limitations associated with the questionnaire survey method (Oppenheim, 1966). One concern is that responses to the questionnaire may not always reflect practice. Another limitation concerns the scales used to measure the core constructs. Difficulties involve operationalizing the variables and possible problems with self-assessed measurements. In addition, the dependent variable of the study was measured with only one item indicator. Although the single-item scale showed adequate validity and reliability in this study, it is acknowledged that multi-item scales usually demonstrate greater reliability and validity overall. Therefore, the measures used may be relatively crude and perhaps not achieve the depth and intensity of the whole assessment, something that should considered and developed in future studies. Third, one concern with empirical studies is generalizability. Without replication, it cannot

be determined what effect the sample size used has on the generalizability of the results. Moreover, the small sample size and the low response rate also indicate the need for caution in drawing conclusions based on the findings. The respondents worked at the managerial level of their organizations (because they were accessible via emails), but future studies could strive to collect data from respondents carrying out everyday accounting tasks. Such respondents might have different perceptions of changes in MA practices. Finally, it is acknowledged that there will be alternatives to the model used here. For example, the added construct *Tasks* may also be considered an outcome of efficiency/effectiveness instead of an independent variable, considering the theorizing of the feedback loop. Nevertheless, while it is important to recognize other independent variables or antecedents related to the capabilities of the ERP system, and that the organization or the users could be relevant to the research model, the focus of the current study was to test the proposed research model and not to develop and test numerous alternative models.

Therefore, future research could focus on identifying other factors to enhance changes in MA practices. The interesting finding that the use of BI tools significantly affects changes in MA practices merits further analysis. Furthermore, factors in the external environment and beyond the possible capabilities of the individual company would also be worth considering, but were excluded from this study. Given that the practical importance of finding attributes that enhance changes in MA practices in an ERP environment is of interest to both scholars and practitioners, there is considerable potential for further studies in this research area.

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Appendix 1: Measurement instrument

To what extent are the statements below true after the implementation of an ERP system? Please rate using a Likert scale of 1-7, where n/a = *don't know*, 1=*Not at all,* 2=*To a very low extent,* 3=*To a low extent,* 4=*To some extent,* 5=*To a great extent,* 6=*To a very great extent,* 7=*To an extremely great extent*.

Data Quality (DataQ)
DQ1. The recorded data conform better with the actual value (Data Accuracy).
DQ2. All data for a certain variable are recorded (Data Completeness).
DQ3. The representation of the data value is the same in all cases (Data Consistency).

Information Quality (InfoQ)
IQ1. The ERP system provides more real-time information.
IQ2. The ERP system has increased flexibility in information generation.
IQ3. The accuracy of reports and information has improved.
IQ4. Users compile reports more frequently.

MA Tasks
T1. Management accountants and controllers spend less time on routine jobs (cost accounting, data collection, preparing budgets and reports).
T2. Management accountants and controllers spend more time analysing and interpreting data.
T3. Management accountants' and controllers' current tasks involve more business-oriented tasks.
T4. Management accountants' and controllers' current tasks involve more decision-making tasks.

Efficiency
Ecy1. Costs within the management accounting department have been reduced.
Ecy2. The quality of management accounting work has improved.
Ecy3. Management accounting tasks are now performed more efficiently.

Effectiveness
Efs1. Management accounting reports are provided more frequently, systematically and regularly (e.g. daily or weekly reports).
Efs2. The information provided for the ongoing monitoring of decisions and actions is now more useful.
Efs3. Decision-makers are more satisfied with the quality of management accounting information outputs since implementation of the ERP system.

Impact on management accounting practices (MA-Impact)
To what extent… (Likert scale 1–7, as above)
C1. …do you utilize the ERP system to perform budgeting tasks? *(Deleted)*
C2. …has the implementation of the ERP system led to the adoption of new management accounting techniques?

Appendix 2: **Table 4: Discriminant Validity Coefficients (n= 70)**

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1_Aud_Firm	1.000												
2_BI_use	0.168	1.000											
3_MA_impact	0.026	0.289*	1.000										
4_Success	0.009	0.176	0.625**	1.000									
5_Effectiveness	-0.002	0.120	0.581**	0.651**	**0.877**								
6_Efficiency	0.084	0.097	0.534**	0.753**	0.809**	**0.854**							
7_FirmAge	0.174	0.124	0.012	-0.108	-0.134	-0.133	1.000						
8_ERP_scope	-0.014	-0.025	-0.483**	-0.497**	-0.422**	-0.505**	-0.079	1.000					
9_Industry	-0.128	0.154	0.293*	0.376**	0.231*	0.303**	0.089	-0.373*	1.000				
10_MA_tasks	-0.073	0.239*	0.466**	0.567**	0.717**	0.743**	-0.103	-0.382**	0.288**	**0.929**			
11_DataQ	0.050	0.272*	0.676**	0.676**	0.778**	0.759**	-0.100	-0.546**	0.373**	0.603**	**0.912**		
12_InfoQ	0.082	0.070	0.649**	0.788**	0.845**	0.866**	-0.158	-0.528**	0.271*	0.665**	0.827**	**0.885**	
13_ERP_time	-0.004	0.087	-0.284*	-0.334**	-0.263*	-0.355**	0.022	0.345*	-0.390**	-0.258*	-0.240	-0.337**	1.000

Correlations between different constructs in the lower left off-diagonal elements of the matrix.
The square root of the AVE value for each of the constructs along the diagonal (in bold).
* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed).