HOW DIAGNOSTIC AND INTERACTIVE USE OF MAS DETERMINE THE RELATIONSHIP BETWEEN TASK UNCERTAINTY AND ORGANIZATIONAL PERFORMANCE

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How diagnostic and interactive use of MAS determine the relationship between task uncertainty and organizational performance

Abstract

This study investigated the interaction effect of task uncertainty, diagnostic use of MAS, and interactive use of MAS on organizational performance. Survey results obtained from 211 managers showed a three-way interaction model. The results indicate that the relationship between performance and task uncertainty was dependent on the level of the diagnostic and interactive use of MAS. More specifically, the results indicated that performance was positive under high levels of task uncertainty when managers employ low diagnostic and high interactive use of MAS. The managerial implications of these findings are discussed.

Key words: management accounting system, diagnostic, interactive, task uncertainty, performance

Introduction

The importance of the design and use of management accounting system (MAS) on enhancing performance has received the attention of management accounting researchers (e.g. Chenhall & Morris, 1986; Gul, 1991; Gul & Chia, 1994; Chong, 1996; Chang et al., 2005). These studies suggest that there must be an appropriate fit between contextual variables (e.g. environment, task and structure) and information characteristics to enhance performance. In addition, previous researchers considered information characteristics such as nature of scope (information may be narrow or broad in its representation), levels of aggregation, its integrative nature, and timeliness (Chenhall & Morris, 1986). Recently there has been a growing interest in the style of use of MAS (Simons, 1990; Abernethy & Brownell, 1999; Bibse & Otley, 2004). For example, Simon (1990) explains the style of MAS use in terms of diagnostic and interactive use of management control system. In addition, researchers (e.g. Tuomela, 2005: Henri, 2006) suggests the dual use of diagnostic and interactive MAS. For example, Henri (2006) suggests that diagnostic and interactive uses of MAS work simultaneously but for different purposes.

Researchers have been mostly concerned with an organization's information characteristics within the context of given environmental and organizational conditions. Under this view MASs are seen as facilitating decision-making within organizations and should be tailored to the organization's environment, task requirements, and structure (Chenhall & Morris, 1986; Chang et al., 2003). Uncertainty has been described as one of the most important variables in the MAS-performance relationship (Chenhall, 2003). Although the literature (e.g., Daft & Lengel, 1986) suggests three sources of uncertainty: task, environment, and interdependence, most of the studies examining uncertainty in a MAS-performance setting have focused on environmental uncertainty. Mia (1993) and Gul (1991), for example, perceived environmental uncertainty, Gul and Chia (1994) decentralization and perceived environmental uncertainty, Chong & Chong (1997) strategy and perceived environmental uncertainty. Specifically, only Chong (1996) and Chang et al. (2003) examines the interactive effects of task uncertainty on the MAS-performance relationship. Galbraith (1977) shows that task uncertainty is a major determinant of the amount of information processing needed to achieve a given level of performance. Although the issue of uncertainty in the work task environment influencing the nature of information process is well documented in the management accounting literature (Mia, 1987; Brownell & Dunk, 1991; Lau et al., 1995; Chong, 1996), no research has examined the moderating effect of task uncertainty and the style of MAS (diagnostic or interactive) use on organizational performance. In other words, there is little knowledge (empirically) on how the combinations of diagnostic and interactive use of MAS might have regarding the relationship between task uncertainty and performance

The objective of this study is to examine the simultaneous use of interactive and diagnostic use of MAS and their role in uncertain situations and how it affects performance. Specifically, this study examines the three-way interactive effects between task uncertainty, diagnostic use, and interactive use of MAS affecting organizational

performance. In addition, this study is one of the few empirical studies examining the relationship between the style of MAS use and performance (Abernethy & Brownell; Bibse & Otley, 2004; Henri, 2006). This paper extends previous research by considering the simultaneous use of interactive and diagnostic MAS and their role in uncertain situations.

The results of the study indicate that the relationship between performance and task uncertainty was dependent on the level of the diagnostic and interactive use of MAS. More specifically, the results indicated that performance was positive under high levels of task uncertainty when managers employ low diagnostic and high interactive use of MAS. The results also indicate a significant three-way interaction for service firms, but not production.

This paper is organized as follows. First, the descriptions of the variables and the theoretical model used in the study are discussed. Next, the research method is outlined, followed by the presentation of the results. Finally, the findings of the study are reviewed, major issues are discussed and conclusions presented.

Definitions of constructs

Task uncertainty

Task uncertainty is defined as the difference between the amount of information required to perform the task and the amount of information already possessed (Galbraith, 1973). Emphasizing the importance of task uncertainty in information processing, Galbraith (1973) states the greater the task uncertainty, the greater the amount of information that must be processed among decision makers during task execution in order to achieve a given level of performance. The degree of task uncertainty is a combination of the diversity of outputs, the number of different input resources, and the level of goal difficulty. As the complexity of different variables increases, there is a greater need to provide pertinent information to decision makers (Dibrell & Miller, 2002). Regarding the impact of task on information processing requirements, Perrow (1967) suggest two basic dimensions of task uncertainty: variability and analyzability, which are major determinants of information processing for an organization. Task variety[1] is the degree of unanticipated or novel events occurring in a process, while analyzability[2] is the breakdown of a process into formalized steps to reduce uncertainty. Researchers (e.g., Overton et al., 1977; Leatt & Schneck, 1982) find that variety and analyzability are related. If a task has low variety and high analyzability, it can be considered a routine task. At the other end of the continuum, non-routine technologies (task) have high task variety and low task analyzability. In practice, task variety and analyzability are correlated and difficult to distinguish, so they have been combined into a single dimension of task non-routineness (routine versus non-routine). The analyses of different

[1] This concept is similar to task variability (Pugh et al., 1969; Van de Ven & Delbecq, 1974), predictability (Galbraith, 1977), and complexity (Duncan, 1973).

[2] Conceptually, this notion is the same as Thompson's (1967) knowledge of cause-effect relationships, and the search procedure described by Cyert and March (1963).

types of tasks (i.e., routine and non-routine) provide insights into an organization's information processing requirements and, consequently, its performance. In summary, task uncertainty is defined as the uncertainty caused by the complexity and diversity of task performed by managers (Thompson, 1967). Unlike environmental uncertainty, task uncertainty is an inherent job characteristic that relates to managerial work processes (Hartman, 2005).

Use of management accounting system

MAS is defined as a set of management practices which are an essential part of organizations' decision making and control system, and which are designed to provide information to managers for their decision making and control function (Chenhall, 2003: Simons, 1995). Researchers (e.g. Abernethy & Brownell, 1999; Bibse & Otley, 2004) in management accounting discuss the role of MAS in the enhancement of performance. Simons (1990) suggests three styles of MAS use: diagnostic, interactive, and dysfunctional. This study focuses mainly on diagnostic and interactive use of MAS. The diagnostic use of MAS represents the traditional feedback role as MASs are used on an exceptional basis to monitor and reward the achievement of pre-established goals (Henri, 2006). Following a traditional mechanistic notion of control, a diagnostic style of MAS use relates to using a formal information system to monitor organizational outcomes and correct deviations from pre-set standards of performance. An interactive style of MAS use refers to motivating and coordinating the activities of an organization, focusing attention, and encouraging continuous learning (e.g., Simons, 1995). The interactive use of MAS promotes dialogue within the organization by reflecting signals sent by top managers. It generates the development of new ideas and initiatives and guides the bottom-up emergence of strategies by concentrating on strategic uncertainties. When MAS is used interactively, the information generated is frequent, regular, and debated among different hierarchical levels and used for strategic plans..

Unlike previous studies on style of MAS use, for example, Abernethy and Brownell (1999) that focuses on budgets, Bibse and Otley (2004) on project management systems, balanced scorecards, this study follows the approach of Gil et al. (2004), and Fereira & Otley (2004) by using a broader conceptualization of MAS (see Chenhall, 2004;). Table 1 summarizes the style of MAS use and the underlying variables used in the study.

INSERT TABLE 1

Theoretical development

Task uncertainty and diagnostic use of MAS

From the contingency perspective, this study aims to explore whether the impact of task performed by managers on performance is conditioned by the style of MAS used by managers. Researchers (e.g., Keller, 1994; Chenhall, 2003) suggest that the capacity of information processing must fit the processing requirements to obtain high performance. MacIntosh (1981) suggests that different types of task should match different types of information requirements. Galbraith (1973) argues that if the task is routine, much of the

activity can be pre-planned. If the task is non-routine and not well understood, then the actual execution of the task would demand more knowledge, which may lead to changes in schedules and priorities. Thus, the amount of MAS information that managers use for decision making is likely to be a function of their perceived task uncertainty. Very few studies (e.g., Specht, 1986; Chong, 1996; Chang et al., 2003) find the interaction effects of task uncertainty and MAS on performance. In addition, these studies have focused on the design characteristics of MAS. Specht (1986) find that when task uncertainty is high, broad scope information is needed to cover various exceptional events, and the need for manipulated information (this includes analyzed or aggregated data (means, ranges, etc.) and decision aids (e.g., graphics) may also increase to reduce the time required to make a decision. Therefore, managers may have to process and receive more broad scope, timely and aggregated information to deal with higher task uncertainty. Chong (1996) find that under high task uncertainty situations, the extent of use of broad scope MAS information led to effective managerial decisions and hence to improved performance. Similarly, Chang et al. (2003) find that broad scope of MAS improves performance in high task uncertainty, but not in the case of aggregated and timely use of MAS. The inconsistency in the results of Specht and Chang et al. (2003) may be attributed to the emphasis on information characteristics instead of the style of MAS use. In light of these, this study extend previous research by focusing on the style of MAS use as proposed by Simons.

Perrow (1967) argue that if a task has low variety and high analyzability, it can be considered a routine task. He argues that a routine task consists of processes that are standard, repetitive, predictable and well understood by members of the organization. A task can be considered routine if the task remains consistent over time. However, Perrow (1967) believe that if a task has low analyzability and high variety, then the task is considered non-routine, as a non-routine task process does not remain consistent over time. These different task characteristics and the classification of routine versus non-routine have a strong influence on the style of MAS use.

The diagnostic use of MAS is likely to be more effective in situations where change is either limited or non-existent (Abernethy & Brownell, 1999). In this setting there would be little ambiguity concerning organizational goals, and the nature of work is relatively stable, with well-established, well-understood routines for performing tasks. The focus of MAS is to provide relevant information that enables managers to make better decisions in the face of task uncertainty. Managers can use MAS as a diagnostic tool to detail the process and goals of every activity, and control the performance of them. Thus, the diagnostic use of MAS is appropriate in situations where task uncertainty is low, and is well understood, which leads to performance enhancement. When tasks are easy to define, diagnostic use of MAS may provide a means of ensuring that people are acting in accordance with organizational goals. On the other hand, when tasks are highly uncertain, the diagnostic use of MAS may limit creativity and could likely have a negative impact on performance.

Task uncertainty and interactive use of MAS

Tasks that are low in analyzability and high in variety are characterized by high task uncertainty. Tasks are not well understood, and there are no objective and correct procedures or rules to follow. In addition, the cause-effect relationships are not well understood under high task uncertainty and more information is required at the point of execution (Chang et al., 2003). Managers operating in such conditions may not have all the information needed to perform the task; they need to obtain additional information to understand the task more clearly if they are to improve their decision effectiveness (Chong, 1996). To manage effectively in settings, managers require an information exchange process that is interactive and dynamic. The interactive use of MAS enables the interchange of information concerning how the task should be performed. Decision-making is less rigid, allowing employees to define and redefine their tasks and relationships as necessary. The use of an interactive control system with its focus on dialogue, communication and learning enables managers to use every possible piece of data to collectively make sense of changing circumstances (non-routine tasks). The dialogue focuses on new information, assumptions, and action plans. By focusing attention on task uncertainties, managers can use the interactive MAS information to guide the search for new opportunities, stimulate experimentation and rapid response, and maintain control over what could otherwise be a chaotic process (Simons, 2000).

Task uncertainty, diagnostic and interactive use of MAS, and performance

Researchers (e.g., Weingart & Weldon, 1991; Weingart, 1992; Kernan, Bruning, & Miller-Guhde, 1994) provide evidence on the effects of task uncertainty and information on performance. These studies suggest the importance of several input (group norms, task uncertainty) and process (i.e., effort, planning, performance monitoring) variables in explaining the task uncertainty-performance relationship. From the management accounting literature, (e.g. Abernethy & Brownell, 1999: Bibse & Otley, 2004) suggests the moderating effect of interactive use of MAS on the relationship between strategic change/innovative and performance. Furthermore, research work on the style of MAS use can be classified in two ways. The first suggests that managers employ either diagnostic or interactive use of MAS (Simons, 1990; Bibse & Otley, 2004). The second suggests that managers may employ both interactive and diagnostic use of MAS (Haas & Kleingeld, 1999; Tuomela, 2005; Henri, 2006). Haas and Kleingeld (2005) find that the diagnostic use of MAS may not be an end in itself, but is required to initiate a strategic dialogue and interactive use of MAS. Similarly, Tuomela (2005) point out that the diagnostic use of MAS can lead to interactive MAS use. Specifically, Tuomela (2005) indicates that the development of a management accounting system evolved from the support of belief systems via establishing a diagnostic control system to an interactive control system in order to learn about strategy and related factors. Henri (2006) suggest that the diagnostic and interactive use of MAS work simultaneously but for different purposes, and suggested that the use of MAS ranges from mostly diagnostic to a combination of diagnostic and interactive. While the interactive use of MAS promotes dialogue and acts as a learning tool, it can be hampered by the cost of data collection and information load, implying a tradeoff between the diagnostic and interactive use of MAS. This is consistent with Early (1985) view that performance was higher when information

was high, strategy choice was high, and task uncertainty was low. In addition, when information was high, performance was the same across the two task uncertainty conditions; however, when information was low, performance was significantly lower in high task uncertainty. Stated in another way, to achieve a high level performance, compromise must occur between the organization's information processing capability and the level of task uncertainty it faces (Rai & Al-Hindi, 2000). Marginson (2002) indicates that the tension between diagnostic and interactive use can create possibilities for trade-offs and organizational bias. In summary, high task uncertainty demands greater information processing. A high interactive use of MAS may create stronger resistance and consumes much managerial time, and may have a negative impact on performance (Tuomela, 2005). Similarly, high diagnostic use MAS in a high task uncertainty situation may fail to meet the information demands of the uncertainty associated with the task performed. Taken together, this study argues that high use of diagnostic and interactive MAS may negatively affect performance (Tuomela, 2005; Henri, 2006).

In methodological terms, this study considers the relationship between task uncertainty and performance given the different conditional values of interactive and diagnostic use of MAS. This study's major question is how low diagnostic and low interactive use of MAS, low diagnostic and high interactive use of MAS, high diagnostic and low interactive use of MAS, and high diagnostic use and interactive use of MAS modify the relationship between task uncertainty and performance. Based on the aforementioned literature and earlier discussions regarding the relationships between task uncertainty and style of MAS use, a three-way interaction between task uncertainty, diagnostic use, and interactive use of MAS on performance is proposed.

The contingency theory suggests that a proper fit between high task uncertainty and information processing activity of an organization can improve performance. However, in the case of high interactive and high diagnostic use of MAS, managers may be confronted with information and work overload, and this may inhibit the relationship between task uncertainty and performance for least two reasons. First, the high interactive use of MAS can be time consuming and expensive and may lead to strong resistance which can have a negative impact on performance (Tuomela, 2005). The argument here is that as the task uncertainty facing mangers increases, the information processing capacity also increases through communication, dialogue, debate, and collection of new information with may be require much attention, demand additional resources, and consume much of the manager's time. Second, the high diagnostic use of MAS may lead to excessive monitoring and discourage innovation that may be required to cope with task uncertainties (Simons, 1995). Taken together, the high use of interactive and diagnostic use of MAS may create dynamic tension that results in defensive routines that inhibit changes and performance improvement. This leads to the following proposition:

Proposition 1**:** *A combination of high diagnostic use of MAS and a high interactive use of MAS will be associated with a negative relationship between task uncertainty and performance.*

In case of high diagnostic and low interactive use of MAS, managers may excessively focus on the deviations between standard and actual results without much dialogue and debate which is essential in high task uncertainty and this may prevent managers from obtaining diverse inputs that can be channeled into productive outcomes (Simons, 1995). Emphasizing high diagnostic use of MAS when the task uncertainty of manager increases may result in negative results due to the fact that the use of diagnostic may focus on mistakes and negative variances (Henri, 2006). Thus the combination of high diagnostic and low interactive use of MAS will also inhibit the relationship between high task uncertainty and performance. This leads to the second proposition of the study.

Proposition 2**:** *A combination of high diagnostic use of MAS and a low interactive use of MAS will be associated with a negative relationship between task uncertainty and performance.*

In case of low diagnostic and high interactive use of MAS, the high interactive MAS are used to encourage innovative behavior while the low diagnostic MAS are used to ascertain that managers behave according to pre-established plans and rules (Simons, 1995). In other words, the diagnostic use of MAS ensures that the goals and critical success factors are made clear, where as the interactive use enables managers to learn about the goals and relevant critical success factor to improve organizational outcomes (Tuomela, 2005). In terms of the moderating effect, a low diagnostic and high interactive use of MAS is expected to produce a positive relationship between high task uncertainty and performance. This leads to the following proposition:

Proposition 3**:** *A combination of low diagnostic use of MAS and a high interactive use of MAS will be associated with a positive relationship between task uncertainty and performance.*

In the case of low diagnostic and interactive use of MAS, managers are devoid from diverse inputs to produce high quality results. In addition, a low interactive use of MAS may lead to neglect of new information and inactivity, and this may also lead to low performance. Therefore the interaction of low diagnostic and low interactive use of MAS may have a negative influence on the relationship between high task uncertainty and performance. This leads to the following proposition:

Proposition 4: *A combination of low diagnostic use of MAS and a low interactive use of MAS will be associated with a negative relationship between task uncertainty and performance.*

Research method

Sampling procedure

The survey was first constructed in English. The English version was then translated into Finnish using a two-stage procedure recommended by Brislin (1980). Initial translation was conducted by three research assistants. The resulting instrument was pre-tested. In the pre-test, input was received from three managers in the area of marketing and operations management. They were asked to review the questionnaire and to comment on the language clarity of each question as well as the overall format of the instrument. Pilot tests showed that the instrument contained no ambiguities and its length was reasonable. The electronic survey mail was sent to 802 managers, including chief operating officers (COO), chief financial officers (CFO), chief administrative officers (CAO), and chief marketing officers (CMO), and it included an introductory letter explaining the purpose of the research and a copy of the survey. Our sample included services, manufacturing, and merchandise sectors. These industries include furniture, telecommunication, printing and publishing, steel and metal products, consumer durable products, retailers and wholesalers, transportation, and consulting. A reminder was sent after two weeks. Subjects were randomly selected from a mailing list purchased from a business consulting firm. Responses were received from 211 organizations, representing a response rate of 26%. Using a technique suggested by Armstrong and Overton (1977), non-response bias was evaluated by comparing the subject response received before the reminder (98) with responses received after the follow-up reminder (72) and final reminder (41). To test for non-response bias, a comparison of the means of all variables was performed for early and late respondents. The results indicated no significant differences ($p > .05$) for responses. Table 2 summarizes the sample characteristics according to industry type and position of respondents.

INSERT TABLE 2

Measurement of constructs

The questionnaire items for measuring research variables have been used in previous empirical works, supporting the validity and reliability of the measures. The Appendix contains an abbreviated copy of the research questionnaire used to measure the self-report variables in this study.

Task uncertainty. The items used to measure task uncertainty were obtained from previous studies (Withey et al., 1983; Scott & Tiessen, 1999). These eight items were measured by a seven point Likert-type scale (1 = low extent, 7 = high extent). Some studies have reported factor analyses that resulted in two factors that correspond to the first four and last four items in Appendix A. The former, referred to as routine, focuses on the repetitiveness of the elements of tasks. The latter, referred to as knowledge, focuses on whether the tasks rely on established bodies of knowledge or require newer,

novel solutions. Confirmatory factor analysis was performed, and this produced two pair of factors, that were highly correlated. In this study, the two factors were combined into one item through simple averaging. All reported results were similar, whether task uncertainty is measured with the combined scale or with two component factors. The Cronbach's alpha was .79, indicating a satisfactory level of internal consistency for the scale (Nunnally, 1978).

Style of MAS use. The interactive and diagnostic styles of MAS[3] use were measured using an instrument from Gil, Hartman, and Alvarez-Dardet (2004) and Fereira and Otley (2004). Responses regarding interactive and diagnostic use of MAS were provided using a seven point scale (1 = low use, 7 = high use). Four items on interactive MAS use and five on diagnostic MAS were used. Principal axis factor analysis employing oblique target rotation produced two dimensions consistent with the instrument. The interactive style of MAS use explained 32% of the variance, and the diagnostic use of MAS explained 26% of the variance. Cronbach's alpha was .76 for interactive use of MAS and .81 for diagnostic use, higher than the recommended 0.70 (Nunally, 1978). This confirm the uni-dimensionality of the two constructs suggesting the different styles of MAS use and consistent with existing literature. The two variables were then constructed by averaging the scores for the respective items.

Organizational performance was measured based on an instrument used by Shields and Young (1993). On a seven point scale, anchored on "Well below (above) industry level," respondents were asked to rate performance, over the last three years against their industry average on each of the four items. These included (1) percentage change in net income, (2) percentage in stock price, (3) percentage in return on investment, and (4) a self reported rating of overall performance compared to peer organizations (1 = very low, 7 = very high). Researchers (e.g., Dess & Robinson, 1984; Venkatraman & Ramanujam, 1987) suggest that, in terms of consistently providing valid and reliable performance, neither objective nor subjective measures are superior. The use of the measure yielded a Cronbach's alpha of 0.74, indicating a satisfactory internal reliability for the scale (Nunnally, 1978). The single global performance rating correlated at 0.711 ($p < .01$) with the composite index used for testing the model suggesting consistency of the ratings.

[3] The respondents were asked to describe the degree to which interactive and diagnostic use is present in the overall use of management accounting systems rather than focusing on specific control system such as budgets. For example, Bibse and Otley (2004) observed that a high score in the overall level of interactive use of management control system is contributed by a high use of a specific management control system, and a low score in the overall level of interactive use of MAS implies a low score on interactive use of specific control system.

Results

Tables 3 and 4 presents the descriptive statistics and correlation matrix for the variables used in the study.

INSERT TABLE 3

INSERT TABLE 4

The propositions were tested using multiple regressions (Pedhazur, 1982) based on the following multiplicative model:

$$Y = b_o + b_1X + b_2Z + b_3W + b_4XZ + b_5XW + b_6ZW + b_7XZW + e \quad (1)$$

Where, Y is organizational performance, X is task uncertainty (TASK), Z is diagnostic use of MAS (DIAG), W is interactive use of MAS (INTER), XZ, XW, ZW, and XZW are the interaction terms, and e is the error term. Examination of the residuals from the regression equation suggested that there were no major violations of assumptions of normality. The three-way interaction among the predictors was found to be significant and negative, $F(1, 203) = 10.54$, $p < .0001$, adjusted $R^2 = .14$ (see Table 5) suggesting that two-way interaction of diagnostic and interactive MAS use varies significantly across task uncertainty.

INSERT TABLE 5

To further explore the interaction effects above, this study tests and plots the regression on Y (performance) on X (task uncertainty) at various combinations of values of Z (diagnostic use of MAS) and W (interactive use of MAS) by inserting high and low values equal to one standard deviation above (+1SD) and below (-1SD) the mean of diagnostic and interactive use of MAS (Aiken & West, 1991; Cohen et al., 2003). Table 6 below indicates a positive and significant regression line for performance only under the conditions of high interactive use of MAS and low diagnostic use of MAS when task uncertainty is high. This supports proposition 3, which states that a combination of low diagnostic use of MAS and a high interactive use of MAS will show a positive relationship between high task uncertainty and performance. Performance did not matter under the conditions of high diagnostic and high interactive use of MAS (B= -.10, t = -.12, n.s.), high diagnostic and low interactive use of MAS (B = -.20, t = -.45, n.s.), and low diagnostic and low interactive use of MAS (B = -.11, t = -.18, n.s.), suggesting that propositions 1, 2 and 4 are not supported.

INSERT TABLE 6

To further advance interpretations, Figures 1 and 2 provide the appropriate regression lines for the effect of performance on task uncertainty. As the graph of Figure 1 shows,

performance of managers decrease when they employ high\low diagnostic and low interactive use of MAS under conditions of high task uncertainty. Figure 2 shows that performance was high for managers when they employ low diagnostic and high interactive use of MAS under conditions of high task uncertainty. This seems to suggest that diagnostic use of MAS may play a vital role under conditions of high task uncertainty. High diagnostic use of MAS seems to have the same effect on performance under both low and high task uncertainty. Although not significant, a high performance level was found for managers who employ high diagnostic/ low interactive use of MAS under conditions of low task uncertainty.

INSERT FIGURE 1

INSERT FIGURE 2

Additional analysis

The model tested above is significant for the relationship between interactive use of MAS, high task uncertainty, and performance. One aspect that might partially explain this result can be the type of industry and type of position of the respondent. It would be interesting to know if the type of sector and functional background influenced the strength of the relationships hypothesized earlier. Researchers (e.g., Hodgkinson & Johnson, 1994; Mia & Chenhall, 1994; Walsh, 1988) have suggested that different types of responsibilities may determine the use of information among managers. Similarly, there is evidence to suggest that the use of MAS may be different across different sectors (Modell, 1998).

To test for sector type, moderated regression analysis was undertaken testing a similar model as proposed in H1-H4 for service, production, and merchandise sectors[4]. As in the propositions stated earlier, there was a negative significant interaction between task uncertainty, diagnostic and interactive use of MAS and performance for the firms in the service sector (see Table 7) and not for the production sector (only results of significant interactions were included).

INSERT TABLE 7

The adjusted R^2 for the service sector sample is .28. ($F = 12.31$ and $p = .001$). Similarly, to test for the effect of managerial background, moderated regression analysis was undertaken testing propositions 1-4 for CMOs and CFOs. A nonsignificant interaction was found for only the CFOs. However, a significant and negative two-way interaction was found between task uncertainty and the use of diagnostic MAS for CFOs (results not reported here). Using the same approach for propositions 1-4 for CMOs, results (see Table 8) indicate a negative and significant interaction for CMOs (adjusted $R^2 = .24$, $F = 7.438$ and $p = .01$).

[4] The sample size for merchandise was small, so we did not include it in our analysis, although it showed significant interaction. Similarly, we did not include COOs because of small sample size.

INSERT TABLE 8

Discussion

The results suggest the present of a contingent relationship between the diagnostic and interactive use of MAS and performance under different levels of task uncertainty. The results, which supported one of the four propositions, are consistent with the literature that performance may be negatively affected when top managers employ high use of diagnostic and interactive MAS under high levels of task uncertainty. Our results suggest that top managers employ both different combinations of diagnostic and interactive use of MAS during conditions of high task uncertainty. This is consistent with the literature (e.g. Tuomela, 2005; Henri, 2006) that argues that top managers employ diagnostic and interactive, and not either diagnostic or interactive use of MAS. While not all slopes are significant, they provide interesting insights into the relationship between task uncertainty and performance under various levels of the use of MAS in a diagnostic or interactive manner.

First, the results of the study suggest that for managers facing high task uncertainty, the high diagnostic and high interactive use of MAS may negatively affect performance. This seems to suggest that although high interactive use of MAS can generate new information, simultaneously emphasizing the high diagnostic use of MAS may create a tension that negate performance. Lewis (2000) suggests that while this kind of situation may lead to change it may activate defensive routines that inhibit change and lead to a decrease in performance. Second, emphasizing high diagnostic and low interactive use of MAS under high level of task uncertainty lead to negative performance. This is supported by literature that argues the diagnostic use of MAS restricts the generation of ideas which is vital for managers dealing with tasks that are uncertainty. The low interactive use of MAS is unable to provide the required information needed to cope with the high task uncertainty. Third, the result show that when task uncertainty is high, top managers will also need more information and ideas through the interactive use of MAS and low diagnostic use to ensure that intended goals are still maintained. The minimal use of diagnostic MAS contributes to performance by monitoring goals and variations in effectives (Henri, 2006). Fourth, the results indicate that low use of diagnostic and interactive MAS leads to negative performance during high task uncertainty. This is consistent with the proposition of the study that suggests low interactive MAS use deprives managers of the diverse information required to improve performance when facing high task uncertainty.

Taken together, the results of study indicate that in situations where task uncertainty is high and top managers employ high interactive MAS, emphasizing high diagnostic use may restrict information flow and restrict the generation of ideas to cope with the activities and procedures associated with task uncertainty. However, a combination of low use of diagnostic MAS and high use of interactive MAS creates the required balance for the use of MAS for managers with high level of task uncertainty, and can lead to improvement in performance. A high/low diagnostic use of MAS under low interactive

use of MAS has a negative effect on performance under high levels of task uncertainty. This seems to suggest that although top managers simultaneously use MAS in a diagnostic and interactive manner, when facing task uncertainty; more emphasis may be placed on the interactive use of MAS. For stable tasks, more emphasis may be placed on diagnostic use and less on interactive. In both cases, top managers employed both uses, but with different emphases depending on the level of task uncertainty. The results imply a trade-off between diagnostic and interactive use of MAS under conditions of task uncertainty and support previous research (Lewis, 2000; Rai and Al-Hindi, 2000; Marginson, 2002).

The results also indicate a significant three-way interaction for service firms, but not production. This is consistent with existing literature that suggests that direct supervision is more difficult in the service sector than in the manufacturing sector because of high frequency of offsite work, multiple engagements, and high proportion of professional members (Norman, 1984; Chatman & Jehn, 1994 Silvestro et al. 1992). Manufacturing firms are likely to use more formal control mechanisms than service firms because processes and products in manufacturing firms are more tractable (e.g., Chatman & Jehn, 1994; Auzair & Langfield-Smith, 2005). Consequently, service firms may rely more heavily on trade-offs in the diagnostic and interactive use of MAS to cope with the varieties of tasks that surround their activities.

Furthermore, the results suggest that CFOs who use diagnostic MAS when tasks are uncertain may negatively contribute to performance. This is consistent with Benveniste (1987), who argued that administrative managers (e.g., CFOs) rely more on routine control for managing organizations. The use of routine control (similar to diagnostic control) under task uncertainty leads to dysfunctional behaviour. On the other hand, CMOs whose tasks are uncertain and who employ high use of diagnostic and interactive MAS may negatively contribute to performance. With the changing dynamic environment, and the desire to monitor customer and product trends (via interactive use of MAS), CMOs are more likely to be confronted with the challenges of maintaining a balance of the risk of market development and customer satisfaction and at the same time achieving competitive advantage. These challenges may result in organization tension and require CMOs to strike a balance between the use of interactive and diagnostic MAS in uncertain task situations.

Conclusion

The aim of this study was to investigate whether task uncertainty interacts with the diagnostic and interactive use of MAS to influence performance. Results support a three-way interaction of task uncertainty, diagnostic use, and interactive use of MAS on performance. More specifically, results show a positive and significant relationship between high interactive and low diagnostic use of MAS under high task uncertainty on performance.

This study contributes to management accounting literature. This study extends the work of Simons (1995), Tuomela (2005) and Henri (2006) by examining how diagnostic and interactive uses of MAS are combined. The results show how the simultaneous use of diagnostic and interactive MAS and task uncertainty impact performance. The findings are consistent with Tuomela's (2005) and Henri's (2006) suggestions that diagnostic and interactive MAS are used simultaneously for different purposes. Second, the results show that the use of MAS under task uncertainty differs among manufacturing and service sectors. The service sector, with a variety of tasks, would require a combination of diagnostic and interactive use of MAS to cope with different demands confronting service firms in the competitive environment. Third, the results indicate that marketing mangers employ high interactive\low diagnostic MAS when task uncertainty is high, contributing to improved performance. Accounting and finance managers' use of diagnostic MAS in high task uncertainty may lead to negative performance. The evidence provided here adds to the limited empirical base and increases our understanding of the relationship between the style of MAS use and task uncertainty and performance.

Future studies could build upon or extend the results of this study in several ways. First, the simultaneous effect of task and environmental uncertainty on the style of MAS use needs to be explored (Fisher, 1995). Whereas similarities exist between technology (task) and the environment, the two concepts are distinct. Probably this may shed more light on when diagnostic use is appropriate in stable situations. Second, further research could examine how design characteristics of MAS (e.g., Chenhall & Morris, 1986) and style of use of MAS together are affected by the nature of uncertainty surrounding the organization. Third, studying the different styles of MAS in service sectors would add more understanding to the complex issues in the relationship between management control and uncertainty.

Some limitations are noted in the present study. The use of a self-rating scale to measure performance may possibly introduce bias to the respondents´ perception, and focuses only on financial measures. Secondly, the overall use of MAS was measured, and it is possible that only specific constructs of MAS may be used in a diagnostic or interactive manner. More research is needed to provide a standard construct of the measurement of the use of MAS to ensure the consistency and comparability of results in this area. Finally, this study suffers from the usual limitations associated with questionnaire survey methods (see Oppenheim, 1966).

Despite the above limitations, one practical implication of the results is that top management should be aware of the trade-offs in the use of management accounting systems. The results of the study indicate that there are benefits of using MAS in a diagnostic and interactive manner. While interactive use may promote dialogue and learning in uncertain tasks, diagnostic use can be used to track and support the achievement of intended goals. Furthermore, the study reveals that high diagnostic/interactive use of MAS in under conditions of high task uncertain may negatively affect performance. In this connection, top managers and organizations should be aware of the dangers of implementing excessive diagnostic control while at the same time using management accounting system in a highly interactive manner. In summary,

this study provides additional insight on the role that interactive use of MAS plays in helping top managers to improve their performance under conditions of high task uncertainty.

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APPENDIX

Task uncertainty (past three years)

Participants were asked to respond to the following questions on a 1-7 scale (1 = completely certain; 7 = completely uncertain).

To what extent would you say your work is routine?
To what extent do your co-workers do the same job in the same way most of the time?
To what extent are you duties repetitious?
To what extent do co-workers perform repetitive activities doing their jobs?
To what extent is there a clearly known way to do the major types of work you normally encounter?
To what extent is there a clearly defined body of knowledge of subject mater which can guide you in doing your work?
To what what extent is there an understandable sequence of steps that can be followed in doing your work?
To do your work, to what extents can you actually rely on established procedures and practices?

Style of use of management accounting system

Please indicate to what extent your overall management accounting system (e.g. product costing, budgeting) have been used in the following ways over the past three years (1= little use, 7 extremely high use).

To set and negotiate goals and target
To performance measures with strategic goals and priorities
To design incentives contingent upon performance
To review regularly exception reports
To follow up significant exceptions and deviations
To signal key strategic areas
As a learning tool
To discuss data with the accountable managers constructively
To continually challenge and debate data, assumptions and action plans.

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Table 1
Styles of use of management accounting system

Diagnostic use	To set and negotiate goals and target To align performance measures with strategic goals and priorities To design incentives contingent upon performance To review regularly exception reports To follow up significant exceptions and deviations
Interactive use	To signal key strategic areas As a learning tool To discus data with the accountable managers constructively To continually challenge and debate data, assumptions and action plans.

Source: Simons (1995)

Table 2
Sample characteristics

Type of industry (N=211)	
Production	83
Services	96
Merchandise	32
Position	
CFO	74
CMO	87
CAO	20
COO	26
Others	4

Table 3
Descriptive statistics (n= 211)

Variables	Mean	S.D	Cronbach alpha
Organizational performance	4.52	1.07	0.75
DIAG-Diagnostic control	5.53	0.92	0.81
INTER-Interactive control	4.66	1.05	0.76
TASK-Task uncertainty	3.50	0.92	0.80

Table 4
Correlation Matrix (n =211)

Variable	1	2	3	4
1. Performance	1.00			
2. Diagnostic use	.22**	1.00		
3. Interactive use	.29**	.58**	1.00	
4. Task uncertainty	.04	-.07	-.05	1.00

**Significant at the 0.01 level

Table 5
Results of multiple regression analysis with performance as the dependent variable used in testing propositions

	Coefficient	Value	Standard error	t	Prob.
Constant	b_0	23.812	7.557	3.151	0.00
TASK (X)	b_1	-5.663	1.928	-2.937	0.00
DIAG (Z)	b_2	-3.156	1.400	-2.254	0.03
INTER (W)	b_3	-5.550	1.683	-3.297	0.00
TASK*DIAG (XZ)	b_4	.861	.357	2.416	0.02
TASK*INTER (XW)	b_5	1.607	.439	3.663	0.00
DIAG*INTER (ZW)	b_6	.907	.296	3.061	0.00
TASK*DIAG*INTER (XZW)	b_7	-.249	.077	-3.246	0.00

Adjusted $R^2 = .14$; $R^2 = .16$, $F = 10.54$, $p < 0.01$

Table 6
Test of simple slopes of regression lines

	Performance			
	B	t	Sig.	Propositions
At DIAG $_{(High),}$ INTER $_{(High)}$	-.10	-.12	.90	1 (not supported
At DIAG $_{(High),}$ INTER $_{(Low)}$	-.20	-.45	.65	2 (not supported)
At DIAG $_{(Low),}$ INTER $_{(High)}$	.24	4.25	.00	3 (supported)
At DIAG $_{(Low),}$ INTER $_{(Low)}$	-.11	-.18	.85	4 (not supported)

Table 7
Results of multiple regression analysis with performance as the dependent variable for service firms

	Coefficient	Value	Standard error	t	Prob.
Constant	b_0	36.017	11.987	3.005	0.00
TASK (X)	b_1	-8.671	2.921	-2.968	0.00
DIAG (Z)	b_2	-5.194	2.266	-2.292	0.02
INTER (W)	b_3	-9.178	2.525	-3.635	0.00
TASK*DIAG (XZ)	b_4	1.369	.550	2.490	0.02
TASK*INTER (XW)	b_5	2.495	.635	3.931	0.00
DIAG*INTER (ZW)	b_6	1.490	.450	3.314	0.00
TASK*DIAG*INTER (XZW)	b_7	-.392	.112	-3.509	0.00

Adjusted $R^2 = .28$; $R^2 = .22$, $F = 12.31$, $p < 0.001$

Table 8
Results of multiple regression analysis with performance as the dependent variable for CMOs

	Coefficient	Value	Standard error	t	Prob.
Constant	b_0	24.576	9.585	2.564	0.01
TASK (X)	b_1	-6.010	2.421	-2.482	0.02
DIAG (Z)	b_2	-3.629	1.784	-2.034	0.05
INTER (W)	b_3	-5.275	2.215	-2.382	0.02
TASK*DIAG (XZ)	b_4	.990	.449	2.207	0.03
TASK*INTER (XW)	b_5	1.623	.571	2.844	0.01
DIAG*INTER (ZW)	b_6	.946	.388	2,439	0.02
TASK*DIAG*INTER (XZW)	b_7	-.270	.099	-2.727	0.01

Adjusted $R^2 = .24$; $R^2 = .17$, $F = 7.43$, $p < 0.01$

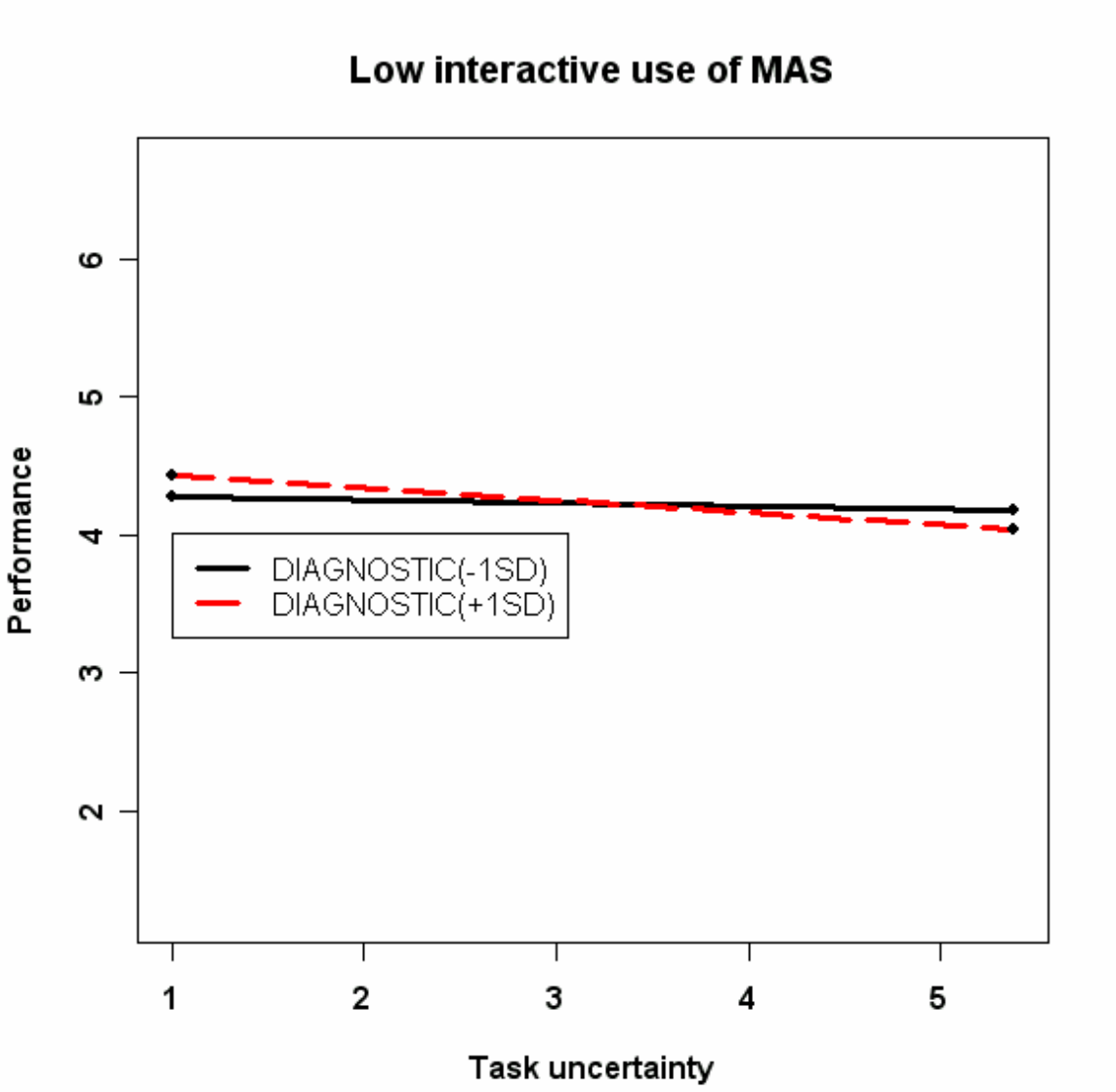

Figure 1. Performance as a function of task uncertainty, diagnostic, and interactive use of management accounting system

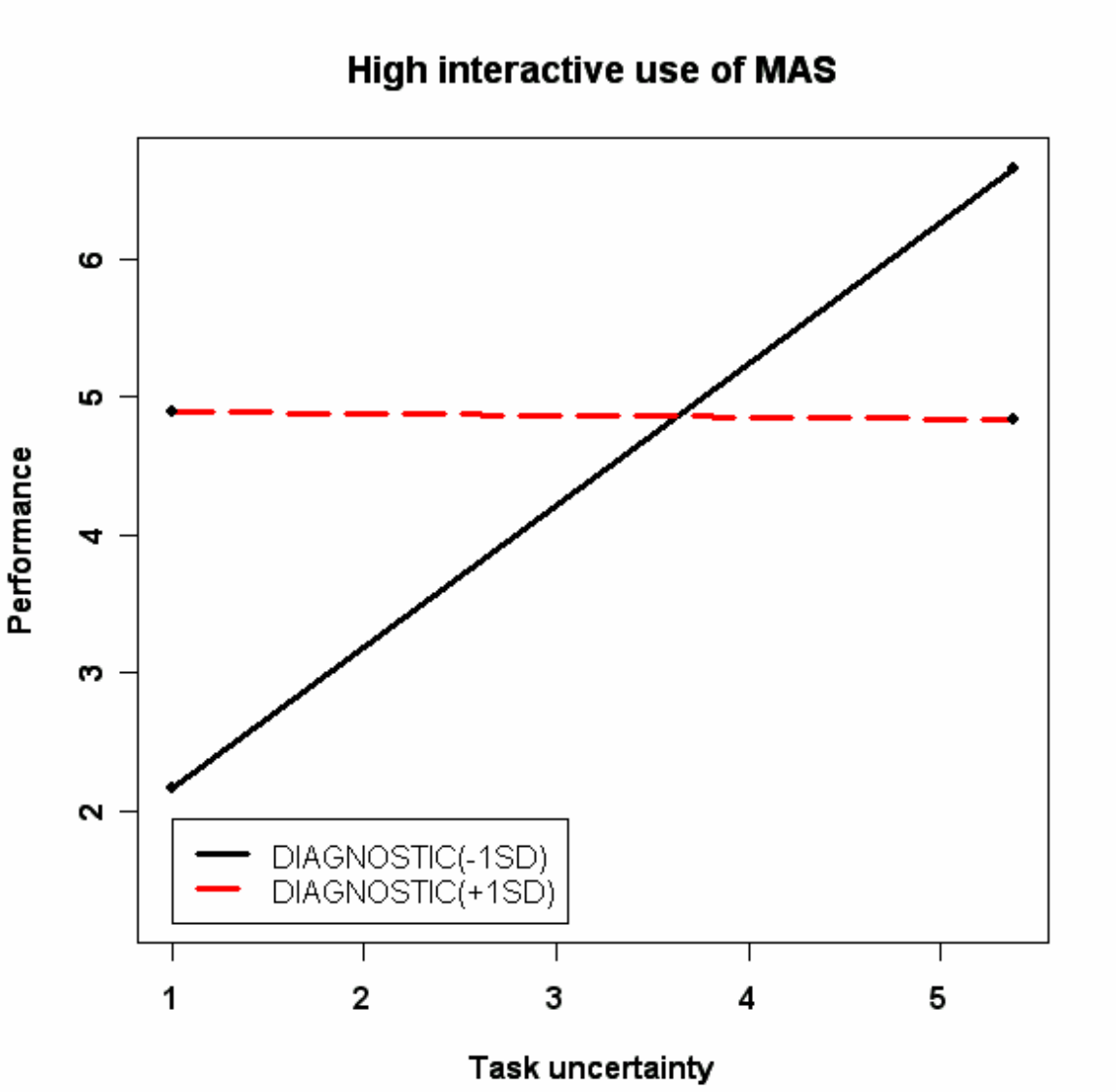

Figure 2. Performance as a function of task uncertainty, diagnostic, and interactive use of management accounting system