Strategic choice and the configuration of management control systems

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Abstract

This paper examines firms' design of performance measurement systems to support the effective implementation of business strategy, and tests whether different strategic choices are associated with the use of different performance measures. Performance measurement choices analyzed are the extensiveness, purposes and types of performance measures used. In addition, the use of alternative controls, action controls and problem solving teams, is examined. To explain these management control choices, the structural model developed also includes other important contingency variables that are associated with business strategy, including firm competencies, technology and environmental uncertainty. An analysis of 387 survey responses from a cross-section of industries suggests the existence of three broad types of business strategy, relating to *innovation*, *customer-quality* and *low-cost*. The findings suggest that emphasis on different strategies is associated differently with firms' competencies, environmental uncertainty, choice of technology, and use of performance measures. Although more emphasis on low-cost or customer-quality is associated with more extensive use of performance measurement information, each of the three strategies is also associated with use of different types of performance measures. Specifically, firms emphasizing innovation emphasize measures related to innovation, cost & efficiency and market performance. High emphasis on a customer-quality strategy is associated with emphasis on measures relating to quality and managers. Firms emphasizing low-cost emphasize measures related to cost & efficiency, production (systems) and employees. These firms also use performance information for more purposes than others. The results further show that most firms pursue combined strategies, which, compared to emphasis on a single strategy, is associated with more extensive and intensive use of performance information. This study thus finds support for contingency propositions that different strategic choices are differently associated with environmental and firm-level contingencies and require different configurations of management control systems.

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Introduction

Prior contingency studies of management control system (MCS) design consider firms' business strategy to be a key determinant of design choices (see e.g. Chapman, 1997; Chenhall, 2003; Langfield-Smith, 1997 for comprehensive reviews). In these studies, management control systems are suggested to support the effective implementation of intended strategies (Henri, 2006). Consequently, alignment between the objectives and strategy of the firm, and its performance measurement system should facilitate effective strategy implementation (e.g. Chenhall, 2005; Ittner, Larcker & Randall, 2003). This paper examines how firms structure and align their MCS in response to their strategic orientation. Contingency arguments put forward the expectation that different strategic choices are associated with different configurations of MCS. Building predominantly on the generic dimensions of business strategy identified by Porter (1985), we analyze the extent to which firms emphasize specific low-cost or differentiation strategies to obtain a competitive advantage. Consistent with arguments that these general strategy types may also comprise multiple dimensions (e.g. Miller, 1988; Chenhall & Langfield-Smith, 1998; Spanos & Lioukas, 2001), in our empirical context we find that firms place more or less emphasis on three types of strategy, relating to *innovation*, *customer-quality* and *low-cost*.[1] Whereas an innovation strategy focuses on developing a diversity of new and innovative products and adapting quickly to changing circumstances to keep on satisfying customers' current and future needs, a customer-quality strategy relates to the timely provision of reliable, high quality products and services that match customers' current needs. A low-cost strategy focuses primarily on efficiency and achieving low cost levels by optimizing capacity use and labor productivity, in order to be able to offer standard products for competitive prices. We analyze whether emphasis on any of these three strategies is associated with more extensive and intensive use of performance measurement (PM) information. While PM extensiveness relates to the extent to which different measures are used (i.e., diversity or scope), intensity of use relates to the different purposes for which PM information is used, such as for planning, decision analysis and performance evaluation. We also analyze whether a focus on different strategic priorities is associated with use of different types of performance measures. Several authors have argued that firms often emphasize multiple strategies simultaneously (e.g. Chenhall & Langfield-Smith 1998; Chenhall, 2003; Hill, 1988; Lillis, 2002; Murray, 1988). Therefore, we also examine *complementarities* between strategic priorities and how these influence MCS design.

In his extensive review of prior contingency studies of MCS design, Chenhall (2003, p.130) concludes that 'it is unfortunate that it is not part of the MCS research tradition to spend more time on developing robust measures of the elements of MCS'.

[1] High emphasis on a type of strategy is analogous to what in the literature is labelled 'strategic priority' (e.g. Chenhall & Langfield-Smith, 1998).

With respect to PM, he suggests that differences in findings between prior studies may relate to differences in the use of performance measures that are being measured. Therefore, this paper in detail examines the extent to which performance measures are used. In the empirical analyses, seven generic performance measure dimensions used by firms are identified: *market performance measures* (such as profit, sales and market share), *cost & efficiency measures*, *innovation measures*, *quality measures*, *production (systems) measures*, *employee measures* and *manager measures*. These measures include both financial and non-financial elements of performance, and exhibit strong interdependencies in their use, consistent with multidimensional performance measurement frameworks, such as the balanced scorecard, that include multiple complementary performance dimensions (Kaplan & Norton, 1996).

While strategy is considered a key choice variable affecting MCS design, prior studies also emphasize the role of firm competencies or capabilities that enable effective strategy implementation (e.g., Henri, 2006; Ittner & Larcker, 2001). The resource-based view of the firm poses that competitive advantage is a function of specific competencies possessed by the firm, which support the effective implementation of particular business strategies (Barney, 1991). Emphasis on innovation, for instance, is unlikely to lead to strategic success when adequate technological skills such as know-how and experience that are required in the innovation process are lacking. MCS may not only support implementation of a particular strategy, but also support the development and maintenance of the competencies necessary to effectively execute the strategy (Henri, 2006).

Prior contingency studies have identified several other factors related to the internal and external firm environment that are associated with strategic choices and that affect MCS design. Key contingencies analyzed in this literature are the external environment, technology, organizational structure, size and national culture (Chenhall, 2003). The theoretical model developed, except for national culture, includes major elements of these contingencies and relates them to both strategic choices and MCS design. In particular, the model includes *environmental uncertainty* following from market and technological fluctuations, *firm competencies* relating to technological, organizational and marketing skills, the choice of *task technology* that determines the degree task repetitiveness and knowledge, and firm *size*. Finally, the model also includes the use of action controls and problem solving teams as part of organizational structuring (cf. Abernethy & Lillis, 1995), providing a more holistic view of firms' MCS (Chenhall, 2003). The theoretical model and empirical analyses explicitly account for interdependencies between these control choices, consistent with frameworks that consider different controls to be interrelated with possible complementary or substitutive effects (e.g., Anderson & Dekker, 2005).

Structural equation modeling (SEM) is used to empirically test the theoretical model in a large sample of survey responses from Dutch firms. The results document that PM information is used more *extensively* by firms that emphasize low-cost or

customer-quality, but not by firms emphasizing innovation. In addition, PM information is used more intensively by firms emphasizing low-cost, but not those pursuing differentiation strategies. The results also indicate that emphasis on low-cost is associated with more repetitive tasks, which in turn are associated with use of action controls. Emphasis on a customer-quality strategy is associated with more task knowledge, which in turn is associated with more extensive and intensive use of PM, and with use of action controls and problem solving teams. Enhanced organizational competencies are also associated with more extensive use of PM information and action controls. Finally, although environmental uncertainty is unrelated to extensiveness and intensity of PM use, it is strongly associated with the use of problem solving teams by firms.

Turning to a more fine-grained analysis of the type of PM information used, we find that different types of PM are used when firms emphasize different strategies. Specifically, firms emphasizing a low-cost strategy emphasize measures related to cost & efficiency, production (systems) and employees. Firms emphasizing an innovation strategy, on the other hand, place more emphasis on outcome measures related to innovation, cost & efficiency and market performance (including profit). More emphasis on a customer-quality strategy, finally, is associated with increased use of measures relating to quality and managers.

A final analysis relates to the implications of complementary emphasis on different strategies. The results show that firms often emphasize multiple strategies simultaneously. With an increasing focus on multiple strategies, firms also use PM information more extensively and intensively, and, depending on the types of strategies pursued, emphasize different combinations of performance measures.

In sum, this study aims to contribute to the existing literature in several ways. First, it aims to test a more comprehensive model of management control by examining the use of several PMS characteristics simultaneously, such as PMS extensiveness and intensity (purposes) of use. In addition, a detailed analysis is made of the specific types of measures used. The study does not focus only on performance measurement choices, but also on alternative controls that may impact the use of PMS, such as action controls and problem solving teams. To explain the use of these control choices, a comprehensive model is built that includes both the internal and external firm environment. Included in this model are the notion of complementary focus on strategic priorities, firm competencies that permit effective implementation of strategy, technology choices following from strategy, and environmental uncertainties associated with strategic positioning. The SEM method employed accounts for the complex interdependencies between these elements and MCS design, and permits simultaneous estimation of the direct and indirect influences of these variables on the multiple dependent variables, and their relative importance.

The next section develops the research model, based on prior contingency studies of MCS design. The sections thereafter describe the data collection, variable measurement, model analysis and empirical results.

Literature review

In developing the research model, this study builds extensively on comprehensive reviews of contingency-based research into MCS design that have been conducted in recent years (Chapman, 1997; Chenhall, 2003; Hartmann, 2000; Langfield-Smith, 1997). This literature posits that the design of effective MCS depends on contextual variables, such as the external environment, strategy, technology, organizational structure and size (Chenhall, 2003). Many prior studies have investigated the effects of these variables on different and often generic conceptualizations of MCS, such as the 'reliance on accounting performance measures' or use of 'financial' versus 'non-financial' information (see e.g. Hartmann, 2000). In conceptualizing MCS, this study focuses specifically on the use of PM information, defining use along three different dimensions: (1) the *extensiveness* of PM information used, (2) the *intensity* of PM use, and (3) the *type* of performance measures used. Extensiveness of PM use in this study refers to the importance placed on PM. This relates to the *diversity* of measures used (Ittner et al., 2003) and the *scope* of PM information (Chenhall & Morris, 1986). Intensity of PM use refers to the purposes for which the PM information is used, i.e. *how* the information is used. A higher intensity of use implies that decision makers use performance information for more purposes, such as for planning, performance evaluation and decision analysis (Tuomela, 2005). In addition, following Abernethy and Lillis (1995) and Chenhall (2003), we simultaneously analyze the use of two alternative controls to obtain a more holistic view MCS design. Specifically, firms' use of action controls and problem solving teams are also examined. The model that we develop to analyze and empirically test these dimensions is depicted in Figure 1.

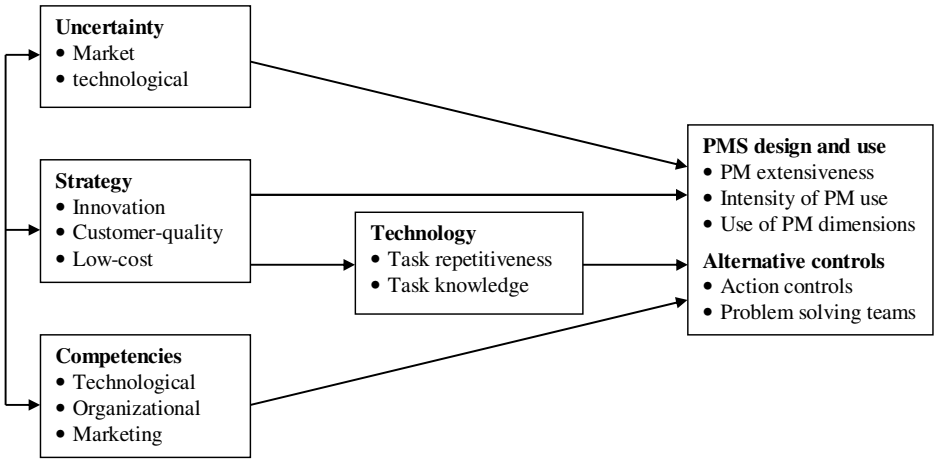

Figure 1: Predictive model of MCS design and use

The next sections discuss each set of contingency variables, starting with business strategy.

Business strategy

In the contingency literature, strategy is considered a key variable, which differs from other contingency variables, since by choosing specific strategic priorities management is able to position the firm in specific environments. Consequently, strategy influences the nature and impact of other contingency variables (Chenhall, 2003). Existing strategy taxonomies categorize strategies into those characterized by a conservative orientation, such as defenders, harvest and cost leadership, and by an entrepreneurial orientation, such as prospectors, build and product differentiation (Chenhall, 2003; Langfield-Smith, 1997). The alignment argument in the contingency literature posits that different strategic choices are supported by different forms of MCS that support effective strategy implementation (Ittner, et al. 2003). Prior studies, for instance, find that conservative strategies, such as low-cost, are usually associated with centralized control, specific operating goals and formalized work instructions. Entrepreneurial strategies, instead, are often associated with decentralized structures, results-oriented evaluation and interactive relations within the firm (Chenhall, 2003). This study examines the degree to which firms' strategic priorities emphasize low cost versus differentiation, and the implications of these strategic priorities for PM choices. Since differentiation may be achieved in multiple (and potentially complementary) ways, the PM information used to support different differentiation strategies may also differ (e.g., Chenhall & Langfield-Smith, 1998). Specifically, the analysis investigates two dimensions of differentiation, innovation and customer-quality. Prior studies focus on both innovation strategies (e.g., Davila, 2000, Bisbe & Otley, 2004) and strategies related to customization and quality (e.g. Bouwens & Abernethy, 2000, Ittner & Larcker, 1997; Ittner et al., 2003; Lillis, 2002; Van der Stede, Chow & Lin, 2006; Perera et al., 1997), suggesting these are supported by different types of performance measures. Thus, we expect more emphasis on low-cost, innovation and customer-quality to be associated with increased use of PM information, however, the type of PM information is expected to differ between strategic priorities. In addition, different strategies may also be complementary and thus pursued by firms simultaneously (e.g. Chenhall & Langfield-Smith, 1998; Chenhall, 2003; Hill, 1988; Lillis, 2002; Murray, 1988), leading to joint influences on PMS design.

Prior contingency studies thus provide the general expectation that the nature of PMS need to be aligned with firms' strategic priorities. In the analyses, we first focus on the extensiveness and intensity of PM use, testing whether more emphasis on any strategy is associated with more extensive and intensive PM use, without yet differentiating between types of PMs. This leads to the following two hypotheses:

H1: Emphasis on strategy is positively associated with the extensiveness of PM information use.

H2: Emphasis on strategy is positively associated with the intensity of PM information use.

While these two predictions provide a broad view of firms' PM design in response to strategic choices, they are uninformative about the content of performance information used. As argued earlier, the alignment argument proposes that different strategic priorities need to be supported by different types of performance measures. Accordingly, different strategic priorities are likely associated with the use of different PM *types*. This expectation is examined after exploring dimensionality in the use of performance measures. However, prior studies do provide some directions as to how strategies will differ in their influence on PM choice and also on task technology choices (cf. Figure 1). Specifically, since innovators continuously face renewal and change, this reduces their opportunities for building concise and stable PMS and to standardize processes (Ittner, et al., 2003; Langfield-Smith, 1997). Thus, strategic emphasis on innovation is likely associated with measurement of innovation outcomes and firm-level outcomes (e.g. profit, sales). Emphasis on a quality-based strategy is more likely associated with increasing use of specific and professional knowledge, a key resource needed to effectively pursue such a strategy (e.g., Tuomela, 2005). For instance, to provide superior service provision firms need well educated and experienced personnel, with low employee turnover to retain specific knowledge and high levels of service quality. Given the importance of attracting, educating and retaining high-quality personnel, firms emphasizing customer-quality likely use more human resource measures, such as employee and manager satisfaction, training, and loyalty/retention. Given the nature of the strategy, a focus on quality measures can also be expected, focusing on customer requirements, satisfaction and operational quality results (Ittner & Larcker, 1997). In addition, the non-repetitive nature of innovation and the increased customization of a customer-quality strategy likely are associated with an increasing number of exceptions in task execution, inhibiting task standardization. Finally, firms emphasizing low-cost are expected to focus in particular on cost, efficiency and productivity measures, which support tight control of resource inputs. On the other hand, these firms are also more likely to use routine technologies and processes that allow standardization to attain higher levels of efficiency (e.g., Abernethy & Lillis, 1995; Miller, 1998). Routine processes, in turn, can effectively be controlled by action controls, such as standardized work methods and work programming, reducing the need for outcome measurement (Abernethy & Brownell, 1997; Perrow, 1970). Following these arguments, two general hypotheses are formulated:

H3: Emphasis on different strategies is associated with the use of different types of PM information.

H4: Emphasis on different strategies is associated with different choices of task technology. Specifically, increasing strategic emphasis on low-cost will be associated with increased task standardization and knowledge as compared to differentiation type strategies.

The last hypotheses related to business strategy reflect the influence of complementarities between strategic choices on PM choices. Several authors have argued that many firms emphasize multiple strategies simultaneously (e.g. Chenhall & Langfield-Smith 1998; Chenhall, 2003; Hill, 1988; Murray, 1988). For instance, firms emphasizing high quality often also focus on innovation, to develop quality products or services that match customers' future requirements. Consistent with the idea of complementarities between strategies Ittner et al. (2003) report positive associations between the innovation, flexibility and maintain strategies that they study. Lillis (2002) similarly observes the majority of her sample pursuing multiple manufacturing strategies, related to quality, flexibility, and low cost. Based on the above discussion, the implication is that emphasizing more than one strategy should be associated with an even increasing degree of PM use, both in terms of extensiveness and intensity of use. Thus, it is hypothesized that:

H5: Emphasis on multiple strategies is positively associated with the extensiveness of PM information use.

H6: Emphasis on multiple strategies is positively associated with the intensity of PM information use.

Firm competencies

Although considered a key determinant of firm effectiveness, strategy can not be expected to fully explain differences in competitive advantage between firms, since it does not contemplate the contribution of specific resources and capabilities used to implement the strategy in a certain competitive environment. The resource-based view of the firm (RBV) conceptualizes firms as bundles of resources that can be physical (e.g., equipment, geographic location), human (e.g., knowledge and expertise), and organizational (e.g., superior work teams and management skills) (Barney, 1991; Wernerfelt, 1984). Resources in the RBV are analogous to *value drivers* in the strategic PM literature (Ittner & Larcker, 2001; Ittner et al., 2003). Deployment of resources that are valuable, rare, inimitable, and nonsubstitutable is suggested to contribute to sustainable competitive advantage (Barney, 1991; Wernerfelt, 1984). Superior skills and resources represent the ability of a firm to outperform its

competitors by securing a positional advantage in terms of superior customer value or lower costs. The conversion of superior skills and resources into positional advantages, and the payoff from this position in performance outcomes, are affected by strategic choices and strategy implementation processes (Day & Wensley, 1988). Superior resources can be classified into *technical know-how*, *marketing competencies*, and *organizational skills* (Spanos & Lioukas, 2001; Teece, Pisano & Shuen, 1997).[2] Empirical evidence on the association between organizational resources and PM use is limited. Henri (2006) finds that capabilities related to innovation, organizational learning, market orientation and entrepreneurship are associated with how firms use MCS. Ittner et al. (2003) provide evidence that value driver choice and strategy selection represent independent constructs and argue that measuring a firm's overall strategy without considering its value drivers provides an incomplete representation of strategic attributes. Enhanced organizational, technological and marketing competencies may also relate to the ability to measure performance on multiple dimensions well and provide a need for PM to further develop and maintain these competencies. Accordingly, organizational, technological and marketing competencies are included in the model as covariates of strategic choices and determinants of PMS design. In addition, a relation is specified between competencies and environmental uncertainty, expecting firms not only to match their strategy with the environment they operate in, but also to possess the right competencies to effectively operate in that environment.

Based on this discussion the following hypotheses are specified:

H7: Enhanced firm competencies are positively associated with the extensiveness of PM information use.

H8: Enhanced firm competencies are positively associated with the intensity of PM information use.

H9: Different firm competencies are associated with the use of different types of PM information.

Environmental uncertainty

The theoretical model differentiates between two types of uncertainty: task uncertainty, stemming from task technology choices which are discussed in the next section, and environmental uncertainty (cf. Hartmann, 2000). In contingency research, environmental conditions have long been regarded as important conditions impacting strategy, organizational structure, operations and MCS design. Two key sources of environmental uncertainty relate to *market changes* (resulting from e.g. changing

[2] DeSarbo et al. (2005, 2006) also classify capabilities into marketing, technology and management capabilities and in addition distinguish market linking and information technology capabilities.

customer demands, and competitors' and suppliers' actions) and *technological changes* (caused by e.g. technology changes and new product introductions) (e.g. Davila, 2000; DeSarbo et al. 2005). Strategy and uncertainty are related constructs since strategic choices involve the choice to operate in particular environments, while perceptions of environmental uncertainty affect top managers' strategic choices (e.g. Tymon et al, 1998). DeSarbo et al. (2005) note that although firms pursuing different strategies are expected to thrive in different environmental conditions, these conditions are underinvestigated in empirical strategy research. Similarly, to effectively operate and implement strategy in specific environments, firms also need particular competencies. DeSarbo et al. (2005) therefore stress there is a need for greater consideration of environmental uncertainty and firm capabilities in the study of strategic choice. These associations are reflected in Figure 1 with the two-headed arrows between strategy, competencies and environmental uncertainty. Prior studies have characterized environmental conditions in different ways, looking at factors that affect environmental variability, unpredictability or uncertainty (Hartmann, 2000). While uncertainty provides complications in predicting the future, setting performance targets and evaluating whether good or bad performance was caused by managerial effort or (bad) luck, it also generates conditions under which more control and performance information is needed (Anderson & Dekker, 2005; Hartmann, 2000). In his literature review, Hartmann (2000) concludes that evidence about environmental uncertainty and the use of accounting performance measures is mixed at best. Some prior studies find that with increasing uncertainty the scope of information is broadened with external and non-financial information (e.g. Chenhall & Morris, 1986; Gordon & Narayanan, 1984). This leads to the expectation that uncertainty is positively associated with the extensiveness of PM information, which will include more non-financial information (i.e. broader scope). Similarly, also the purposes or 'roles' (Chapman, 1997; Hartmann, 2000) of PM information are expected to broaden with increasing uncertainty, such as for assessing decisions and activities, more frequently (re)assessing planning assumptions and increasing interaction with lower-level managers about performance, thus leading to more intensive PM use. Thus, it is hypothesized that:

H10: Environmental uncertainty is positively associated with the extensiveness of PM information use.

H11: Environmental uncertainty is positively associated with the intensity of PM information use.

We make no predictions about the relations between environmental uncertainty and types of PM information, and explore these in the empirical analyses.

One reason for the mixed findings across prior studies may be the limited inclusion of other contingency variables, which may be associated with both uncertainty and MCS choices. This inhibits investigating whether uncertainty has autonomous effects on PM use, or whether it is associated with other variables that affect PM use. For instance, a firm's strategic positioning and resource configuration may be associated with specific uncertainties and generate a need for specific types of PM information. When excluding these strategic variables, their effects would be (indirectly) captured by uncertainty. Therefore, in the empirical analyses we examine the associations between uncertainty and MCS design in an additional model that excludes the influence of strategy and compare the effects with the theorized model.

Technology

Technology refers to how the firm's internal work processes operate, and includes hardware (machines, tools), materials, people, software and knowledge (Chenhall, 2003). Following Perrow's (1970) framework, which describes technology in terms of *task analyzability* and *number of exceptions*, we expect PM design to depend upon knowledge of transformation processes and the repetitiveness of tasks. These technology dimensions both relate to the level of task uncertainty (Hartmann, 2000). We expect detailed task knowledge to be associated with more extensive and intensive use of PM information, in particular since this knowledge allows easy (low cost) identification and measurement of relevant performance dimensions, and determination of adequate performance standards. More specifically, we expect that more task knowledge is associated with increasing reliance on non-financial, operational performance data, and with behavior controls such as operating procedures, programs and plans (e.g., Daft & Macintosh, 1981). Although repetitive tasks are likely associated with more task knowledge, the standardization that task repetitiveness allows may actually mitigate the need for detailed PM. Instead, standardization is likely associated with use of more general outcome/output measures, leading to less extensive and intensive PM use.[3] Repetitive tasks are also expected to be associated with more intensive use of behavior controls. Non-repetitive tasks, on the other hand, require controls to encourage flexible responses and high levels of open communication in order to learn from past performance and to adapt to changing demands (Chenhall, 2003).

While we expect technology choices to influence the design of PMS, we also expect the choice for particular types of technology to be endogenous and to be influenced by the firm's strategic priorities (see Figure 1) (e.g., Tymon, et al. 1998). In particular, we expect that differentiation-based strategies are associated with a lower degree of task standardization, while cost-based strategies are associated with

[3] While standardization of activities allows cost efficient design of operations, it also can be considered a 'control problem avoidance strategy', which is associated with a reduced need for PMS (Merchant & van der Stede, 2003).

increased process standardization. Chenhall (2003) notes that firms producing specialized, nonstandard and differentiated products likely employ complex technologies that are non-repetitive and have low analyzability. In contrast, firms producing standard, undifferentiated products likely employ more repetitive and better analyzable technologies.

H12: Task repetitiveness is negatively associated with the extensiveness of PM information use.

H13: Task repetitiveness is negatively associated with the intensity of PM information use.

H14: Task knowledge is positively associated with the extensiveness of PM information use.

H15: Task knowledge is positively associated with the intensity of PM information use.

Data and sample selection

The data used to test the model are obtained from a large-scale survey that was administered at the end of 2004 until the beginning of 2005. To develop a sampling frame, cooperation was sought with the Controllers Instituut, a Dutch professional organization for executives with a postgraduate education in financial management, which provided us with their member list. We used several criteria to select suitable respondents from the list. First, the firm the respondent worked for needed to employ more than 100 employees to make sure that these firms were sufficiently large to use performance measurement systems. Second, we sampled only for-profit firms and excluded non-profit organizations, as these pursue different goals (see e.g. Chenhall, 2003) and the strategy and MCS dimensions that we use are less applicable to them. Third, we looked at the job title and the respondent's hierarchical level, to ensure the respondent had sufficient oversight over the firm's strategy, MCS, and internal and external environment. Typical functions selected were CEO, CFO, financial director, and financial controller. Finally, the firm had to be located in the Netherlands to avoid cultural differences influencing measurement and relations between constructs (e.g., Chenhall, 2003). These criteria resulted in a list of 2,584 names, which were sent a questionnaire with a prepaid return-envelope to their home address, and a reminder including a new questionnaire after one month. To further increase the sample size and to collect information about reasons for non-participation, we sent out a second

reminder by email providing the non-respondents the opportunity to fill in the survey online.[4]

In total 454 questionnaires were returned (17.6%). Given the extensive length of the survey (20 pages) and the hierarchical level of targeted respondents, we consider this a satisfactory response. However, not all responses were useable for analysis. The main reasons for removing responses were that respondents had moved to organizations that did not meet the selection criteria (e.g. non-profit or too small) and that responses had too many missing values. Given the large number of variables included in the survey, using listwise deletion would substantially reduce our sample size. We therefore imputed values for responses on independent model variables with only a limited number of missing values, using the maximum likelihood EM method.[5] This provided a final sample for analysis of 387 responses.

Consistent with our selection criteria, most respondents occupy high positions in their organization. Of the final sample, 127 respondents report to be member of the board of directors (e.g. CEO, CFO, VP), 61 head a department supporting the central board (e.g., corporate controller), and 37 are a member of this department. Another 24 respondents are BU or location managers, 84 are leading a department supporting the BU or location management (e.g. division/region controller), and 28 are member of this department. Finally, 14 respondents head a BU department and 12 are financial professionals. Also corresponding with our selection criteria, the sample includes firms operating in a wide range of industries. Broadly classified, the following types of industries are represented in the sample: manufacturing (125), construction (22), trade (48), transportation, warehousing & communication (44), financial services (73), professional services (50), and other (22). Three surveys were returned anonymously.

To check for potential non-response bias, we compared the scores for all model variables between the first 100 respondents and last 100 respondents of the paper-based survey, and with the 42 responses to the web-based survey. No meaningful differences were found across the three groups.

[4] Email addresses of 1.800 selected members that did not participate in the first two rounds were available. 96 non-respondents filled in a short 'sign-out' survey, which we developed for the second reminder, asking reasons for non-participation. The main reason for not cooperating was that the respondent considered filling in the survey too time consuming. Another 45 respondents used the main survey to sign out of the study.

[5] Missing values generally were limited, and detailed missing value analyses suggested these were well dispersed over cases. Only a few variables with a high 'production content' (in particular two items relating to inventory levels, which are not relevant to all industries), generated a larger number of missing values (>10%) because a large number of respondents provided the answer 'not applicable'. These items were removed from the analysis. In addition, for the PM items, we first provided all responses with 'not applicable' a score of 1 (unimportant), and then used EM imputation to substitute the few remaining 'real' missing values (<2% per variable). Correlations between construct scores of the model variables are very similar before and after imputation.

Variable measurement

To measure the latent variables of the model we use exploratory factor analysis and include factor scores of constructs in the empirical structural model. Even though for some variables (e.g. technology) prior scales were available, given the cross-industry nature of the study, most scales required adaptations to develop more generic items or required the development of new items (e.g., competencies). Thus, although for all instruments we had ex-ante expectations of which type of dimensions to expect, we chose not to use confirmatory factor analysis, because of the adaptations made to the measurement instruments. All factor analyses are conducted using maximum likelihood (ML) estimation, which for larger samples is robust against small to medium deviations from normality. Oblique rotations are used, since the dimensions are expected to relate to each other (Fabrigar et al., 1999).[6] For instance, task repetitiveness and knowledge are unlikely to be orthogonal, and similarly the use of different performance dimensions is unlikely to be independent. Instead, interrelatedness and complementary effects between dimensions are more likely, indicating the importance of using oblique rotation.

Performance measurement: extensiveness and nature of performance measures

We considered it important to carefully measure the content of PMS and have specific notions of what firms' PMS consist of. Therefore, elements that could be (but not necessarily are) used by firms for PM and evaluation were comprehensively measured. A list of 29 performance measures was used, asking for the extent to which these measures are used by the firm *to evaluate the performance of the manager(s)* of the primary operating units. Descriptive statistics for these measures are shown in Table 1.[7] For each item the full range of the scale (1=very unimportant – 7=very important) is used and there is substantial variation across firms in PM use. The performance indictors considered most important are profit, sales, cost, customer satisfaction and quality.

The first measure developed is labeled 'PM extensiveness' and is a simple average score of the 25 PM items. A high score on this measure indicates that many performance measures ('diversity') are important for measuring managerial performance. Conversely, a low score means not many measures are used and considered important. The distribution of this variable ranges from 2.38 to 6.65, with a mean score of 4.62 (*sd*=0.73), and approximates a normal distribution. To establish the robustness of this key construct, an alternative measure was constructed by

[6] We further replicated the factor solutions using principal axis factoring and found no meaningful differences in factor structures, loadings, communalities and variance explained.

[7] Three measured performance criteria were not included in the factor analyses because of too many missing values. These relate to inventory levels, value-based measures and accounting return measures. These last two measures likely are more relevant for large and listed firms, causing more missing values for smaller firms. Correlation analyses support that these items are more intensively used by larger firms. In addition, one measure, 'worker conditions', was removed from the analysis because it loaded weakly on three factors (employees, cost & efficiency, and production (systems)).

providing a value of one only for items with a score larger than 5 (signifying the importance of the measure for the firm) and taking the sum over the 25 items. This measure averages 9.20 (*sd*=4.83, range 0-25), and approximates a normal distribution. Since it includes only performance measures considered highly important by the firm, a high score on this scale reflects high *diversity* of PM use (e.g. Ittner et al, 2003). The correlation with PM extensiveness is high (*r*=0.82), which supports the robustness of the PM extensiveness measure.[8]

Table 1: Use of performance measures and dimensions

Indicators	***Mean***	***sd***	***Factor loadings***						
			Mark.	***Innov.***	***Prod***	***Cost***	***Qual.***	***Man.***	***Empl.***
Net sales	5.50	1.61	0.75						
Market share	4.54	1.78	0.57						0.30
Sales volume	4.62	1.93	0.58			0.31			
Profit	5.80	1.50	0.54						
Number of improvements of existing products/services	4.15	1.45		0.92					
Number of new product / service introductions	3.71	1.74		0.68					
Improvements in production systems	3.93	1.73		0.46	0.41				
Production volume	4.20	1.78			0.57				
Expansion of production capacity	3.43	1.71			0.53				
Labor productivity	5.18	1.31				0.61			
Cost per employee	4.80	1.58				0.52			
Cost	5.69	1.09				0.44			
Capacity utilization	4.94	1.63				0.58			
Speed of delivery	4.61	1.63					0.56		
Quality of products/services	5.65	1.17					0.54		
Customer satisfaction	5.69	1.21					0.46		
Quality of after-sales service	4.22	1.63					0.30		
The manager's ability to quickly adapt to changing circumstances	4.72	1.47						0.66	
The manager's loyalty towards the firm	4.55	1.47						0.64	
The view of the decentralized manager on firm strategy	3.95	1.53						0.51	
The manager's ability to cooperate with others	5.00	1.20						0.46	
The way the manager interacts with employees	4.39	1.36						0.42	0.39
Loyalty of employees (turnover)	3.98	1.46							0.72
Training and improvement of the level of knowledge of the employees	4.32	1.36							0.59
Employee satisfaction	4.31	1.32							0.64
Cronbach Alpha			**0.69**	**0.75**	**0.72**	**0.66**	**0.67**	**0.79**	**0.81**

KMO Measure of Sampling Adequacy = 0.85; Bartlett's test of sphericity = 0.000.

[8] Two other variables constructed by scoring one and cumulating all items values >4, and only values of 7, again correlate well with PM extensiveness (*r*=0.91 and *r*=0.56).

Whereas PM extensiveness provides information about the degree to which firms use PM, in its simplicity, it is uninformative about the *nature* of the measures used. Since firms emphasizing different strategies are hypothesized to align the type of PM with their strategic priorities, testing this proposition requires a more fine-grained analysis of PM use. We use exploratory factor analysis to assess dimensionality of PM use. A ML estimation of the 25 items yields a well-behaved solution with seven well-interpretable factors with eigenvalues larger than one, jointly explaining 49.1% of the variance. These PM dimensions relate to: 1. *market performance*; 2. *innovation*; 3. *production (systems)*; 4. *cost & efficiency*; 5. *quality*; 6. *managers* and 7. *employees*.[9] A few cross-loadings occur in the solution, such as improvements in production systems relating both to the innovation and production (systems) dimensions.[10] The Cronbach Alpha values ranging from 0.66 to 0.81 indicate adequate reliability of all dimensions.[11] Correlation analyses between the constructs further show positive and significant correlations between most dimensions (see Table 3), consistent with the expectation of complementary PM use.

Performance measurement: purposes of use

In addition to inquiring about the measures used for PM, we also measured five purposes for which the PM information could be used, since firms facing different conditions may use the same type of information for different purposes and with different intensity. Table 2 presents these purposes (1=disagree completely, 7=agree completely). The descriptive statistics show substantial variation in the purposes of use between firms, and indicate that assessing the situation, evaluating the

[9] Estimating a reduced number of factors causes the factors to merge in predictable ways. In a five-factor solution, the managers and employee measures form one dimension, and so do the production (systems) and cost & efficiency dimensions. In a four-factor solution, the quality dimension merges with the managers and employee dimensions. A split-sample analysis based on organizational level of the respondent similarly provides a seven-factor solution for both respondents at the firm level and the BU/location level. The correlations between the factor scores in the full sample and those in the sub-sample range from 0.52 – 0.99. Factor analyzing the dummy scores for all observations with a value >5 similarly provided a seven-factor solution, and factor scores correlate well with the reported solution.

[10] These cross-loadings are unproblematic, since they relate to items at the boundary of related PM dimensions (Hayduk, 1996). Only the (weak) loading of market share on the employee measures dimension is not straightforward and we consider this a statistical artifact. The loading of sales volume on the production (systems) measures dimension makes sense, since sales volume is logically associated with production volume.

[11] This multiple factor solution reveals commonalities with existing multidimensional PM frameworks, such as the balanced scorecard that includes multiple performance dimensions (Kaplan & Norton, 1996). Clearly, the market performance dimension includes financial performance, although it also includes information about market share and sales volume that would fit with the BSC's customer dimension. Production (systems) measures and cost & efficiency measures relate to internal operations. The measures labeled 'quality' also relate to internal operations as well as to its effect on the customer dimensions (satisfaction). Innovation, manager and employee measures, finally, seem to match with the BSC's learning & growth perspective. In contrast with the BSC, we do not find a separate dimension reflecting the use of financial measures. Instead, financial measures are part of two dimensions relating to internal efficiency (i.e., cost measures) and external performance (i.e., market performance).

manager(s), and providing a basis for discussions with the responsible manager(s) are considered the most important uses of PM information. Investigating and discussing activities and decisions, and investigating and revising the assumptions of planning are on average considered less important.

Table 2: Purposes of use of PM

Purposes of use	*Mean*	*sd*	*Factor loading*
Management uses the performance information:			
to evaluate the manager(s)	5.27	1.18	0.71
to investigate and discuss activities and decisions	4.87	1.28	0.77
to assess the situation	5.27	1.16	0.79
as a basis for discussions with the responsible manager(s)[#]	5.20	1.17	0.77
to investigate, and revise when necessary, the assumptions on which the planning was based	4.76	1.40	0.65
Cronbach Alpha			**0.85**

KMO Measure of Sampling Adequacy = 0.85; Bartlett's test of sphericity = 0.000
[#]Responses for this item range from 2-7; all other items 1-7.

The dimensionality of the purposes of use of PM information was assessed using ML factor analysis. A one-factor solution explains 52.1% of the variance in items, and reveals no differences in dimensions of use of PM information, such as planning and control purposes. Although the differences in mean level of different items correspond somewhat with the expectation that use of measures for planning and control purposes may differ, the high level of correlation between all five items indicates that more use of PM information for one purpose is often associated with more use for the other purposes. As a consequence, the one-factor solution describes the intensity of use of PM information, for both planning *and* control purposes. The reliability of the construct is high (alpha 0.85).[12]

As seen in Table 3, PM extensiveness is significantly associated with each of the seven PM dimensions and with intensity of use. Except for the production (systems) dimension, all other PM dimensions are also positively associated with intensity of use. Also noticeable are the generally weaker correlations that the market performance dimension has with PM extensiveness, intensity of use and the other dimensions. This indicates that the general outcome measures such as profit, market share and sales (volume) are used less in combination with other measures. All other PM dimensions correlate moderately to high, indicating that different PM dimensions are used as complements.

[12] This one-factor solution also emerges when splitting the sample based on the position of respondents (organization vs. BU or location). Correlations between the construct scores for the full sample solution and those of the sub-samples are both equal to one.

Table 3: Correlations between PM extensiveness, intensity and dimensions

	1	2	3	4	5	6	7	8
1. PM extensiveness	-							
2. Intensity of use	0.33***	-						
3. Manager	0.61***	0.18***	-					
4. Innovation	0.61***	0.17***	0.21***	-				
5. Market performance	0.37***	0.16***	-0.01	0.19***	-			
6. Production (systems)	0.42***	-0.06	0.16***	0.22***	-0.01	-		
7. Quality	0.48***	0.20***	0.15***	0.24***	0.08	0.08	-	
8. Cost & efficiency	0.48***	0.23***	0.14***	0.12**	0.09*	0.06	0.13***	-
9. Employee	0.57***	0.24***	0.33***	0.22***	0.04	0.05	0.21***	0.14***

***, **, * indicate a p value of ≤ 0.01, 0.05 and 0.10 in a two-tailed test.

Alternative controls

We based on Abernethy and Lillis (1995) to measure the two alternative control mechanisms in Figure 1. The use of action controls was measured with the following statement: 'The operations of the firm are strongly determined by standardized work methods or production manuals' (1=completely disagree – 7=completely agree). The importance of teams was assessed by the frequency with which temporary task forces or teams are used for problem solving and coordination across departments (1=never – 7=always). With a mean score of 4.56 and 4.52, action controls and teams are used frequently, although the variation across firms is substantial (sd=1.59 and 1.40).

Strategy

Firms' strategic priorities were measured by the extent to which firms emphasize several strategic issues to achieve a competitive advantage. Following the multivariate measurement approach suggested by Hambrick (1980; see also Langfield-Smith, 1997), multiple dimensions were expected. Consistent with the framework of Porter (1985), the items used for measurement relate to different elements of strategies based on cost and differentiation, and were based on prior studies (Baines & Langfield-Smith, 2003; Boyer et al., 1997; Chenhall & Langfield-Smith, 1998; Ittner et al., 2003). Emphasis on differentiation was captured by items relating to product and service quality and diversity, product innovation and introduction, service levels, and flexibility. Emphasis on low-cost was captured by items relating to firm's focus on resource and capacity use, and its desire for low cost levels. A seven-point scale was used to ask how important each item is to achieve a competitive advantage over competitors (1=very unimportant – 7=very important). Asking respondents to make comparisons with competitors is particularly important when conducting cross-industry analyses (Campbell-Hunt, 2000; Chenhall, 2003; DeSarbo et al., 2005). Table 4 shows that substantial variation exists across firms in strategic priorities.[13]

[13] We left out four items from the measurement instrument (related to low inventory levels, speed of adjusting production capacity, speed of adjusting production volumes demand changes, and production speed) since these items had too many missing values for non-manufacturing firms.

Table 4: Measurement of strategy

Indicators	***Mean***	***sd***	***Factor loadings***		
			Innov	***Cust.-quality***	***Low- cost***
Short introduction times for new products/services	4.66	1.62	0.87		
Fast adjustment of the product/service assortment	4.34	1.48	0.61		
Innovative products/services	5.40	1.40	0.60		
Products/services matching customer demands[#]	5.81	1.07	0.33	0.40	
Offering a large diversity of products/services	4.42	1.44	0.32	0.32	
Accurately meeting delivery agreements	5.57	1.20		0.72	
Reliable products/services[#]	5.97	0.98		0.58	
Providing good after-sales service	5.21	1.36		0.52	
Fast delivery of products/services	5.34	1.35		0.46	
High quality of products/services[#]	6.03	0.90		0.41	
High labor productivity[#]	5.48	1.10			0.75
Optimal utilization of production capacity	5.49	1.35			0.71
Low cost[#]	5.47	1.36			0.55
Cronbach Alpha			*0.75*	*0.73*	*0.70*

KMO Measure of sampling adequacy = 0.77; Bartlett's test of sphericity = 0.000.
[#] *Responses for these items range 2-7; all other items 1-7.*

A ML factor analysis with oblique rotation extracts three well-interpretable factors with eigenvalues larger than one that jointly explain 40.9% of the variance in the items.[14] These factors represent different strategic priorities and are labeled as *innovation*, *customer-quality* and *low-cost*.[15] The innovation dimension loads most strongly on items related to timely introducing new products and services, adaptability in offerings and providing new, innovative products and services. These items are strongly oriented towards customers' *future* needs. Two items also contain elements of required flexibility when pursuing an innovation strategy, in terms of short introduction times and fast adaptations to changing customer preferences (Chenhall & Langfield-Smith, 1998; Ittner et al., 2003). A customer-quality strategy relates more to customers' *current* needs and fulfilling these in a timely and reliable way. Thus, the factor loads on items such as providing reliable and high-quality products and services, accurate and fast delivery, with adequate levels of after-sales service.[16] A

[14] One item that did not fit the solution, 'low price', was deleted. Including this item leads to a four-factor solution, with only low price constituting the fourth factor. In a specified three-factor solution the low price item becomes part of the low-cost strategy dimension, however its communality (0.17) is below accepted levels.

[15] A factor analysis conducted for only the manufacturing firms in the sample that includes the four omitted production-type items shows the inventory level and production speed items predictably loaded on *Low-cost*, while the adjustment items loaded on both *Low-cost* and *Innovation*. This indicates that both strategies in a manufacturing context require flexibility and timely adaptations. Factor scores that include these items correlate well with their reported counterparts (r=0.93, r=0.76 and r=0.88).

[16] The customer-quality construct is analogous to the "customer service" strategic priority in Chenhall & Langfield-Smith (1998).

low-cost strategy, finally, is oriented towards efficient use of firm resources and capacity, with a key focus on low cost levels. The reliability of all three dimensions is adequate, with Cronbach Alpha values of 0.70 and higher.

As expected, correlations between the three dimensions (see Table 8) indicate complementarities between strategic priorities. More emphasis on customer-quality is associated with more emphasis on innovation, indicating that innovation is important for continuous renewal of high-quality products and services to retain the ability to match customers' current and future needs. This is also indicated by the two cross-loadings of the items '*products/services matching customer demands*' and '*offering a large diversity of products/services*' on these factors, indicating these items relate to both domains (Hayduk, 1996). Indeed, these items reflect reactions to both customer's current and future needs and preferences. Since innovation enables firms to support a customer-quality strategy by responding to changing customer needs, these differentiation strategies are clearly related. Emphasis on customer-quality and on low-cost further correlates positively, indicating that cost-efficient solutions even for high-quality products and services are important to compete effectively.[17]

Firm competencies

Using conceptions of competencies in the strategic management literature of firm competencies, we developed a general instrument to measure in our cross-industry setting three types of competencies: technological, organizational/managerial and marketing competencies (Spanos & Lioukas 2001; Teece et al. 1997). Technological competencies are reflected by the extent to which the firm's market position is protected by (1) (superior) know-how of products and production systems, and (2) (technological) knowledge and experience. Organizational competences are reflected by the extent to which, compared to competitors, personnel is better educated and motivated, the organization is better managed, and developments in the market are better anticipated.[18] Marketing skills are reflected by the benefits that the firm

[17] Given the importance of the strategy constructs for this study, we took additional steps to establish the validity of the dimensions identified. First, we corroborated the three dimensions using a second set of items measuring the importance of several performance dimensions 'for achieving the firm's strategy'.[17] While the items to measure strategy were located on page 6 of the questionnaire, the items measuring importance of performance dimensions for strategy realization were located on page 19, mitigating 'matching or memory' effects. In addition, items expected to belong to one dimension were presented in mixed order.Factor analysis of these items similarly yields a well-interpretable three-factor solution, reflecting the same strategy dimensions. Correlations between the matched strategy dimensions and importance dimensions are strong, and are substantially weaker for the non-matching dimensions. Second, we split the sample into respondents at the firm-level (*N*=205) and at the BU or location level (*N*=182). A qualitatively similar factor solution was derived in the sub-samples, indicating no differences caused by organizational position. Correlations between the factor scores for the full sample and those in the two sub-samples provides correlations ranging from 0.968 - 0.995, indicating convergence across the samples.

[18] One item, relating to the degree of cooperation with business partners, was deleted from the construct measurement because of a low item communality and bad fit with the factor solution.

receives from its brand name. A strong brand name reflects strong marketing skills and is a valuable and durable resource that is not easily replicated by other firms.

Two factors emerged from the factor analysis, relating to (1) *organizational competencies* and (2) *technological competencies*. Although marketing skills did not form a separate factor in the analysis, it also did not fit with the other two factors (factor loading <0.30), and therefore is included in the analyses separately. All response categories (1=not applicable to us – 7=very applicable to us) of the items reported in Table 5 were used. In addition, the correlations between factors (see also Table 8) show that different competencies relate positively to each other, in particular organizational and technological competencies. This is consistent with the argument that competencies in combination reinforce each other, leading jointly to greater value than the individual parts (Spanos & Lioukas, 2001), and also indicates the need to model interdependencies between the different competencies.

Table 5: Measurement of competencies

Indicators	***Mean***	***sd***	***Factor loading***		
Constructs			***Organ.***	***Techn.***	***Market.***
We have qualitatively better educated personnel than our competitors	4.39	1.29	0.47		
Our employees are more motivated than those of our competitors	4.35	1.18	0.84		
Our company is internally better managed than our competitors are, we have better management	4.31	1.29	0.70		
We are better than others able to predict market developments and to anticipate on them	4.19	1.24	0.48		
Our market position is protected by our (technological) knowledge and experience	4.44	1.50		0.92	
Our market position is protected by our superior (technical) know-how of products and production systems	3.96	1.54		0.71	
We owe a large part of our success to our brand name	4.80	1.56			-
Cronbach Alpha			**0.71**	**0.79**	**-**

KMO Measure of Sampling Adequacy = 0.63; Bartlett's test of sphericity = 0.000

Environmental uncertainty

We measured environmental uncertainty based on the items used in Tan and Litschert (1994), which are based on Khandwalla (1977). This measurement instrument is (with small adaptations) widely used in the literature (e.g. Baines & Langfield-Smith, 2003; Gordon & Narayanan, 1984; Govindarajan, 1984) and asks respondents to rate the extent to which they perceive the environment of their firm has changed in the last three years with respect to the mentioned items (see Table 6). Since we are primarily interested in the effects of uncertainty related to market and technological changes, we excluded items related to changes in the macro-economic environment and government policy. Three items reflect market uncertainty, relating to the changes in actions of competitors and suppliers, and in customer preferences. Two items reflect

technological uncertainty, following from changes in production technologies and knowledge, and development of new products and services in the sector.[19] All items were measured on a seven-point scale (1 = little change – 7 = much change) and all response categories were used.[20] The Cronbach alpha of the construct is 0.68.

Table 6: Measurement of uncertainty

Indicators	*Mean*	*sd*	*Factor loadings*[#]
Market activities of competitors	5.03	1.38	0.52
Customer demands, tastes and preferences	5.26	1.18	0.57
Supplier's actions	4.26	1.37	0.41
Production technologies and knowledge	4.36	1.43	0.60
Development of new products/services in the sector	4.45	1.54	0.64
Cronbach Alpha			**0.68**

KMO Measure of Sampling Adequacy = 0.70; Bartlett's test of sphericity = 0.000

Technology

Technology was conceptualized as consisting of two related task dimensions, *task repetitiveness* and *task knowledge* (Perrow, 1970). To measure task technology, we followed Abernethy & Brownell (1997), who used the Withey et al. (1983) instrument to measure both task analyzability (task knowledge) and number of exceptions (task repetitiveness). Given the extensive length of the questionnaire, we chose to use four items for each dimension, as shown in Table 7.[21] All items are measured on a 7-point scale (1 = very little – 7 = very much), and all response categories are used. Table 7 shows that the first factor captures the repetitiveness of task technology, and the second factor knowledge of tasks. The correlation between the dimensions (r=0.49; see Table 8) is consistent with expectations and prior studies (e.g., Abernethy & Brownell, 1997; Daft & Macintosh, 1981; Perrow, 1970; Withey et al. 1983). The reliability of the constructs is adequate (Cronbach α = 0.91 and 0.78, respectively).[22]

[19] Although exploratory factor analysis yields one factor with an Eigenvalue of 2.21, the second Eigenvalue is close to one (0.98). Estimating a two-factor solution discriminates between technological and market uncertainty. The structural model results are very similar when using a two-factor solution.

[20] A concern is that respondents at lower organizational levels perceive uncertainty different than at higher management levels (e.g. Tymon, et al., 1998). We examined the factor solution for differences between respondents at the firm level and at the BU / location level. Although some minor differences in item loadings emerged, the pattern of loadings is generally similar between the two response levels.

[21] We omitted the items "To what extent is there an understandable sequence of steps that can be followed in doing the work in your production units?" and "Basically, unit members perform repetitive activities in doing their jobs", which are very similar to two other items in the measurement instrument.

[22] As expected, firms that report the nature of their primary operations to include the manufacturing of products report to have significantly more repetitive tasks and more task knowledge than non-manufacturing firms (both constructs p<0.01), while firms that provide services have significantly less repetitive tasks and task knowledge than firms not providing services (both p<0.05).

Table 7: Measurement of technology

Indicators	*Mean*	*sd*	*Factor loadings*	
			Repet.	*Know.*
How repetitive are the activities in your production units?	5.55	1.38	0.82	
To what extent would you say that the activities in your production units are routine?	5.03	1.46	0.99	
How many of the tasks in your production units are the same from day to day?	4.71	1.58	0.88	
How many people in your production units do the same tasks in the same way most of the time?	4.86	1.25	0.56	
To what extent is there an understandable sequence of steps that can be followed in carrying out the work in your production units?	5.59	1.04		0.52
To what extent is there a clearly known way to do the major types of work normally encountered in your production units?	5.23	1.11		0.71
To what extent is there a clearly defined body of knowledge of subject matter which can guide the work done in your production units?	5.47	1.02		0.82
To do the work in your production units, to what extent can personnel actually rely on established procedures and practices?	5.03	1.39		0.58
Cronbach Alpha			**0.91**	**0.78**

KMO Measure of Sampling Adequacy = 0.87; Bartlett's test of sphericity = 0.000

Control variables

Firm size is included as a control variable, since size may relate to both technology choices and MCS design (Chenhall, 2003). Larger organizations tend to operate more different product lines using more mass production techniques, are more divisionalized and likely make greater use of sophisticated controls, while generating more external information (Khandwalla, 1977). Larger firms are also expected to have more resources available to build more extensive MCS. Including size also controls for possible associations with firms' strategy choices, competencies and experienced uncertainties. In addition, an indicator variable is included for the organizational level of the respondent, denoting whether this is tot management level at the firms' head quarters (1) or at the level of the BU or independent location (0).

Table 8 provides Pearson correlations between the construct measures.

Table 8: Correlations among the model variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. PM extens.														
2. Intensity of use	0.33***													
3. Action controls	0.11**	0.05												
4. Teams	0.25***	0.21***	0.13***											
5. Innovation	0.30***	0.22***	-0.10**	0.13***										
6. Cust.-quality	0.40***	0.22***	0.04	0.13***	0.32***									
7. Low-cost	0.26***	0.15***	0.12**	-0.01	-0.09*	0.12**								
8. Env. uncertainy	0.25***	0.19***	-0.09*	0.20***	0.47***	0.06	0.24***							
9. Techn.comp.	0.18***	0.06	-0.03	0.11**	0.19***	-0.03	0.25***	0.18***						
10. Org.comp.	0.39***	0.17***	0.04	0.01	0.26***	0.02	0.23***	0.14***	0.27***					
11. Mark.comp.	0.13**	0.13***	-0.02	0.01	0.24***	0.05	0.14***	0.13***	0.10**	0.25***				
12. Repetitiveness	0.09*	0.07	0.45***	0.11**	-0.02	0.15***	0.02	-0.10**	-0.15***	-0.05	0.04			
13. Knowledge	0.22***	0.22***	0.46***	0.18***	0.01	0.09*	0.16***	0.00	0.07	0.06	0.11**	0.49***		
14. Size	-0.08	0.11**	0.05	0.11**	0.09*	0.02	0.08	0.09*	0.03	-0.08*	0.16***	0.08	0.09*	
15. Position	0.15***	-0.01	0.00	0.08	0.09*	-0.01	0.02	-0.09*	-0.04	0.16***	0.01	0.13**	0.07	-0.21***

***, **, * indicate a p value of $\leq$ 0.01, 0.05 and 0.10 in a two-tailed test. N=387.

Table 8 shows that PM extensiveness and intensity of use correlate positively with each other and with most other model variables. PM extensiveness correlates most strongly with emphasis on a customer-quality strategy and with organizational competencies. Intensity of use correlates almost evenly strong with strategic emphasis on customer-quality and innovation, task knowledge and the use of teams. PM extensiveness and intensity of use also correlate positively with environmental uncertainty, indicating that uncertainty is associated with use of more (diverse) performance measures and more complex forms of communication (Chapman, 1997). The use of other controls also correlates with the model variables, in particular the use of action controls with task knowledge and repetitiveness. Teams are used more often when environmental uncertainty increases and with enhanced task knowledge. The independent variables also exhibit relationships with each other. In particular, more emphasis on an innovation strategy or customer-quality strategy is associated with increased environmental uncertainty and with enhanced technological, organizational and marketing competencies. Emphasis on a low-cost strategy is associated with task knowledge and repetitiveness. While an innovation strategy is unrelated to the technology variables, a customer-quality strategy is also associated with task knowledge. The correlations further show that environmental uncertainty is positively associated with technological, organizational and marketing competencies, while it is negatively associated with task repetitiveness. The different dimensions of competencies are also interrelated, which is also the case for the technology dimensions. These correlations indicate the importance of modeling interdependencies (i.e. covariances) among the independent variables in estimating their effects on MCS design.

Model analyses and results

To test our predictions we use ML estimation of the structural models developed in the prior sections, using LISREL 8.72 (Jöreskog & Sörbom, 1999). Given the large number of variables and relationships analyzed relative to the sample size, for all constructs we include factor scores in the model, reducing the number of paths to be estimated. To still filter out measurement error, one of the main benefits of SEM, we fix a proportion of error variance by multiplying the factor's unreliability (i.e. 1-Cronbach α) with the estimated total variance (Jöreskog & Sörbom, 1999). For single item indicators (size and brand name), we use a subjectively determined error of 0.20 for this purpose (see Anderson & Dekker (2005) for a similar procedure).

A combination of model fit statistics is used to assess the extent to which the estimated model fits the sample data, and to increase the probability of rejecting false models and not rejecting 'true' models (Hu & Bentler, 1999). The goodness-of-fit index (GFI), standardized root mean residual (SRMR), and root mean squared error of approximation (RMSEA) indicate how well the model reproduces the sample data. In addition, the non-normed fit index (NNFI) and comparative fit index (CFI) compare

the discrepancies from a null-model with the discrepancies from the fitted model to assess the extent to which specifying relationships improves model fit. Recommended cutoff values are 0.08 for SRMR, 0.06 for RMSEA and 0.95 for GFI, NNFI and CFI, with 'loosened' values for combinations of measures (Fan et al., 1999; Hu & Bentler, 1999). Since by including factor scores, the model estimates are not influenced by the measurement model, the fit statistics reflect how well the specified structural model is able to reproduce the underlying data. Model paths are assessed by inspecting the direction, significance and strength of parameter estimates. In addition, we discuss the covariances between the exogenous variables and between the endogenous variables, showing how strategy, competencies and uncertainties, and the different MCS dimensions relate to each other.

Extensiveness and intensity of PMS use

The first analysis of PM use tests the expectation that more emphasis on any strategy dimension is associated with (1) more extensive PM use and (2) more intense use of these measures for different purposes (H1 and H2). Since PM extensiveness and intensity of use are likely interrelated, we specify a covariance between these dependent variables (cf. Anderson & Dekker, 2005). In addition, we specify covariances with the two other types of control which are simultaneously modeled as dependent variables: action controls and teams.[23] Similarly, we specify covariances between environmental uncertainty, strategies and competencies, and between task repetitiveness and knowledge. Table 9 presents the results of this analysis.

[23] Following Abernethy & Lillis (1995), we also included two other types of control: *regular meetings* and *spontaneous contact/meetings*. While the use of regular meetings is only significantly positive associated with task knowledge, the frequency of spontaneous contacts is unrelated to the exogenous variables. Looking at interdependencies between the dependent variables, the frequency of spontaneous meetings is, however, positively associated with the use of teams and regular meetings, while the use of regular meetings is also positively associated with PM extensiveness, action controls and problem solving teams.

Table 9: Analysis of PM extensiveness and intensity of use

Independent variables	*Repet. Tasks*	*Know. Tasks*	*PM Extens.*	*Intens. of use*	*Action controls*	*Teams*
Innovation strategy	-0.07	-0.11	0.10	0.20	-0.11	-0.21
	-0.98	*-1.35*	*1.32*	*1.53*	*-0.96*	*-0.91*
	-0.07	-0.11	0.15	0.19	-0.11	-0.12
Low-cost strategy	0.18***	0.07	0.19***	0.18**	0.04	-0.15
	2.65	*1.00*	*4.34*	*2.33*	*0.61*	*-1.12*
	0.18	0.07	0.29	0.17	0.04	-0.09
Customer-quality strategy	-0.02	0.23***	0.17***	0.07	-0.03	0.10
	-0.20	*2.89*	*3.44*	*0.85*	*-0.37*	*0.68*
	-0.02	0.23	0.26	0.07	-0.03	0.06
Technological competencies			-0.02	-0.09	-0.02	0.16
			-0.47	*-1.28*	*-0.25*	*1.27*
			-0.03	-0.09	-0.02	0.09
Organizational competencies			0.23***	0.13	0.16**	-0.13
			4.51	*1.51*	*2.09*	*-0.85*
			0.34	0.13	0.16	-0.08
Marketing competencies			-0.05	0.03	-0.07	-0.06
			-1.31	*0.39*	*-1.28*	*-0.54*
			-0.08	0.03	-0.08	-0.04
Environmental uncertainty			0.07	0.05	-0.03	0.63***
			1.04	*0.42*	*-0.30*	*3.04*
			0.11	0.05	-0.03	0.37
Task repetitiveness			-0.02	-0.10	0.29***	0.00
			-0.47	*-1.35*	*4.16*	*0.00*
			-0.03	-0.10	0.29	0.00
Task knowledge			0.13***	0.28***	0.43***	0.38***
			2.61	*3.34*	*5.71*	*2.63*
			0.19	0.28	0.44	0.22
Size	0.19***	0.16**	-0.08*	0.07	-0.01	0.27**
	2.77	*2.12*	*-1.72*	*0.94*	*-0.09*	*2.01*
	0.17	0.14	-0.10	0.06	-0.01	0.14
Position	0.23***	0.15**	0.05	-0.05	-0.14**	0.39***
	4.11	*2.48*	*1.35*	*-0.78*	*-2.32*	*3.36*
	0.23	0.15	0.08	-0.05	-0.14	0.23
R^2	9%	9%	56%	22%	46%	21%

Cell statistics are unstandardized coefficient, *t* value and completely standardized coefficient.
***, **, * indicate a *p* value of ≤ 0.01, 0.05 and 0.10 in a two-tailed test. GOF statistics: *df* = 8, χ^2=20.23 (*p*=0.01), *RMSEA*=0.062, *SRMR*=0.015, *GFI*=0.99, *CFI*=0.99, *NNFI*=0.85.

Although the χ^2 statistic is significant, all other fit statistics indicate the model reproduces the sample data well. Focusing first on PM extensiveness, the results show that the independent variables contribute significantly to explaining 56% of the variance in PM extensiveness. The coefficient estimates indicate that more emphasis on a low-cost or customer-quality strategy is associated with more extensive use of PM information, consistent with H1. The positive though non-significant effect for innovation strategy may relate to the relative difficulty to develop comprehensive and structured PMS for effectively coordinating and controlling innovative activities (e.g., Davila, 2000). The results further show that enhanced organizational competencies

are associated with more extensive PM, indicating that more comprehensive PMS are used to support organizational capabilities. Technological and marketing competencies are however unrelated to PM extensiveness, providing only partial support for H7. Contrary to H10, environmental uncertainty is not significant associated with PM extensiveness. In contrast to H12, standardization of task technologies is unrelated to PM extensiveness. However, consistent with H14, task knowledge is also significantly positively associated with extensiveness of PM use. Size, finally, has a marginally significant negative effect, indicating that larger firms use PM information less extensively.

Turning to the *intensity* of PM information use, the results show that although the variance explained is lower (R^2=22%), more emphasis on a low-cost strategy is also associated with more intensive PM use. Emphasis on a differentiation strategy, by emphasizing innovation or customer-quality, is not significantly associated with intensity of PM use. These results thus only partially support H2, and document that type of strategy is important in explaining intensity of PM use. Inconsistent with H8, H11, and H13, competencies, environmental uncertainty and task repetitiveness have no significant influence on the intensity of PM use. However, task knowledge has a significant positive effect, supporting H15. We further observe a positive and significant covariance between PM intensity and extensiveness (consistent with Table 8), indicating that more extensive PM use is associated with use for multiple purposes.

Looking at the other two types of control, Table 9 shows that action controls are associated with enhanced organizational competencies, and are used more often when task knowledge and repetitiveness are high. These are conditions that enable the writing of effective standardized task procedures. Position is negatively associated with the use of action controls, indicating that respondent at a higher firm level report less use of action controls. Problem solving teams are also used more often when more task knowledge is present and in larger firms. In addition, environmental uncertainty is strongly associated with the use of these teams. Respondent position has a significant positive effect, indicating such teams are used less frequently when respondents are at the BU or location level. Analyses of the covariances between these endogenous variables, which control for the influence of all exogenous variables, further show the use of problem solving teams is significantly associated with both PM extensiveness and intensity of use, indicating PM information is an important element in the functioning of these teams. Action controls are not significantly associated with the use of other control mechanisms.

For the explanation of the two technology dimensions, the R^2 values suggest that the model variables only moderately explain the dimensions of technology. As expected, emphasis on a low-cost strategy is associated with more repetitive tasks (which in turn leads to an increased use of action controls). Firms emphasizing a customer-quality strategy further have significantly more task knowledge, which in turn (i.e., indirectly) allows more extensive and intensive PM use. Firm size and

position also show significant effects, indicating that larger firms and respondents at the firm level report more repetitive tasks and task knowledge than smaller firms and respondents at the BU / location level.

An analysis of the estimated model covariances between the exogenous variables (unreported) as expected shows several significant associations between strategic priorities, environmental uncertainty and competencies. More emphasis on both innovation and customer-quality strategies is positively associated with increased uncertainty and with enhanced organizational, technological and marketing competencies (see also Table 8). Emphasis on a low-cost strategy is not significantly associated with any other exogenous factor. The execution of a differentiation strategy - by innovation, customer-quality, or both - thus appears to require a broad set of firm competencies and is associated with higher environmental uncertainty than is a cost-based strategy.

Somewhat surprising in these results is that environmental uncertainty has no significant effects on PM use or the other dimensions of control, except for the use of problem solving teams. This is in contrast with H10 and H11, and with Table 8, which showed positive and significant correlations between uncertainty and PM extensiveness and intensity of use. Thus by including additional model variables, such as strategy and competencies, the direct effects of uncertainty become insignificant, suggesting uncertainty influences control design through its association with other variables. Estimating a structural model that excludes the strategy dimensions supports this reasoning. The results (unreported) show that environmental uncertainty significantly influences both PM extensiveness ($p<0.01$) and the intensity of use ($p<0.01$). In addition, it is significantly associated with the use of teams ($p<0.01$) and regular meetings ($p<0.10$) and negatively associated with the use of action controls ($p<0.10$[24]). Jointly, these results indicate that firms' strategic choices are strongly associated with uncertainty, and that these choices generate a need for PM information. This is in contrast with environmental uncertainty *independently* affecting MCS design choices.

In sum, Table 9 provides evidence that emphasis on different types of strategy is differently associated with extensiveness and intensity of PM use. This model, however, does not provide insight into the nature of the PM information used. We turn to this issue in the following analyses that differentiate between PM dimensions.

Use of PM dimensions

Table 10 provides the results of the model analysis with the seven different PM dimensions as the dependent variables. Since the free paths in the model are similar to Table 9, model fit is identical (except for NNFI and SRMR which take into account model complexity). Looking first at the effects of the different strategic priorities, the

[24] In this model, the R^2 of *PM extensiveness* drops to 41%, for *Intensity of use* R^2 drops to 17%, for *Action controls* to 45% and for *Teams* to 20%.

results show that emphasis on different strategies is associated with use of different PM dimensions, consistent with H3. Thus the results support that different types of performance measures are needed to support and implement different strategies. Emphasis on an innovation strategy is positively associated with innovation, market outcome and cost measures. These measures reflect the degree and effectiveness in terms of sales, market share and profit of innovation, and the inputs (cost) consumed to achieve these outcomes. More emphasis on a low-cost strategy is associated with more measures related to cost & efficiency, employees and production (systems). The standardized effect on the cost & efficiency type measures is particularly strong, suggesting that intensive measurement of efficiency and cost levels is crucial to support a cost-based strategy. A similar argument holds for the measurement of production (in particular the measurement of production volume, timely expansion of capacity and efficiency improvements). The reason for emphasis on measuring employees, however, appears to be related to the potentially high cost of personnel turnover (e.g. the cost of regularly training new employees and loss of routines); personnel satisfaction and retention likely are key drivers of successfully executing this strategy.

Emphasis on a customer-quality strategy is associated with increased measurement of the quality and management dimensions. Measuring managers in terms of flexibility, cooperativeness, development, loyalty and interaction with employees seems crucial when pursuing a strategy based on specific knowledge possessed by organizational participants, in order to further develop and retain this knowledge. Indeed, the positive significant covariation between a customer-quality strategy and organizational skills (that include superior employee and managerial competencies) underscores the importance of carefully monitoring the firm's human capital. Measuring quality outcomes is logically related to the nature of this strategy and seems essential for supporting and measuring its effective implementation.

Table 10: Use of PM dimensions

Independent variables	*Mark.*	*Innov.*	*Prod.*	*Cost*	*Qual.*	*Man.*	*Empl.*
Innovation strategy	0.29**	0.27**	-0.17	0.32**	-0.10	-0.09	0.02
	2.09	*2.24*	*-1.13*	*2.24*	*-0.69*	*-0.60*	*0.17*
	0.30	0.29	-0.16	0.32	-0.10	-0.08	0.02
Low-cost strategy	-0.02	-0.07	0.19**	0.85***	-0.13	0.11	0.19**
	-0.29	*-0.97*	*2.16*	*10.04*	*-1.56*	*1.36*	*2.44*
	-0.02	-0.07	0.18	0.85	-0.13	0.11	0.18
Customer-quality strategy	0.14	0.01	0.16	-0.10	0.46***	0.25***	0.11
	1.56	*0.14*	*1.58*	*-1.14*	*4.75*	*2.67*	*1.20*
	0.15	0.01	0.15	-0.11	0.45	0.24	0.10
Technological competencies	-0.12	0.16**	0.20**	-0.02	0.03	-0.09	-0.21***
	-1.58	*2.33*	*2.43*	*-0.28*	*0.42*	*-1.08*	*-2.75*
	-0.12	0.16	0.19	-0.02	0.03	-0.08	-0.20
Organizational competencies	0.15*	0.05	0.02	0.05	0.01	0.34***	0.60***
	1.65	*0.56*	*0.19*	*0.56*	*0.10*	*3.59*	*6.44*
	0.15	0.05	0.02	0.05	0.01	0.32	0.56
Marketing competencies	0.01	-0.01	-0.14*	-0.08	0.11	-0.07	-0.10
	0.19	*-0.17*	*-1.85*	*-1.20*	*1.50*	*-1.03*	*-1.51*
	0.01	-0.01	-0.14	-0.09	0.12	-0.08	-0.11
Environmental uncertainty	-0.04	0.18*	0.12	-0.19	0.24*	0.09	0.02
	-0.34	*1.67*	*0.91*	*-1.50*	*1.83*	*0.70*	*0.15*
	-0.04	0.19	0.12	-0.19	0.23	0.08	0.02
Task repetitiveness	0.16*	-0.01	0.24***	-0.08	0.04	-0.17**	-0.22***
	1.95	*-0.16*	*2.68*	*-0.93*	*0.46*	*-1.99*	*-2.81*
	0.17	-0.02	0.23	-0.08	0.04	-0.16	-0.22
Task knowledge	-0.10	0.21***	-0.09	0.18**	0.12	0.14	0.21**
	-1.13	*2.72*	*-0.91*	*2.10*	*1.24*	*1.54*	*2.46*
	-0.11	0.23	-0.08	0.18	0.11	0.13	0.20
Size	-0.13	-0.10	-0.02	0.00	-0.36***	-0.05	0.12
	-1.61	*-1.43*	*-0.27*	*0.01*	*-4.29*	*-0.58*	*1.51*
	-0.12	-0.10	-0.02	0.00	-0.32	-0.04	0.10
Position	0.08	0.11*	-0.05	0.04	0.05	0.06	-0.01
	1.23	*1.76*	*-0.71*	*0.56*	*0.63*	*0.80*	*-0.08*
	0.09	0.12	-0.05	0.04	0.04	0.05	-0.01
R^2	23%	37%	18%	69%	39%	23%	37%

Cell statistics are unstandardized coefficient, *t* value and completely standardized coefficient.
***, **, * indicate a *p* value of ≤ 0.01, 0.05 and 0.10 in a two-tailed test. GOF statistics: *df* = 10, χ^2=20.23 (*p*=0.01), *RMSEA*=0.062, *SRMR*=0.014, *GFI*=0.99, *CFI*=0.99, *NNFI*=0.83.
Note: The effects on task repetitiveness and knowledge are identical to those reported in Table 9.

The other relationships in the table also provide support for contingency predictions. The effects of the competency variables provide some support for H9 that different types of competencies are supported by different types of performance measures. Organizational competencies are positively and significantly associated with both manager and employee type measures, and also marginally significant with market outcomes. Enhanced organizational competencies thus seem to be well supported by measurement of critical human resources.[25] Technological competencies, on the other hand, are positively associated with the use of innovation ad production (systems) measures, while they are negatively associated with employee type measures. Thus

[25] Tuomela (2005) similarly finds in a company pursuing a customer-oriented strategy that the substantial importance placed on organizational competencies is associated with a focus on personnel skills, reflected in measures such as development of personnel abilities and education.

advanced technological skills seem to be supported by measurement of performance related to innovation and production (systems). We have no explanation for the significant negative association with employee measures. Marketing competencies are generally unrelated to PM and show only a marginally significant negative relationship with production (systems) measures.

Task knowledge is positively associated with use of innovation, cost and employee measures. Task repetitiveness is positively associated with the use of market outcomes and production (systems) measures. Since repetitive tasks allow standardization of processes, this may reduce the overall need for performance measurement (as also indicated by the increased use of action controls in Table 9) and shift the attention to global outcome controls.[26] The positive association with production (systems) measures indicates that these measures are useful to support the standardization of production methods. The negative association with manager and employee measures on the other hand appears to indicate that manager and employee issues, such as training, loyalty and satisfaction, are less important for repetitive tasks, likely since standardization allows easier replacement of personnel possessing less specific skills and knowledge.[27]

Environmental uncertainty again has no strong associations with PM choices, and is only marginally significant associated with use of innovation and quality type measures. Given the strong associations between environmental uncertainty and strategy (Table 8), this again provides support that uncertainty predominantly affects PM design through strategic choices, and not directly. This is supported by estimating a model that excludes the strategy dimensions. For all PM dimensions R^2 reduces significantly. Nevertheless, in this model environmental uncertainty is significantly associated with the use of innovation measures ($p<0.01$), market outcome measures ($p<0.05$), and quality measures ($p<0.01$). These effects thus substantially reduce in strength, once information is added about firms' strategic orientation. Accordingly, we conclude from Table 10 and this additional analysis that PM choices are primarily driven by firms' strategic choices, which are strongly associated with the possession of specific competencies and the choice of environment to operate in.

Complementarities between strategic choices and the effects on PM use

The results presented in Tables 9 and 10 provide evidence of the influence of individual strategies on PM use. Several studies, however, argue and find that strategies are often pursued in combination (e.g., Chenhall & Langfield-Smith 1998;

[26] Indeed Table 9 shows that repetitive tasks are significantly associated with the use of standardized work methods. Although the same holds for task knowledge, the difference appears to be that task knowledge *reduces* the cost of information collection, while repetitive tasks allow mitigating costs of information systems in instances where measurement may be less efficient.

[27] Consistent with this, we find that task repetitiveness correlates significantly negative with an item measuring the extent to which professional knowledge is required for the operations ($r= -0.18$, $p<0.01$).

Chenhall, 2003; Hill, 1988; Ittner et al., 2003; Murray, 1988). Indeed the positive correlations between strategic priorities in Table 8 provide evidence that the strategies identified in this study are often emphasized simultaneously. To further examine the influence of complementarities between strategic priorities on PM use, subgroups were created by classifying firms below or above the median score for each type of strategy. This generates eight subgroups, with firms placing a relatively low emphasis on any strategy (0), firms emphasizing mainly one strategy (1), firms pursuing a combination of two strategies (2), and firms emphasizing all three strategies (3), when their construct score for each strategy is higher than the sample median. While 56 firms have no explicit strategic priority, 118 emphasize one strategy, most often low-cost. The pursuit of combined strategies is observed more frequently. Emphasis on two strategies simultaneously is mostly oriented towards both innovation and customer-quality (see also the correlation of 0.32 in Table 8). A combination of all three strategies is observed most often (in 22% of all cases), underscoring the importance of studying strategic choices not in isolation.

Figure 2 graphs the mean intensity and extensiveness of PM use for the different strategy combinations. The figure shows that the mean group scores on both PM extensiveness and intensity of use increase with an increasing emphasis on multiple strategies. ANOVA tests (see Table 11) indicate these differences are significant for both PM dimensions ($p<0.01$). These analyses are consistent with the prior findings and support H5 and H6 by showing that emphasizing multiple dimensions of strategy leads to increasing use of PM information.

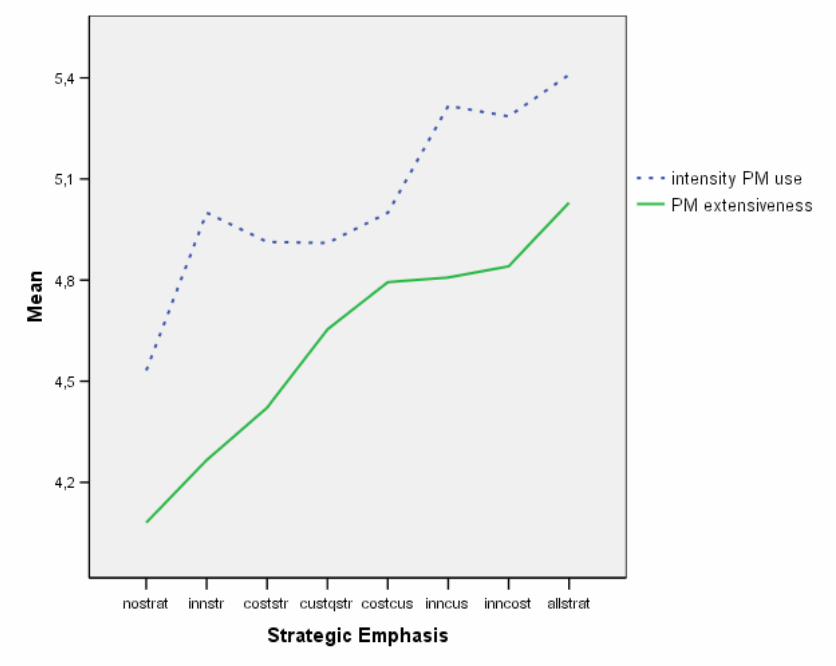

Figure 2 Strategy combinations and PM use

Table 11 details these results for the different PM dimensions (to enhance interpretation mean scores for the PM constructs are used).

Table 11: Strategy combinations and PM use

	PM Extens.	Int. of use	Market outc.	Innov.	Prod.	Cost	Quality	Man.	Empl.
0. No str (56)	4,08	4,53	4,61	3,43	3,54	4,29	4,58	4,08	3,71
	0,61	*0,96*	*1,19*	*1,15*	*1,06*	*0,79*	*0,97*	*0,86*	*0,99*
1. Inn str (31)	4,27	5,00	5,29	3,84	3,39	4,56	4,56	3,96	3,81
	0,59	*0,92*	*0,96*	*1,15*	*1,04*	*0,98*	*0,76*	*1,03*	*1,23*
1. Cost str (67)	4,42	4,91	4,79	3,42	4,45	5,54	4,54	4,19	4,03
	0,64	*0,88*	*1,32*	*1,32*	*1,04*	*0,83*	*0,87*	*0,95*	*0,94*
1. Cust str (20)	4,65	4,91	4,97	3,56	4,25	4,86	5,37	4,74	4,44
	0,61	*1,11*	*1,33*	*1,42*	*1,14*	*0,75*	*0,78*	*1,03*	*0,99*
2. Cost cust (35)	4,79	5,00	5,20	3,63	4,36	5,40	5,35	4,88	4,44
	0,69	*1,03*	*1,03*	*1,32*	*1,32*	*0,77*	*1,02*	*1,10*	*1,02*
2. Inn cust (65)	4,81	5,32	5,27	4,66	4,25	4,96	5,42	4,63	4,26
	0,65	*0,91*	*1,40*	*1,05*	*1,10*	*0,99*	*0,93*	*1,00*	*1,07*
2. Inn cost (28)	4,84	5,29	5,05	4,19	4,36	5,62	5,09	4,86	4,56
	0,56	*0,90*	*1,03*	*1,23*	*1,13*	*0,55*	*0,86*	*0,93*	*0,93*
3. All str (85)	5,03	5,41	5,53	4,26	4,58	5,58	5,41	4,89	4,71
	0,74	*0,96*	*1,13*	*1,48*	*1,27*	*1,01*	*1,05*	*1,01*	*1,10*
Sample (387)	4,63	5,08	5,11	3,93	4,20	5,15	5,04	4,52	4,25
	0,73	*0,98*	*1,24*	*1,35*	*1,21*	*1,00*	*1,01*	*1,04*	*1,09*

Cells contain subgroup mean and standard deviation (in italics). Subgroup sample sizes between brackets. Group means for all PM dimensions differ significantly at $p < 0.01$.

For each PM dimension, ANOVA analyses show that generally the mean PM use increases with increasing emphasis on multiple strategies. Six out of seven PM dimensions are on average most extensively used by firms emphasizing all three strategies. The table further shows some interesting patterns when looking at firms that have a single strategic priority or that emphasize two. Market outcome measures are used relatively much by firms emphasizing innovation, alone or in combination with customer-quality. Innovation measures are used most extensively by firms pursuing an innovation and customer-quality strategy. Production measures are used much by firms emphasizing low-cost, alone or in combination with innovation or customer-quality. Similarly, cost measures are used most extensively by firms emphasizing low-cost, either alone, or in combination with the other strategies. Quality measures are used most extensively when firms emphasize customer-quality, or combine this with emphasis on innovation or low-cost. Manager measures are used more extensive by firms emphasizing customer-quality alone, and firms combining any two strategies. Finally, employee measures are used more extensively by firms emphasizing low-cost and innovation.

Conclusion

This paper develops and empirically tests a comprehensive model of firms' management control system design. Contingency literature posits that firms' strategic choices exert a key influence on these design choices, and provides the alignment hypothesis that different strategic choices require different configurations of management control systems. In our empirical analyses, we conduct a comprehensive analysis of firms' performance measurement systems and relate this to strategic priorities and firm contingencies. The results are consistent with contingency predictions, and show that increasing strategic emphasis on low-cost or customer-quality is associated with more extensive use of performance information. Emphasis on a low-cost strategy is also associated with more intensive use of performance information for multiple purposes. However, depending on the strategic priorities pursued, firms use different types of performance measures. Increased emphasis on low cost is associated with increased measurement of cost, production and employee type measures. Increased emphasis on customer-quality is associated with increased measurement of quality and managerial measures. Increased emphasis on innovation is associated with more measurement of innovation, market outcomes and cost. The emphasis of multiple strategies simultaneously is associated with an even increasing level of performance measurement, combining measures that are associated with single strategies. Finally, the results indicate that performance measure choices are substantially influenced by organizational competencies and task technologies. Environmental uncertainty, which is strongly associated with strategic choices, however, has no distinct impact on performance measurement choices. However, when strategy is excluded from the analysis, uncertainty is strongly related to performance measurement choices. This finding suggests that strategic choices include the choice of environment to operate in, and by implication the use of particular measures. Jointly, these effects strongly support the influence of strategy as a leading factor in the design of management control systems. In addition, these strategic choices are associated with the presence of specific technological, organizational and marketing competencies, and with specific task technologies, which in turn are associated with management control choices.

An important contribution of this study, in addition to the analysis of the relation between strategy and MCS design, is the measurement of strategic priorities across a range of different industries. The innovation, customer-quality and low-cost strategies that are identified reflect broad and seemingly generic strategy dimensions applicable to different industries, and are consistent with the differentiation and cost-leadership strategies as defined by Porter (1985). Similarly, our detailed analysis of different performance measure dimensions, allowed by the relatively large sample, constitutes an important contribution. The seven complementary performance measure dimensions form a broad classification of performance measures and relate to

other multidimensional performance measurement frameworks, such as the balanced scorecard dimensions (Kaplan & Norton, 1996). Interestingly, in our analysis financial measures are spread over two performance categories that also include non-financial performance indicators and that look at the firm's internal efficiency (cost) and it's external effectiveness (sales, profit). Certainly within the identified dimensions (leading-lagging) relationships will exist among measures (e.g. improved capacity use reduces cost), however, exploring these linkages is beyond the scope of this study. The key conclusion developed here is that these performance dimensions relate to different dimensions of strategy, and to different elements of the firm's internal and external environment.

As with any study, the research design that we used is subject to a number of limitations. First, the model and data used cannot fully rule out issues of endogeneity and causality among variables. While we specify an effect of strategy on MCS design, the question is whether this effect over time may be reciprocal, with knowledge generated by the MCS feeding the strategy development process (e.g., Chenhall, 2005; Henri, 2006). The interactive use of MCS by top managers is a clear example of how MCS can contribute to the evolution and change of strategy (Simons, 1991, 1994). A longitudinal research design would be better able to answer questions of endogeneity and causality. Second, although we tried to comprehensively measure dimensions of performance measures, more dimensions might be used in practice that we did not capture. Finally, all data were collected from one key informant in the firm. Although all respondents occupy key positions in the firm, providing us confidence in their responses to our questions, survey research is always associated with concerns about common method bias. Despite these limitations, we believe this study presents a step further in the development of a contingency framework of MCS design.

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