8TH CONFERENCE ON PERFORMANCE MEASUREMENT AND MANAGEMENT CONTROL

TITLE: PERFORMANCE MANAGEMENT INFORMATION SYSTEMS: DO THEY CONVEY (SUSTAINABLE) COMPETITIVE ADVANTAGE?

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ABSTRACT

Performance management information systems (PMIS) have been a 'hot topic' for Chief Information Officers (CIOs) and Chief Financial Officers (CFOs) for close to a decade. PMIS range from low-functionality spreadsheet-based solutions through to high-functionality business intelligence solutions. As yet, this area has not yet received sufficient academic enquiry. Our research questions concern: what are PMIS functionalities, and whether and how do they contribute to competitive advantage? We conceptualize functionality as reflected by system usability and data multi-dimensionality. We examine functionalities of the two types of PMIS: performance planning systems (for budgeting and forecasting) and performance reporting systems (for reporting results information to management). We apply resource-based theory. We hypothesize mediation chains, in which the two PMIS functionality constructs link to competitive advantage, mediated by performance management capabilities and mediated by a resource-base of organizational culture. We use partial least squares path modelling using survey data collected from senior managers of 264 Australian firms. We find support for the hypotheses. We also unexpectedly find that the two types of PMIS functionality operate in sequential, rather than parallel, mediation. The findings have implications for CIOs, CFOs and other managers responsible for development of PMIS.

Keywords: business intelligence, competitive advantage, flexibility values, system functionality, organizational culture, performance management, resource-based theory, stability values.

PERFORMANCE MANAGEMENT INFORMATION SYSTEMS: DO THEY CONVEY (SUSTAINABLE) COMPETITIVE ADVANTAGE?

INTRODUCTION

There are many vendors and consultants for contemporary performance management information systems (PMIS). The 'high-functionality' variants of PMIS that they offer are based upon sophisticated business intelligence infrastructure, combining integrated data architecture and specialist applications (Chaudhuri et al. 2011; Chen et al. 2012; Clark et al. 2007; Elbashir et al. 2011). These high-functionality PMIS are often promoted as 'competitively advantageous' compared to the traditional alternative of a 'low-functionality' spreadsheet-based PMIS. In academia, where competitive advantage from information technology (IT) is an important long-standing question (e.g. Melville et al. 2004; Mithas et al. 2012), seasoned observers might well wonder if high-functionality PMIS are just another 'passing IT fashion' (Baskerville et al. 2009; Wang 2010). In the absence of related academic research, we examine the research questions concern: what are PMIS functionalities, and whether and how do they contribute to competitive advantage?

We draw from seminal academic literature (Ariav 1992) and diverse practitioner literature to conceptualize PMIS functionalities. Functionality is related to the ease, extent and speed of structured data processing and it is reflected by system usability and data multi-dimensionality (Ariav 1992). There are two types of PMIS: performance planning systems (PPS) and performance reporting systems (PRS). Practically all firms have a PPS and a PRS, with varying levels of functionality (Libby et al. 2010; Sivabalan et al. 2009). Thus, we develop conceptualizations for PPS functionality and for PRS functionality.

To develop our research model, we apply resource-based theory (Barney 1991; Penrose 1959; Wernerfelt 1984). Without resource-based deployment, PPS and PRS functionalities might provide a competitive advantage to early adopters; however, because every firm can procure them, any competitive advantage would erode as rivals also adopt them. For a persistent competitive advantage, a resource-base would provide an isolating mechanism, allowing only those firms that sufficiently possess that resource-base to fully deploy PPS and PRS functionalities. One example of such a resource-base is organizational culture (Barney 1986; Barney 1991). We study flexibility and stability values of organizational culture (Fey et al. 2003) and performance management capabilities, which are multilevel processes for emergent and intended strategy-making (Simons 1990; Simons 1994; Simons et al. 2000). In our research model, as shown in Figure 1, we hypothesize that PPS and PRS functionalities enable fuller expression of pre-existing cultural values in performance management capabilities, leveraging those cultural values as a source of persistent competitive advantage.

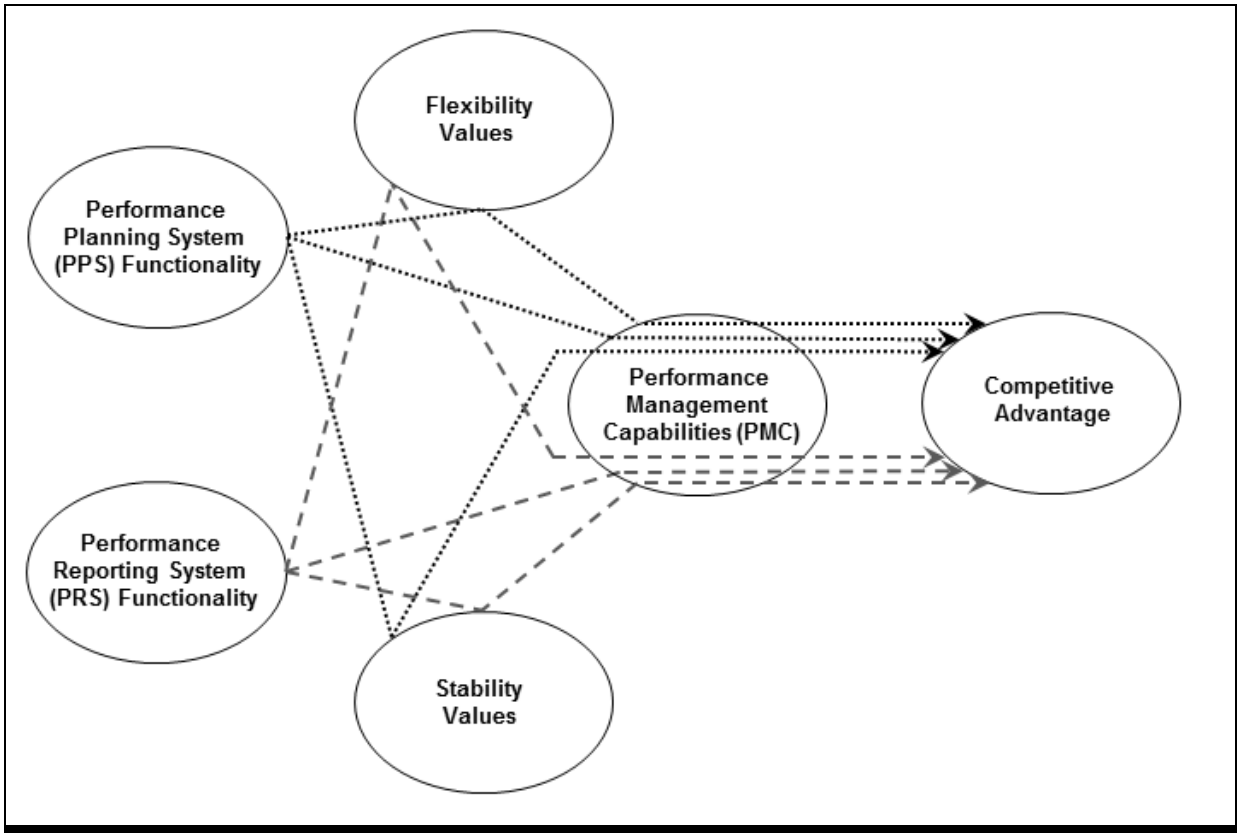


Figure 1. Research Model: Hypothesized Mediation Paths

We use partial least squares (PLS) path modelling to test the research model using survey data (n = 264) from senior managers of Australian firms. We find support for the hypotheses that PPS functionality makes performance management capabilities more competitively advantageous, and that flexibility values and stability values are important resource-bases. PRS functionalities are also evidenced to be competitively advantageous, but not as simply as hypothesized. Post hoc analyses reveal that PRS functionality affects performance management capabilities only when mediated by PPS functionality, with flexibility values and stability values also providing resource-bases for these effects. That is, PRS functionality is found to be mediated by PPS functionality.

We claim two main contributions to the academic literature. First, we respond to a call for research into management information system (MIS) functionality (Clark et al. 2007). We add to the limited literature on PMIS (Elbashir et al. 2011), which is a significant topic in industry where it is sometimes termed Enterprise Perfomance Management (Chaudhuri et al. 2011; Chen et al. 2012). Specifically, we extend prior PMIS research (Elbashir et al. 2011) by conceptualising and operationalising functionalities, by distinguishing between the two types of PMIS, and by linking to competitive advantage. Second, competitive advantage from MIS remains an important issue (e.g. Melville et al. 2004; Mithas et al. 2012). The resource-based theorization that we contribute has a nuanced perspective of organizational culture as latent and leverage-able. This perspective is different to, yet also consistent with, prior resource-based theorizations of organizational culture as rare and inimitable (Barney 1986; Barney 1991). Thus,

we contribute to the application and development of resource-based theory in the MIS literature (Oh et al. 2007; Wade et al. 2004) and also to the extensive literature concerning organizational culture and MIS (e.g. Bradley et al. 2006; Leidner et al. 2006).

The remainder of this paper is structured in the following order: overview of constructs; hypotheses development; research design; PLS analysis and results; findings summary and discussion; contributions, future research and limitations; conclusion and managerial implications.

OVERVIEW OF CONSTRUCTS

PMIS are a type of 'business intelligence' system (Chaudhuri et al. 2011), a term that broadly refers to management support systems for gathering, storing and accessing data for decision making (Clark et al. 2007; Fedorowicz et al. 1992). PMIS functionality depends on the sophistication of IT infrastructure, which may range from a highly manual series of spreadsheets through to integrated data architecture with specialist applications (Chaudhuri et al. 2011; Clark et al. 2007).

PPS and PRS are the two essential sub-systems of a PMIS, providing a comprehensive cybernetic feedback framework for use in performance management capabilities. Performance management data includes profit-planning, financial and non-financial data (Malmi et al. 2008). A PPS is used to produce budgets (e.g., annually) and forecasts (e.g., monthly) and contains historical data from the PRS as a basis for extrapolative modelling into future time periods. A PRS is for management reporting and analysis of performance measure outcomes (e.g., monthly, quarterly and year-end), to compare results with budgets or forecasts. A PRS is for the feedback stage of cybernetic control, and contains variance baseline data from PPS and historical data from transactional systems.

Functionality of a PPS or PRS, in general, relates to the ease, extent and speed of structured data processing. Specifically, this functionality reflects: (1) system usability, and (2) data multi-dimensionality (Ariav 1992). First, usability requires unified access and user manipulation of and between current, historic and future data cubes, where cubes comprise objects, attributes and time (Ariav 1992). Second, multi-dimensionality refers to the extent of objects, attributes and temporality (Ariav 1992). Objects include responsibility centre arrays (e.g., profit centre, revenue centre, cost centre), responsibility centre aggregation patterns (e.g., manager, regional, national), and plan versions (e.g., actual results, budget, forecast, latest forecast). Attributes refer to calculative elements (e.g., amounts, stock keeping units, employees). Temporal dimensionality refers to time periods (e.g., day, month, quarter, or year).

PPS functionality refers to the level of usability and multi-dimensionality of PPS, such that higher functionality enables faster creation and revision of more multi-dimensional budgets and forecasts.

PRS functionality refers to the level of usability and multi-dimensionality of PRS, such that higher functionality provides more customizable reports, more sophisticated formats and presentation features, and more multi-dimensional data structuring.

Performance management capabilities (PMC) are collective bundles of information-based routines for maintaining or altering operations in line with strategies and objectives (Simons 1995). We use a two-dimensional, emergent (i.e., second-order formative) construct conceptualization, comprising: (1) diagnostic PMC, and (2) interactive PMC. This framework is a comprehensive conceptualization of performance management practices and has widespread application in contemporary management accounting literature (Grafton et al. 2010; Simons 1990). Each dimension differs in style of use of perfomance management information, relating to either intended or emergent aspects of realised strategies (Mintzberg 1979). *Interactive PMC* are for emergent strategy-making, whereby top and lower managers frequently debate and develop emergent strategies using performance management information. *Diagnostic PMC* implement intended strategies, requiring top management involvement for tracking performance outcomes (Simons 1990; Simons 1994; Simons et al. 2000).

An organizational culture is "a system of shared values (that define what is important) and norms that define appropriate attitudes and behaviours for organizational members (how to feel and behave)" (O'Reilly et al. 1996). We use the Organizational Culture Values Framework of flexibility values and stability values (Fey et al. 2003) as prior research has related such values to the PMCs (Henri 2006). In contrast to other dimensions of organizational culture (e.g., assumptions and artefacts), the values dimension (Schein 1992) is often treated as a measurable variable in the MIS and management accounting literature (e.g. Bradley et al. 2006; Henri 2006).

Flexibility values have two traits: (1) involvement (participation, responsibility, organizational commitment and employee autonomy); and (2) adaptability (responsiveness, trial and error learning, questioning and changing of assumptions, innovation and experimentation).

Stability values consist of two traits: (1) consistency (coordination, integration, agreement and core values); and (2) mission (clearly defined vision, goals and strategic direction).

HYPOTHESES DEVELOPMENT

Adopting the capability hierarchy notion (Winter 2000), PMC are a bundled collection of four types of performance management routines: diagnostic planning; interactive planning; diagnostic reporting; and interactive reporting. The degree to which a firm possesses the routines determines the degree to which it possesses PMC. The routines are socially complex (Barney 1986; Barney 1991) and based on performance management information (Simons 1995). In performance management routines, data from PPS and PRS is patterned into information and communicated with information from other data or knowledge sources. Greater

PPS or PRS functionality means more system usability and data multi-dimensionality (Ariav 1992), which provides greater *data possibilities*.

With greater data possibilities, performance management routines can be more rigorously and accurately informed. For PPS, greater functionality can enhance planning routines with greater deliberation and knowledge creation for selecting and actioning performance plan data. For PRS, greater functionality can enhance reporting routines to be more rigorously and accurately informed, with more comprehensive variance and problem analyses. Thus, greater PPS and PRS functionalities can provide a stronger basis for performance management routines, and thereby increase the degree to which a firm possesses the PMC.

H1a: PPS functionality has a positive effect on PMC.

H1b: PRS functionality has a positive effect on PMC.

We next hypothesize that some of the effects of PMIS functionalities on PMC occur indirectly through cultural values. Cultural values are historically and socially constructed, making them very difficult and time-consuming to systematically change (Barney 1986; Barney 1991; Ouchi 1979; Sørensen 2002). PMIS functionalities cannot be used to establish new cultural values. However, as we argue, PMIS functionalities can potentially enable fuller expression of pre-existing cultural values, provided those cultural values are relevant to PMC.

Cultural values can affect how individuals and groups filter and process data, such that those cultural values become embedded in information and associated managerial knowledge (e.g. Birnberg et al. 1988; Henri 2006; Leidner et al. 2006; Livari et al. 2007). It follows that greater data possibilities, from higher PPS and PRS functionalities, provide more opportunities for cultural values to be expressed and embedded in performance management data selections and consequent information choices. Both flexibility values and stability values are likely to be relevant to data filtering and processing in PMC (Henri 2006). Flexibility values provide a collectively generated adaptation orientation (Fey et al. 2003). Stability values provide an integrated and collective enactment of a commonly understood strategic mission (Fey et al. 2003). Both an adaptation orientation and strategic consensus are likely to enhance the intended and emergent strategy-making purposes of PMC, and so we predict:

H2a: The positive effect of PPS functionality on PMC is mediated by stability values.

H2b: The positive effect of PPS functionality on PMC is mediated by flexibility values.

H2c: The positive effect of PRS functionality on PMC is mediated by stability values.

H2d: The positive effect of PRS functionality on PMC is mediated by flexibility values.

We next link PMC to competitive advantage, being the last link in the mediation chain between PMIS functionalities and competitive advantage. PMC create value by playing unique roles in

intended and emergent strategy-making capabilities (Simons 1995). This value creation can be a source of competitive advantage provided that it is non-substitutable and heterogeneously distributed across rival firms (Barney 1991). It is non-substitutable because it is derived from a syntax that uniquely weaves together a firm's entire operations (Simons 1995). Heterogeneous distribution is likely because PMC require learning and development time and because the inherent social complexity requires a resource-base (Barney 1991; Teece et al. 1997). In support of these arguments, research has consistently found positive relationships between PMC and competitive advantage (Widener 2007).

H3: PMC have a positive effect on competitive advantage.

Next we hypothesize that PPS and PRS functionality each have a total effect on competitive advantage. We assume that these effects are solely through mediation by PMC as per the explanation provided later in H5.

H4a: PPS functionality has a positive effect on competitive advantage.

H4b: PRS functionality has a positive effect on competitive advantage.

We next hypothesize that the effects of PMIS functionalities on competitive advantage are mediated by PMC. This would require that PMIS functionalities make PMC more competitively advantageous. In H1 we argued that greater PPS and PRS functionalities provide a stronger basis for performance management routines, thereby increasing the degree to which a firm possesses the PMC. In H3 we argued that PMC create value for achieving competitive advantage by playing unique roles in intended and emergent strategy-making capabilities (Simons 1995). Therefore, PMIS functionalities likely create competitive advantage by enhancing PMC, thereby increasing intended and emergent strategy-making capabilities.

H5a: The positive effect of PPS functionality on competitive advantage is mediated by PMC.

H5b: The positive effect of PRS functionality on competitive advantage is mediated by PMC.

We next include the cultural values in the mediation chain between PMIS functionalities and competitive advantage, on the basis that they likely provide an explicit resource-base for PMCs. Resource-bases act as isolating mechanisms, allowing only those firms that possess them to adopt the valuable routines and capabilities that deploy them. A resource-base of cultural values would prevent widespread industry development of PMC routines that fully deploy PMIS functionalities, thereby making the value created a source of persistent competitive advantage (Barney 1991; Penrose 1959; Wernerfelt 1984).

Resource-bases must be valuable, rare, non-substitutable and inimitable (Barney 1986; Barney 1991). We address each of these four properties in turn. First, cultural values would be valuable if they enable PMIS functionalities to enhance competitive advantages achieved by PMC. Second, cultural values are rare, because they are formed historically and are path dependent (Barney 1991). Third, flexibility values and stability values play a non-substitutable role because without them the information flows derived from PMIS functionalities would lack the orientations that they provide. Fourth, cultural values are largely inimitable by other firms, because they are historically and socially constructed. Thus, whilst PMIS functionalities can enable fuller expression of cultural values that are pre-existing (as per H2), it would be very difficult and time-consuming to systematically initiate and create new cultural values (Barney 1986; Barney 1991; Ouchi 1979; Sørensen 2002). Thus we predict:

H6a: The positive effect of PPS functionality on competitive advantage is mediated by stability values and PMC.

H6b: The positive effect of PPS functionality on competitive advantage is mediated by flexibility values and PMC.

H6c: The positive effect of PRS functionality on competitive advantage is mediated by stability values and PMC.

H6d: The positive effect of PRS functionality on competitive advantage is mediated by flexibility values and PMC.

RESEARCH DESIGN

For the survey design and administration there were two stages: (1) a PMIS scale development survey stage; and (2) the hypotheses testing survey stage. For both stages we applied conventional design and administration procedures (Dillman 2007; Netemeyer et al. 2003, p. 100), and procedures to ensure face and content validities (Tourangeau et al. 2000). The items from the hypothesis testing survey are shown in Appendix B.

Construct Measurement

PPS Functionality and PRS Functionality

Prior research had not operationalized PPS functionality or PRS functionality. We used an established methodology to develop the meanings and epistemic relationships for the measurement scales (Bisbe et al. 2007). We drew from academic literature (Ariav 1992) to conceptualize functionality as reflecting usability and multi-dimensionality. We drew the distinction between PPS and PRS from practice. We reviewed the extensive practitioner literature, including vendor promotional materials and status reports. To ensure face and content validities (Tourangeau et al. 2000) we carried out a multiple-round PMIS scale development

survey, in parallel to pre-testing consultations with five expert-practitioners. From these processes, notably, the terms 'usability' and 'multi-dimensionality' were ambiguous to practitioners, and so we very carefully and iteratively developed and tested related terms. The PMIS scale development survey had a wide range of PPS and PRS related measurement items, and 142 usable responses (12.0% response rate) were received. Guided by analyses of the response data, we developed a four-item set of reflective scales for PPS functionality, and also for PRS functionality.

Given the newness of the scales, we also performed convergent validity testing using data collected with the hypotheses testing survey. We included scales for two other constructs: (1) *PPS infrastructure*, and (2) *PRS infrastructure*, which we also had developed in the PMIS scale development process. As discussed, low PPS/PRS functionality is derived from a dynamic series of spreadsheet arrays, while high functionality is related to integrated data infrastructures and specialist applications. For the two infrastructure constructs, the four-item scales were: our PPS/PRS' (1) are purely spreadsheet based through to (5) have a fully integrated IT systems architecture; (1) consist solely of isolated individualized spreadsheets through to (5) are integrated by a common, shared online platform and database; (1) use highly manual processes to extract data from transactional systems through to (5) have fully automated integration with all relevant transactional systems; (1) are based on data from disparate spreadsheets through to (5) source all data from a single data warehouse .' Using latent variable scores from PLS (n = 264) , the Spearman correlations are: .63 ($p < .001$) for PPS functionality with PPS infrastructure and; .61 ($p < .001$) for PRS functionality with PRS infrastructure. Thus, these 'strong' correlations provide evidence of satisfactory convergent validities for the PPS and PRS functionality constructs. In the hypotheses testing survey, the scores for PPS functionality and PRS functionality were coded from 1 to 5, with 5 representing high functionality.

Performance Management Capabilities

PMC is a two-dimensional emergent construct. The two dimensions are interactive PMC and diagnostic PMC. For each dimension we had 12 scale items: four for profit-planning information; four for financial key performance indicators and; four for non-financial key performance indicators (Malmi et al. 2008). The scales were adapted from prior literature (Abernethy et al. 1999; Bisbe et al. 2004; Naranjo-Gil et al. 2007; Widener 2007). We averaged each four-item set of scores, so that each dimension had three reflective indicators. The diagnostic PMC scores were coded from 1 to 5, with 5 representing a high degree of diagnostic PMC. The interactive PMC scores were coded from 1 to 7, with 7 representing a high degree of interactive PMC. In PLS the two emergent dimensions were modelled hierarchically as the construct PMC (Wetzels et al. 2009).

Flexibility Values and Stability Values

From the Denison Organizational Culture Survey (Denison et al. 1995; Fey et al. 2003) we took six items for flexibility values and six items for stability values. After removing items that failed

our PLS reliability tests, there remained four items for flexibility values (two for adaptability traits and two for involvement traits) and four items for stability values (two for mission traits and two for consistency traits). Scores were coded from 1 to 7, with 7 representing strong values.

Competitive Advantage

Competitive advantage is defined as superior financial performance relative to competitors. This approach controls for differences in performance that are due to effects from industry, environment, and strategy (Garg et al. 2003). Respondents were asked to rate their business unit's performance last year relative to competitors across three dimensions: sales growth; market share and profitability. Such subjective performance measures are common in the MIS literature (Bhatt et al. 2005; Oh et al. 2007; Ravichandran et al. 2005). Subjective and objective measures of financial performance have been found to correlate highly and to provide similar results in PLS modelling (Rai et al. 2006). With our data, in the PLS analyses the three measures all load very strongly (.90, .91 and .81) giving confidence about reliability and validity. Scores were coded from 1 to 9, with 9 representing high performance.

Sample Selection and Data Collection

For hypotheses testing, data was collected over a three month period using a cross-sectional survey. To design and administer the survey we followed the Total Design Method (Dillman 2007), including pre-testing and pilot-testing with five academics and nine practitioners (Dillman 2007). The survey was targeted to senior managers of 1,607 business units of Australian companies, with a list purchased from a commercial provider. Industries that were unlikely to provide valid results for our research model were excluded (e.g. public sector organizations). It was conducted in four rounds, each with an email invitation and hyperlink to an online survey, followed three days later by a postal invitation and attached hardcopy survey (Dillman 2007). We received 507 responses, a 31.6% response rate, of which 430 were complete. Our research model does not apply to small firms, and assumes a certain maturity of operations. Thus we excluded responses from business units with less than AUD20m annual revenue or less than 100 employees, and business units less than 3 years old. We also excluded responses where the respondent had less than 12 months experience in the role. We were left with 264 useable responses, being 130 online and 134 paper responses. The respondents were predominantly CFOs or other senior finance managers (76.9%), with the remainder being CEOs and general managers. The majority of responses (77.4%) were from the services sector, with the remaining 32.6% from manufacturing firms.

Analysis of Data Characteristics and Data Quality

Tests for Data Normality

To determine whether to use parametric or non-parametric procedures, all indicators were tested for normality (Bollen et al. 1990; Ringle et al. 2012). The Shapiro-Wilk test and the Kolmogorov-Smirnov test, as reported in Table 3 in Appendix 1, strongly suggest that our dataset is not normally distributed. The indicators and corresponding latent variables representing organizational culture and PMC have a strong negative skew, whereas the PMIS measures have excess negative kurtosis. In both cases, the absolute value of the test statistic skewness (kurtosis) to standard error of skewness (kurtosis) is > 2, i.e. skew and kurtosis are significant at $p < .05$. Consequently, as discussed in following, we used non-parametric procedures.

Method Bias

We applied numerous procedural remedies to mitigate potential method bias. The potential effects of media preferences (e.g. email filters or email avoidance) were reduced by contacting all target respondents both via email and post, and independent sample tests confirm homogeneous distribution of indicator scores across online and paper surveys.

Ability factors, motivational factors and task factors can contribute to common method bias (Podsakoff et al. 2012). We considered these factors by changing or eliminating ambiguous items during the testing with practitioners, by targeting only very senior executives who have been in their role for at least one year and by ensuring the voluntary survey was anonymous. To further increase participants' motivation to respond accurately, they were invited to register for a preliminary findings report by separate mail or email. The survey invitation letter (email) avoided any hints on our research question and hypotheses, and partially counterbalancing the question order aimed at minimizing the risk of respondents guessing such relationships. In addition, the number of Likert scale points varied between five, seven and nine (Netemeyer et al. 2003) and different anchor labels were used for related constructs (Podsakoff et al. 2012) (see Appendix B).

The statistical remedies used to assess for common method bias were Harman's single-factor test and the unmeasured latent method factor technique (Podsakoff et al. 2003; Podsakoff et al. 2012). Exploratory factor analysis of the 47 measurement items in the sample (n = 264) resulted in 11 factors with eigenvalues > 1, with the strongest factor explaining 31.28% of the total variance, suggesting that common method variance due to single source bias was not present (Podsakoff et al. 1986). For the unmeasured latent method factor technique, we used a covariance-based structural equation modelling package (AMOS). In alignment with our hypothesized research model, we prepared a structural model with the constructs: PMIS; organizational culture; PMC; and competitive advantage. This model provided significant estimates for the structural relationships in line with our hypotheses. We then added a general latent method factor, measured by all indicators of the constructs; when we ran this model the

structural relationships remained significant, providing further evidence that common method bias was not present (Podsakoff et al. 2003; Podsakoff et al. 2012).

Non-Response Bias Testing

Non-response bias was assessed by comparing responses of early and late respondents (Armstrong et al. 1977). We used the midpoint of the data collected to classify responses as early or late. Independent sample tests (Mann-Whitney U) showed no significant differences between the distributions of all data between early and late respondents, suggesting that non-response bias is not a considerable problem in this study.

PLS ANALYSIS AND RESULTS

We used the PLS path modelling procedure, because it best suits the non-normal dataset and small sample size in our study. PLS uses very general, soft distributional assumptions and non-parametric prediction-orientated model evaluation measures (Chin 1998b; Wold 1982). PLS is particularly suitable for indirect effect analysis in multi-mediator models (Liang et al. 2007; Taylor et al. 2008). 'SmartPLS' version 2.00 M3 (Ringle et al. 2005) and 'R' (package 'plspm') were used for PLS analyses and bootstrapping, and the results are reported following recently published guidelines (Chin 2010; Ringle et al. 2012).

Measurement Models – Tests of Reliability and Validity

All first-order constructs were measured reflectively, and so were tested for: (1) convergent validity, and (2) discriminant validity (Chin 1998b; Hulland 1999). Regarding convergent validity, indicator reliability was assessed by examining the significance of the construct loadings. Table 4 in Appendix A reports the measurement indicator loadings and t-statistics. All indicator loadings are significant at $p < .001$. Regarding construct reliability and validity, Table 4 indicates high internal consistency in terms of composite reliability (Dillon-Goldstein's $\rho \geq .60$ and Cronbach's $\alpha \geq .70$) (Bagozzi et al. 1988; Chin 1998b; Nunnally 1978). Convergent validity is confirmed as all average variances extracted (AVE) clearly exceed .50 (Fornell et al. 1981). Thus, convergent validity is successfully evidenced.

Discriminant validity of the construct indicators was examined by analysing the loading of each indicator on its first-order construct, relative to its loading on other constructs. Table 5 in Appendix A confirms that all construct-specific loadings are > .70 (Chin 1998b; Hulland 1999) and that each indicator loads highest on the relevant construct (Fornell et al. 1981). Discriminant validity of the constructs is evidenced by the fact that all square roots of the AVE in the diagonal exceed the correlations with the other constructs (Barclay et al. 1995; Chin 1998a; Fornell et al. 1981). Thus, discriminant validity is successfully evidenced.

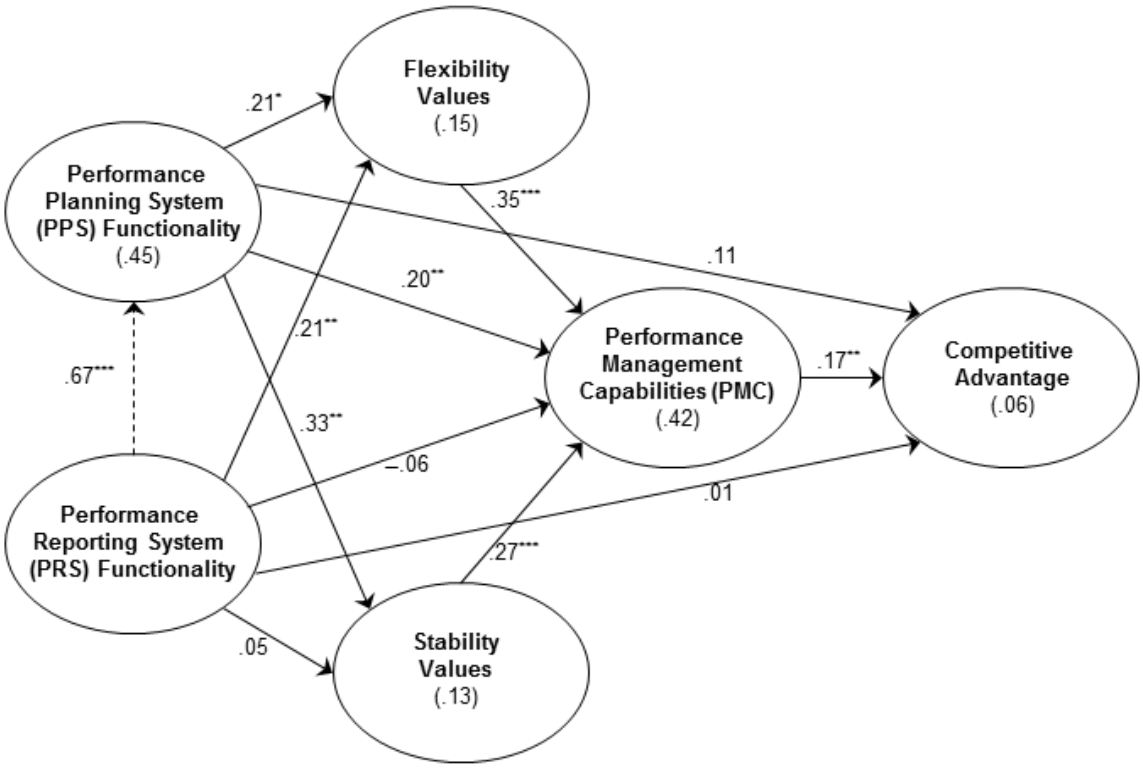
Outline of Hypothesis Testing Procedures

As per Figure 2, the PLS path model includes all hypothesized effects. Importantly, an un-hypothesized effect is included, shown with a broken-line, whereby PRS is antecedent to PPS. This effect is needed to correctly specify the path model, and would not have arisen had we hypothesized PPS to mediate PRS. It comes to light due to an unexpected negative suppression effect of PRS on PPS, as evidenced by the negative beta of the path from PRS to PMC (Cohen et al. 2003; MacKinnon et al. 2000). Unexpected negative path coefficients can provide an opportunity for further investigation of the underlying reasons (Hayes 2009; Maassen et al. 2001; MacKinnon et al. 2002; Taylor et al. 2008). In this case, the negative suppression is because PPS mediates the effects of PRS. This negative suppression is consistent with the strong correlation between PRS and PPS, as reported in Table 6. Without inclusion of this path, the 'true' effects of PRS cannot be revealed (Conger 1974; Pandey et al. 2010; Rucker et al. 2011). We explain this effect in relation to the hypotheses in the findings section.

In mediation analysis, a total effect represents an unmediated relationship, and is decomposed into: (1) the direct effect, and (2) the indirect effects. Table 1 reports the effect magnitudes and Table 2 reports the effect sizes, all based upon the path model presented in Figure 2.

The magnitude of a direct effect is simply the path coefficient. The magnitude of an indirect effect is the multiplication of the coefficients of the paths in the mediational chain (Baron et al. 1986; Taylor et al. 2008). The significance of these effects is determined by the percentile bootstrap method (Preacher et al. 2008; Shrout et al. 2002; Taylor et al. 2008). Bootstrap methods generally outperform other methods of significance testing in mediation models (MacKinnon et al. 2004) and – particularly with small samples – the bootstrap percentile method captures the asymmetry in the sampling distribution missed by the product-of-coefficients test using the standard error (Cheung et al. 2008; Shrout et al. 2002). The advantages of bootstrap percentile methods have also been confirmed for three-path mediation models (Taylor et al. 2008).

To determine effect sizes, we decompose the R-squares of the endogenous variables into direct and indirect effects using a difference-in-R-squares approach (de Heus 2012; Fairchild et al. 2009; Preacher et al. 2011). The R-square of a total effect was determined from the full path model; partial path models were used to determine the incremental R-square contribution of each exogenous variable.



The broken-line arrow represents an un-hypothesized relationship.

Figure 2: PLS Path Model

Results

First we report on all the hypotheses for PPS, starting with the links between PPS and PMC. H1a, which predicted a positive relationship between PPS and PMC, is supported with a total effect of $\beta = .36$ ($p < .001$), of which there is a relatively large direct effect ($\beta = .20$, $p < .01$). The indirect effect between PPS and PMC via stability values, per H2a, is supported ($\beta = .09$, $p < .01$). H2b predicted an indirect effect of PPS on PMC instead through flexibility values, which is also supported ($\beta = .07$, $p < .05$). Thus, all hypothesized effects of PPS on PMC find support. Next we report on the hypothesized links between PPS and competitive advantage. H4a, which predicted a total effect of PPS on competitive advantage, is supported ($\beta = .17$, $p < .05$). The hypothesized indirect effect of PPS on competitive advantage mediated by PMC, as per H5a, is supported ($\beta = .03$, $p < .05$). For H6a, the indirect effect ($\beta = .02$, $p < .01$) supports the hypothesis that stability values and PMC sequentially mediate between PPS and competitive advantage. Lastly, H6b is also supported, with the indirect effect of $\beta = .01$ ($p < .05$), evidencing that PPS likely affects competitive advantage also when mediated by PMC and by flexibility values. These findings are corroborated by the R-square analysis in Table 2, which reveal that the indirect effects of PPS explain substantially more of the variance of PMC (9%) and competitive advantage (2%) compared to the direct effects (2% and 1% respectively).

Next we report on all the findings for PRS. We have included the un-hypothesized path from PRS to PPS, as discussed in the previous section. We commence with the links between PRS and PMC. H1b is supported, by the total effect of PRS on PMC of $\beta = .27$ ($p < .001$). Of this total effect the reported direct effect is suppressed ($\beta = -.06$, $p > .10$) and thereby unreliable for interpretation, whilst the indirect effects are made 'true' by inclusion of the path from PRS to PPS (Pandey et al. 2010; Rucker et al. 2011). H2c is not supported, that is, there is not a significant indirect effect of PRS on PMC through stability values. On the other hand, H2d is supported, with the indirect effect of PRS on PMC through flexibility values of $\beta = .08$ ($p < .01$). The findings for H2d are important, as they reveal that a substantial part of the total effects of PRS are not mediated by PPS; that is the effects of PRS are only partially, not fully, mediated by PPS. Next we report on the hypothesized links between PRS and competitive advantage. H4b, which predicted a total effect of PRS on competitive advantage, is supported ($\beta = .14$, $p < .05$). The hypothesized indirect effect of PRS on competitive advantage mediated by PMC, as per H5b, is not supported, as is expected given the suppression effect dynamic. Consistent with the lack of support found for H2c, H6c is not supported, that is there is not a significant indirect effect of PRS on competitive advantage mediated by PMC and by stability values. Consistent with the support found for H2d, H6d is supported by the indirect effect of PRS on competitive advantage mediated by PMC and by flexibility values of $\beta = .01$ ($p < .01$). Beyond the hypothesized effects there are several significant mediation chains from PRS through PPS, by way of the inclusion of the un-hypothesized path from PRS to PPS. First, PPS mediates PRS on PMC ($\beta = .14$, $p > .01$), including with stability values ($\beta = .06$, $p > .01$) and including with flexibility values ($\beta = .05$, $p > .05$). Second, PPS mediates PRS on competitive advantage with PMC ($\beta = .02$, $p > .05$), and with PMC and stability values ($\beta = .01$, $p > .01$), and with PMC and flexibility values ($\beta = .01$, $p > .05$). All these findings regarding PRS are also corroborated by the R-square analysis in Table 2, which shows that only the indirect effect of PPS explains the variance of PMC (4%) and competitive advantage (1%).

Table 1. Path Model Analysis				
Path	**Hypothesis**	**Total Effect**	**Direct Effect**	**Indirect Effect**
PPS → PMC	H1a	**.36*****	**.20****	**.16****
via *stability*	H2a			.09**
via *flexibility*	H2b			.07*
PRS → PMC	H1b	**.27*****	**–.06**	**.33*****
via *stability*	H2c			.01
via *flexibility*	H2d			.08**
via *PPS*	[a]			.14**
via *PPS* + *stability*	[a]			.06**
via *PPS* + *flexibility*	[a]			.05*
PMC → Competitive Advantage	H3	**.17****	**.17****	
PPS → Competitive Advantage	H4a	**.17***	**.11**	**.06****
via *PMC*	H5a			.03*
via *stability* + *PMC*	H6a			.02**
via *flexibility* + *PMC*	H6b			.01*
PRS → Competitive Advantage	H4b	**.13***	**.01**	**.12***
via *PMC*	H5b			–.01
via *stability* + *PMC*	H6c			.00
via *flexibility* + *PMC*	H6d			.01**
via *PPS*	[a]			.07
via *PPS* + *PMC*	[a]			.02*
via *PPS* + *stability* + *PMC*	[a]			.01**
via *PPS* + *flexibility* + *PMC*	[a]			.01*

Notes:

a) The mediation effects of PPS were not hypothesized.

Significance levels are: *** $p < .001$, ** $p < .01$ and * $p < .05$ (one-tailed).

Acronyms: PPS … performance planning systems PRS … performance reporting systems
PMC …performance management capabilities

Table 2. R-squares of Total, Direct and Indirect Effects		
	PMC (R^2)	**CA (R^2)**
Total R^2 (see Figure 2)	**.42**	**.06**
Direct effect of PPS	.02	.01
Direct effect of PRS	.00	.00
Indirect effect of PPS	.09	.02
Indirect effect of PRS	.04	.01
Total effect of PPS	.11	.03
Total effect of PRS	.04	.01
Combined total effect of PPS and PRS	**.15**	**.04**
Combined direct effect of mediators	**.28**	**.02**

Acronyms: PPS … performance planning system PRS … performance reporting system
PMC …performance management capabilities CA … competitive advantage

FINDINGS: SUMMARY AND DISCUSSION

Our research is concerned with whether and how PMIS functionalities contribute to competitive advantage. According to our research design and dataset, PPS and PRS functionalities each positively relate to competitive advantage by enhancing PMC. With some of these effects attributable to the resource-bases of flexibility and stability values of organizational culture, there is some sustainability to this competitive advantage. Thus, even if all firms were to eventually adopt high-functionality PMIS, only firms with sufficient flexibility values and stability values could fully extract such value creation potential. Whilst other non-identified resource-bases are likely involved in PMIS deployment, it appears that these two aspects of organizational culture account for much of the variance in the competitive advantage effects.

Our hypotheses assumed that PPS and PRS functionalities would be effective solely in parallel. However, we found evidence that they also operate sequentially, whereby PRS functionalities are also competitively advantageous by partial mediation through PPS functionality. Moreover, PPS functionality substantially depends on PRS functionality, and this dependence is consequential for competitively advantageous deployment of PMIS functionalities in PMC. This mediation sequence also occurs in mediation chains that include flexibility or stability values.

We have two explanations for the sequential mediation effect of PRS functionality through PPS functionality. Firstly, an initial step in preparing a performance plan is to populate a PPS application with historical data, which is then used as a basis for extrapolative data modelling. As PPS functionality increases, this step would require the historical data to be more multi-dimensional and quickly available for input. Such historical data characteristics are relatedly constituted by PRS functionality. Hence, it seems that PPS are populated with historical data sourced from PRS, such that PRS functionality partly determines PPS functionality. Secondly, effective deployment of PRS functionality relies on the cybernetic feedback mechanism. In

providing feedback information, PRS provide historical data as well as feedback in the form of variances to performance plan data sourced from PPS. The capacity to calculate and report such feedback variances via PRS functionality is thus limited by the degree of multi-dimensionality in the baseline performance plan dataset from PPS. That is, the extent to which PRS functionality is of cybernetic usefulness in PMC is limited by the degree of multi-dimensionality in the accompanying PPS. Therefore, PPS functionality limits and enables – that is, it mediates – the deployment of PRS functionality in PMC.

CONTRIBUTIONS, FUTURE RESEARCH AND LIMITATIONS

This study responds to a call for researchers to examine contemporary MIS functionalities (Clark et al. 2007). We rigorously developed the PPS and PRS functionality constructs from seminal academic concepts (Ariav 1992) and practitioner literature. As reflective constructs, they capture the data infrastructures and applications that underlie PMIS functionalities. Unlike prior survey-based treatment of PMIS as a binary variable (Elbashir et al. 2011), our study reveals a mediation relationship between the two sub-systems that comprise a PMIS. Future research could usefully employ the two functionality constructs for other research questions. Our focus was on mediation effects; future research could examine moderating variables, such as operational complexities and other business model specifics.

Our research model contributes a synthesis of important prevailing theories in the MIS, management accounting and strategic management literatures. We bring together resource-based and interactive/diagnostic controls theories. Given the importance of resource-based theory in the MIS literature (Oh et al. 2007; Wade et al. 2004) and that organizational culture was a seminal example of a resource-base for MIS (Barney 1986; Barney 1991), it is surprising that no other study has systematically linked organizational culture to MIS and competitive advantage. Our mediation model adds a nuanced perspective, in which greater data possibilities provide more opportunities for pre-existing cultural values to be leveraged within managerial information production routines. This perspective is consistent with the tenet that a resource-base be very difficult to change (Barney 1986; Barney 1991), whilst also consistent with the modelling of it as an exogenous variable. Future research could examine other ways that organizational culture provides a resource-base for realizing sustainable competitive advantage from MIS.

Lastly, given that management accounting practices (such as performance management) are underpinned by MIS, we contribute to the paucity of cross-disciplinary research between the MIS and management accounting literatures (e.g. Chapman et al. 2009; Elbashir et al. 2011; Mithas et al. 2011). Our study contributes to the treatment of performance management in the MIS literature (Mithas et al. 2011) and also contributes to the treatment of PMIS in the management accounting literature (Elbashir et al. 2011). Future research could fruitfully investigate linkages between PMIS and other established management accounting constructs, such as participative budgeting or strategic management accounting.

This study has several noteworthy limitations. First, as was discussed in detail, whilst significant procedural remedies were taken, some common method bias and method bias could be present. We however note that the statistical remedies suggest otherwise, and that the strong reliability and validity of the measurement models further reduce any concerns. Second, the survey captured multiple Australian industries, which whilst not controlling for industry effects, does however help to generalize the findings. A third limitation is the somewhat constricted conceptualization of organizational culture.

CONCLUSION AND MANAGERIAL IMPLICATIONS

Whilst an important and enduring practitioner topic, PMIS functionality has not yet received sufficient academic enquiry (Chaudhuri et al. 2011; Chen et al. 2012; Clark et al. 2007; Elbashir et al. 2011). We contribute an academically-grounded conceptualisation of PMIS functionality, as a continuous variable reflected by system usability and data multi-dimensionality (Ariav 1992). Applying this conceptualization to the two types of PMIS in practice, we find that PPS functionality and PRS functionality operate in parallel, and also sequentially, to contribute to competitive advantage. Our findings suggest that the greater data possibilities provided by higher PPS and PRS functionalities can enhance performance management information, strengthening intended and emergent strategy-making in performance management capabilities, thereby conferring competitive advantages. Our findings also suggest that flexibility values and stability values provide a resource-based component to this competitive advantage, by extracting from the data possibilities more opportunities for informing intended and emergent strategy-making in performance management capabilities.

This study has clear implications for CIOs, CFOs and other managers responsible for development and deployment of PMIS. Practically all firms have a PPS and a PRS, each with some level of functionality. Based on our findings, to enhance performance management capabilities, some aspects of PPS and PRS functionalities are beneficial together, whilst other aspects are independently effective. The implication is that firms should invest in both the business intelligence solutions needed for high functionality PRS and for high functionality PPS.

Appendix A

Analysis

Table 3. Descriptive Statistics

Constructs and Indicators (Likert scale in brackets)	Mean	Standard deviation	Skew/SE$_{skew}$ [a]	Kurtosis/SE$_{kurt}$ [b]
PRS[c]	**2.96**	**.92**	**–.68**	**–1.12**
Response/refresh time (1–5)	3.02	1.06	–1.33	–2.12
Ease of use (1–5)	2.77	1.04	.76	–1.61
Interactive reporting (1–5)	2.99	1.02	–.13	–1.74
Format/presentation features (1–5)	3.05	1.06	–.84	–2.07
PPS	**2.92**	**1.00**	**–.05**	**–2.09**
Response/refresh time (1–5)	2.98	1.10	–.55	–2.58
Actuals update speed (1–5)	3.05	1.12	–.81	–2.83
Forecast speed (1–5)	2.99	1.09	–.68	–2.77
Planning model sophistication (1–5)	2.67	1.07	1.20	–1.99
Flexibility Values	**4.80**	**1.06**	**–4.59**	**1.13**
Involvement I (1–7)	5.14	1.24	–5.21	1.75
Involvement II (1–7)	5.03	1.32	–5.58	2.07
Adaptability I (1–7)	4.69	1.32	–2.14	–1.57
Adaptability II (1–7)	4.25	1.42	–2.14	–1.76
Stability Values	**5.02**	**1.14**	**–4.87**	**.94**
Consistency I (1–7)	4.55	1.33	–4.01	–.48
Consistency II (1–7)	4.83	1.32	–4.47	–.19
Mission I (1–7)	5.50	1.32	–7.01	3.91
Mission II (1–7)	5.17	1.41	–5.27	.30
Diagnostic PMC	**3.84**	**.71**	**–7.71**	**8.12**
DPMC Profit planning[d] (1–5)	3.94	.79	–7.84	7.11
DPMC Financial KPIs[d] (1–5)	3.96	.85	–7.61	5.33
DPMC Non-financial KPIs[d] (1–5)	3.58	.87	–4.83	2.21
Interactive PMC	**4.64**	**1.13**	**–4.81**	**2.04**
IPMC Profit planning[d] (1–7)	4.51	1.37	–3.43	–.74
IPMC Financial KPIs[d] (1–7)	4.91	1.29	–5.66	1.07
IPMC Non-financial KPIs[d] (1–7)	4.47	1.28	–3.24	–.02
Competitive Advantage	**5.87**	**1.48**	**.28**	**–.22**
Sales growth (1–9)	5.88	1.56	.19	–.85
Market share (1–9)	5.88	1.50	.80	.58
Profitability (1–9)	5.84	1.95	–1.89	–1.47

Notes:

a) Sample skewness divided by standard error of skewness (SES), with test scores > 2 or < –2 suggesting significant positive or negative skew (Cramer 1997).

b) Sample kurtosis divided by standard error of kurtosis (SEK), with test scores > 2 or < –2 suggesting significant positive or negative kurtosis (Cramer 1997).

c) The scores for the constructs are based on the unstandardized latent variable scores.

b) Mean of four indicator scores (see survey items in Appendix B).

n = 264

Acronyms:

PRS …	performance reporting system;	PPS …	performance planning system
PMC …	performance management capabilities	KPI …	key performance indicator
DPMC …	diagnostic PMC	IPMC …	interactive PMC
SE_{skew} …	skewness standard error (SES)	SE_{kurt} …	kurtosis standard error (SEK)

Table 4. Measurement Model Tests: Indicator Reliability, Construct Reliability and Construct Validity

Constructs and Indicators	Loadings[a]	t-statistic	Composite reliability (ρ)[b]	Cronbach's α[b]	AVE[c]
PRS			.93	.90	.77
Response/refresh time	.87	49.59			
Ease of use	.86	47.98			
Interactive reporting	.90	63.96			
Format/presentation features	.88	48.22			
PPS			.95	.93	.83
Response/refresh time	.90	60.80			
Actuals update speed	.93	89.47			
Forecast create/update speed	.92	81.75			
Planning model sophistication	.90	72.66			
Flexibility Values			.88	.81	.64
Involvement I	.84	26.69			
Involvement II	.82	29.80			
Adaptability I	.76	22.92			
Adaptability II	.78	24.41			
Stability Values			.91	.87	.72
Consistency I	.77	26.10			
Consistency II	.88	48.69			
Mission I	.85	37.60			
Mission II	.89	52.11			
Diagnostic PMC			.88	.80	.72
DPMC Profit planning[d]	.88	44.03			
DPMC Financial KPIs[d]	.89	53.57			
DPMC Non-financial KPIs[d]	.78	16.38			
Interactive PMC			.89	.82	.73
IPMC Profit planning[d]	.83	32.26			
IPMC Financial KPIs[d]	.89	59.59			
IPMC Non-financial KPIs[d]	.85	34.53			
Competitive Advantage			.93	.88	.80
Sales growth	.90	25.49			
Market share	.92	36.86			
Profitability	.87	15.70			

Notes:

a) All loadings are significant at $p < .001$ (two-tailed).

b) Internal consistency: All composite reliability (Dillon-Goldstein's ρ) indices are ≥ .60 (Bagozzi et al. 1988) and all Cronbach's α indices are ≥ .70 (Nunnally 1978).

c) Convergent validity: All AVE indices are ≥ .50 (Fornell et al. 1981).

d) Mean of four indicator scores (see survey items in Appendix B).

Acronyms:

PRS … performance reporting system; PPS … performance planning system
PMC … performance management capabilities KPI … key performance indicator
DPMC … diagnostic PMC IPMC … interactive PMC
AVE … average variance extracted

Table 5. Cross-loadings

Indicator	PRS	PPS	Stability	Flexibility	DPMC	IPMC	CA
Response/refresh time	**.87**	.64	.25	.31	.19	.24	.13
Actuals update speed	**.86**	.58	.25	.32	.20	.23	.13
Forecast create/update speed	**.90**	.57	.24	.33	.23	.29	.08
Planning model sophistication	**.88**	.57	.22	.28	.19	.24	.13
Response/refresh time	.57	**.90**	.36	.34	.32	.37	.16
Ease of use	.61	**.93**	.35	.31	.32	.33	.19
Interactive reporting	.64	**.92**	.28	.30	.30	.32	.16
Format/presentation features	.63	**.90**	.34	.33	.32	.35	.15
Consistency I	.21	.30	**.77**	.56	.37	.44	.14
Consistency II	.28	.35	**.88**	.65	.47	.48	.20
Mission I	.18	.28	**.85**	.64	.49	.48	.30
Mission II	.25	.31	**.89**	.62	.51	.50	.28
Involvement I	.24	.24	.63	**.84**	.46	.50	.33
Involvement II	.29	.28	.68	**.82**	.45	.53	.16
Adaptability I	.32	.29	.48	**.76**	.36	.42	.24
Adaptability II	.29	.32	.52	**.78**	.46	.42	.23
DPMC Profit planning	.21	.31	.47	.46	**.88**	.72	.22
DPMC Financial KPIs	.17	.27	.44	.42	**.89**	.71	.22
DPMC Non-financial KPIs	.20	.30	.48	.51	**.78**	.65	.12
IPMC Profit planning	.22	.33	.45	.50	.60	**.83**	.14
IPMC Financial KPIs	.25	.29	.48	.49	.77	**.89**	.23
IPMC Non-financial KPIs	.26	.35	.50	.51	.72	**.85**	.12
Sales growth	.09	.13	.24	.24	.14	.15	**.90**
Market share	.12	.15	.28	.30	.22	.21	**.92**
Profitability	.13	.20	.21	.25	.22	.16	**.87**

Acronyms:

PRS … performance reporting system; PPS … performance planning system
PMC … performance management capabilities KPI … key performance indicator
DPMC … diagnostic PMC IPMC … interactive PMC
CA … competitive advantage

Table 6. Correlation/Path Coefficient Matrix and Discriminant Validity Assessment

	PRS	PPS	Stability	Flexibility	PMC	CA
PRS	**.88**	*.67****	*.05*	*.21***	*–.06*	*.01*
PPS	.66***	**.91**	*.33***	*.21**	*.20***	*.11*
Stability Values	.31***	.37***	**.85**	-	*.27****	-
Flexibility Values	.35***	.36***	.68***	**.80**	*.35****	-
PMC	.30***	.35***	.52***	.53***	**.81**	*.17***
Competitive Advantage	.14***	.19***	.31***	.33***	.24***	**.90**

Notes:

Numbers in **bold** on the diagonal show the square root of the first-order average variance extracted (AVE) of each construct. Below-diagonal values are construct correlations (Spearman's ρ).
Discriminant validity is assumed if all values in the *diagonal* are greater than those in the corresponding rows and columns *below* (Fornell et al. 1981).
Values above the diagonal are path coefficients of the PLS path model (see also Figure 2) and include one suppressor (PRS → PMC).
Significance levels are: *** $p < .001$, ** $p < .01$ and * $p < .05$ (two-tailed).

Acronyms: PRS … performance reporting system; PPS … performance planning system; PMC … performance management capabilities; CA … competitive advantage

Table 7. Variance Inflation Factors (VIF) and Effect Sizes (f^2)

Independent variable (IV)	Dependent variable (DV)							
	Flexibility		Stability		PMC		CA	
	VIF	f^2	VIF	f^2	VIF	f^2	VIF	f^2
PRS	1.83	.03	1.83	.07	1.91	.03	1.83	.01
PPS	1.83	.03	1.83	.00	1.96	.00	1.98	.00
Flexibility Values					2.24	.10		
Stability Values					2.20	.06		
PMC							1.17	.03

Notes:

$$f^2 = \frac{\mathrm{R}^2_{incl.\,IV} - \mathrm{R}^2_{excl.\,IV}}{1 - \mathrm{R}^2_{incl.\,IV}}$$

Acronyms:
PRS … performance reporting system; PPS … performance planning system; PMC … performance management capabilities; CA … competitive advantage

Appendix B:

Survey instrument

Construct:	Questions/Indicators:
PPS functionality	Our planning, budgeting and forecasting systems [strongly disagree (1); strongly agree (5)]: • Have rapid response and refresh times • Are very quickly updated with actual and base level information • Allow forecasts and budgets to be quickly created and revised • Allow sophisticated planning models to be easily implemented and changed.
PRS functionality	Our management reporting and analysis systems: • Have sophisticated formats and presentation features • Have highly interactive reporting features • Are very easy to use and navigate by all users • Have rapid response and refresh times.
Interactive PMC – profit planning	Please indicate the degree to which you agree or disagree with the following statements regarding your business unit [strongly disagree (1); strongly agree (7)]: • Senior managers meet and discuss profit planning information very frequently (e.g., weekly) • Middle and senior managers meet and discuss profit planning information very frequently (e.g., weekly) • Profit planning meetings always include consideration of multiple alternatives and scenarios • Strategic business changes are always assessed in profit planning meetings.
Interactive PMC – financial KPIs	Please indicate the degree to which you agree or disagree with the following statements regarding your business unit [strongly disagree (1); strongly agree (7)]: • Senior managers are continually involved in discussions of financial key performance indicator (KPIs) with other senior managers • Middle managers constantly interact with senior managers concerning financial KPIs • There is always extensive challenge and debate of assumptions that underlie financial KPIs • The sustainability of our business strategies is a key theme in discussion of financial KPIs.
Interactive PMC – non-financial KPIs	Please indicate the degree to which you agree or disagree with the following statements regarding your business unit [strongly disagree (1); strongly agree (7)]: • Senior managers constantly interact with peers to discuss non-financial KPIs • Middle managers are continually involved in discussing non-financial KPIs with senior managers • Every discussion of non-financial KPIs involves intensive review and revision of action plans • Significant business development opportunities are a key focus in all discussions of non-financial KPIs.

Diagnostic PMC – profit planning	How intensively do senior managers use *profit planning* activities in your business unit to [not at all (1); very intensively (5)]: • Follow-up on targets • Track progress towards goals • Review significant deviations • Evaluate and control subordinates.
Diagnostic PMC – financial KPIs	How intensively do senior managers use *financial* KPIs in your business unit to [not at all (1); very intensively (5)]: • Follow-up on targets • Track progress towards goals • Review significant deviations • Evaluate and control subordinates.
Diagnostic PMC – non-financial KPIs	How intensively do senior managers use *non-financial* KPIs in your business unit to [not at all (1); very intensively (5)]: • Follow-up on targets • Track progress towards goals • Review significant deviations • Evaluate and control subordinates.
Flexibility: - Involvement I and II - Adaptability I and II	Please indicate the degree to which you agree or disagree with the following statements regarding your business unit [strongly disagree (1); strongly agree (7)]: • This organization is constantly improving compared with its competitors in many dimensions • Decisions are usually made at the level where the best information is available • Customer comments and recommendations often lead to changes in this organization • This organization encourages and rewards those who take risk. • *Working in this organization is like being part of a team (dropped)* • *This organization is very responsive and changes easily (dropped).*
Stability: - Consistency I and II - Mission I and II	Please indicate the degree to which you agree or disagree with the following statements regarding your business unit [strongly disagree (1); strongly agree (7)]: • It is easy to reach consensus, even on difficult issues • People from different organizational units still share a common perspective; • This organization has long-term purpose and direction • There is widespread agreement about goals of this organization. • *The leaders and managers follow the guidelines that they set for the rest of the organization (dropped)* • *We have a shared vision of what this organization will be like in the future (dropped).*
Competitive Advantage	Please relate the situation in your business unit last year. Relative to your competitors, how has your business unit performed for the following three areas [much worse (1); much better (9)]: • Sales growth - relative to your major competitors • Market share - relative to your major competitors • Profitability - relative to your major competitors

Acronyms:

PRS …	performance reporting system	PPS …	performance planning system
PMC …	performance management capabilities	KPI …	key performance indicators

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