Do costing system design choices mediate the link between strategic orientation and cost information usage for decision making and control?

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ABSTRACT

This study investigates the mechanisms that link strategic orientation to choices regarding the purposes of cost information use. We do so by examining whether costing system design choices regarding complexity and diversity mediate the relationships between an exploitation or exploration orientation and cost information usage for decision making and control. Our hypotheses are mainly based on information-processing theory and organizational learning. Using survey data collected from 191 business units of medium- and large-sized Thai manufacturing and service firms, structural equation modelling demonstrates different patterns of results between an exploitation and an exploration context. As predicted, we find that costing system design choices are mediating mechanisms only in the context of exploration. More specifically, an exploration orientation is related to more complex costing systems, which, in turn, results in greater usage of the subsequent cost information for decision making. Similarly, costing system diversity also operates as a channel enacting a link between exploration and cost information usage for both decision making and control. For exploitation, we find a significant direct positive effect on cost information usage for decision making as well as for control. By providing insight into antecedents and consequences of costing system design choices, our study complements prior costing research as well as studies on management control practices across different innovation modes.

Keywords: cost accounting; costing system design; decision facilitation; decision influencing; exploitation; exploration

1. Introduction

Given that costing systems become more difficult to implement as they become more complex (Balakrishnan et al., 2012), it is important to understand what drives firms' investments in more complex costing systems. Prior research examining costing system complexity in terms of the applied overhead absorption mechanisms has proposed a number of antecedents, such as product diversity (e.g., Abernethy et al., 2001; Drury and Tayles, 2005), competition (e.g., Al-Omiri and Drury, 2007), firm size (e.g., Al-Omiri and Drury, 2007; Drury and Tayles, 2005) and firm age (e.g., Hadid and Hamdan, 2022). However, these studies have not investigated firms' strategic orientation as a contextual variable explaining variation in costing system design choices. This is surprising as the normative literature has argued that in order to realize an "execution premium" (Kaplan and Norton, 2008), firms should also link the planning of strategy to operations by aligning their process improvement activities with strategic priorities and ensuring that the funding for resources to operate the business are consistent with the strategic plan.

Exploitation and exploration are two strategic orientations that have attracted a lot of research attention. Firms or business units may pursue these strategic orientations to stay competitive and safeguard long-term survival (e.g., March, 1991; Raisch and Birkinshaw, 2008). Whereas exploitation is linked to adaptation and enhancement of existing products, services and processes, exploration is linked to fundamental changes leading to a switch from existing products, services and processes to completely new ones (Davila et al., 2009; Ylinen and Gullkvist, 2014). Apart from examining exploitation and exploration as antecedents of costing system design choices, we also examine the consequences of these design choices in terms of resulting usage choices. Indeed, costing systems are not developed in a vacuum but are designed to fulfil a purpose (Labro, 2019). According to Demski and Feltham (1976), managerial accounting information, of which cost information is a part, has two main purposes: decision facilitating (i.e. decision making) and decision influencing (i.e. control; see also Zimmerman, 2017). Hence, we investigate cost information usage for both decision making as well as for control.

The key point of this study is that it is important to understand how strategic orientation relates to costing system design choices, given the intended usage of cost information to support strategy implementation. Indeed, we will argue that firms design costing systems anticipating the use that managers will make of them, as guided by the strategic orientation they pursue. To build our arguments, we approach exploitation and exploration from an information-processing perspective, which is in line with Huber and Daft (1987), Katila and

Ahuja (2002) and Sidhu et al. (2004, 2007). A firm's need for information-processing capacity arises from uncertainty, which creates a difference between the amount of information needed and the amount of information possessed (Galbraith, 1973, 1977). According to information-processing theory, there is a good fit between strategy and structure when the information-processing requirements of a firm's strategy are satisfied by the information-processing capacities of its structure (Egelhoff, 1991). As information-processing requirements are related to the type of organizational learning, we additionally borrow insights from organizational learning to support our hypotheses linking strategic orientation with costing system design choices. According to the literature on organizational learning, exploration refers to learning about new technologies, new products, new markets, etc. (e.g., March, 1991) and is therefore characterized by higher uncertainty than exploitation, which is linked to the adaptation of existing products, services and processes (Davila et al., 2009; Ylinen and Gullkvist, 2014). Exploration involves the pursuit of new business models, whereas exploitation often takes place within the firm's existing business model.

Managers primarily use accounting information to develop knowledge of their work environment (Hall, 2010). Accounting information (including cost information) may thus help managers to develop knowledge to prepare for unknown future decisions and activities (Hall, 2010). In this respect, in an environment characterized by high uncertainty and a high demand for information, more complex costing systems may foster the creation of new knowledge by increasing understanding of how costs are consumed by individual products, the activities required to produce them, the direct and indirect costs in the various activity centres, and how indirect costs are generated by cost drivers (Zimmerman, 2017). Costing system complexity is a design choice through which managers receive information that covers a firm's internal environment (Mendoza and Bescos, 2001). However, for managers who are engaged in a variety of tasks in complex organizational contexts with a lot of uncertainty, like when pursuing an exploration strategy, information needs are diverse and encompass a wide range of information from various sources, both internal and external to the firm (Hall, 2010). Therefore, besides costing system complexity, we also examine costing system diversity (i.e. the number of different costing practices: standard costing, variance analysis, contribution margin accounting, target costing and life cycle costing) as a second costing system design choice. Although more complex systems may provide more detailed internal information, more diverse costing systems combine information from internal and external sources, such as target costing and life cycle costing, for which data external to the firm need to be collected. As such, diverse costing systems provide information from various sources intended to complement each other.

We argue that in an exploration context, cost information generated by more diverse costing systems may stimulate problem recognition and problem solving (Hall, 2010; McKinnon and Bruns, 1992), which are both mechanisms that foster the creation of new knowledge. Hence, we expect that in an exploration context, to generate entirely new competencies (Bedford et al., 2019), more complex as well as more diverse costing systems are needed. However, more complex and diverse cost information may also create information overload, which might lead to tensions (Henri and Wouters, 2020). Since in an exploitation context, managers are able to use past experience and prior knowledge (often in a tacit format) to develop appropriate responses and make decisions, we expect that the advantage of having more complex and diverse information becomes smaller relative to the disadvantage of information overload. Consequently, we argue that in an exploitation context, because informational needs become smaller and more focused (Henri and Wouters, 2020) and exploitation builds on existing knowledge, which can be of a tacit format, investments in more complex and diverse costing systems will not be undertaken.

The differences between an exploitation versus an exploration orientation are key in this study. We consider exploitation and exploration separately as they are two fundamentally different learning processes required for innovation (e.g., Kane and Alavi, 2007; March, 1991), requiring fundamentally different organizational structures, strategies and contexts (Raisch and Birkinshaw, 2008). Lillis and van Veen-Dirks (2008) further emphasize that the findings of research that relies on an archetypal approach to strategy cannot easily be translated into a mixed strategy. Hence, we focus on exploitation and exploration separately rather than taking an ambidexterity perspective.

Similar to other contingency-based studies on the determinants of costing system complexity (e.g., Abernethy et al., 2001; Al-Omiri and Drury, 2007; Drury and Tayles, 2005), we adopt a selection fit approach. This is in contrast to another series of studies focusing on the outcome effects of costing system design choices. These studies have examined costing system effectiveness using proxies based on satisfaction (e.g., Anderson and Young, 1999; McGowan and Klammer, 1997; Schoute, 2009; Shields, 1995; Swenson, 1995), decision actions taken (e.g., Pike et al., 2011), financial benefits (e.g., Banker et al., 2008; Cagwin and Bouwman, 2002; Ittner et al., 2002) or perceived accuracy (Anderson and Young, 1999). Interestingly, studies on outcome effects of management accounting and control systems have suggested an alignment between design and usage choices (e.g., Guenther and Heinicke, 2019; Schoute, 2009). Hence, although we are interested in strategic orientation as an antecedent of costing system design choices and thus adopt a selection fit approach as in the first series of studies, we expand these studies by arguing that firms design costing systems anticipating the use that managers will make of them as guided by the strategic orientation they pursue (i.e. strategy drives how cost information will be used for which an appropriate design of the costing system is needed).

To develop our hypotheses, we mainly build on information-processing theory and organizational learning. We argue that mediating effects of costing system design choices are only present in the context of exploration. Using survey data collected from 191 business units of medium- and large-sized Thai firms, we test the hypothesized relationships with structural equation modelling. More specifically, we predict and find that an exploration orientation is related to more complex costing systems, which, in turn, results in greater usage of the subsequent cost information for decision making. As predicted, the findings also reveal that costing system diversity operates as a channel enacting a link between exploration and cost information usage for both decision making and control. Conversely, for exploitation, as predicted, we find a direct positive relationship with cost information usage for decision making as well as for control. Empirically, we do not observe evidence of a mediating role of costing system design choices for business units pursuing an exploitation orientation.

Our study offers three contributions. First, we extend prior research on determinants of costing system complexity (e.g., Abernethy et al., 2001; Al-Omiri and Drury, 2007; Drury and Tayles, 2005) in several ways. By adding strategic orientation as a contextual variable that explains variations in costing system complexity, we enhance our understanding of why some firms need more complex costing systems (e.g., Al-Omiri and Drury, 2007; Hadid and Hamdan, 2022; Schoute, 2009, 2011; Wouters and Stecher, 2017). Indeed, our findings reveal costing system complexity as a novel mediating mechanism explaining the relationship between exploration and cost information usage for decision making, which responds to more general calls for research on the decision-facilitating purpose of managerial accounting information (Labro, 2015; Sprinkle and Williamson, 2007). More specifically, we find that investments in more complex costing systems driven by the pursuit of an exploration orientation lead to an increased usage of that information to support decision making. However, these investments in more complex cost information do not generate a higher usage of that information for control purposes. The results further illustrate that for firms pursuing an exploitation orientation, available information is used to support decision making and control in that investments in more complex and diverse costing systems are not needed. Second, while prior costing research has mainly examined costing system complexity, our findings also highlight the importance of costing system diversity as a design choice, especially when viewing costing systems not only from their typical decision-making role but also from their decision-influencing role. More specifically, in contrast to costing system complexity, we find that diverse costing systems act as channels on the relationship between a business unit's exploration orientation and the usage of cost information not only for decision-making but also for control purposes. These results illustrate that investments in more diverse costing systems driven by the pursuit of an exploration orientation are related to an increased usage of cost information both for decision making as well as for control. Third, our focus on choices regarding costing system design and the subsequent purposes of use complements prior work on the design and use of management control practices across different innovation modes (e.g., Bedford, 2015; Bedford et al., 2019; Bisbe and Otley, 2004; Davila, 2000; Dekker et al., 2013; Ylinen and Gullkvist, 2014). While performance measurement systems, budgets, incentives, planning systems and decentralization have already been examined extensively in the context of innovation, less attention has been devoted to costing systems specifically as an individual part of the control mix in this context (Henri and Wouters, 2020), despite the practical importance of cost information for performance management (e.g., Turney, 2010) and the advocacy of the strategy-costing link by the normative literature (Kaplan and Norton, 2008; Sharman, 2012).

The remainder of the paper is organized as follows. The next section includes the literature review and hypotheses development. The third section describes the research method. The fourth section presents the results. The final section provides the discussion and conclusion.

2. Literature review and hypotheses development

2.1. Exploration and exploitation and their information-processing requirements

Following Huber and Daft (1987), Katila and Ahuja (2002) and Sidhu et al. (2004, 2007), we approach exploration and exploitation from an information-processing perspective and consider the differences in information characteristics required for these different strategic orientations. Egelhoff (1982) argues that different elements of a firm's strategy can be seen as posing different requirements on information processing. Consequently, if strategies can be measured in terms of the amount and kind of information processing required to implement them, a general framework for hypothesizing fit between strategy and structure can be developed. Information-processing theory posits that there will be a good fit between strategy and structure when the information-processing requirements of a firm's strategy are satisfied by the information-processing capacities of its structure. According to Galbraith (1973, 1977), a firm's need for information-processing capacity arises from uncertainty. March (1991) argues that an exploration strategy is much more related to outcome uncertainty than an exploitation strategy, as exploitation is linked to refining and extending existing competencies and technologies. In addition, outcome targets of exploration are generally more ambiguous compared to outcome targets of firms pursuing an exploitation strategy (Koza and Lewin, 2000). Compared to exploration, exploitation features less uncertainty since it is based on the refinement and extension of existing competencies, technologies and paradigms with returns that are proximate and predictable (March, 1991). Hence, considering the differences with respect to uncertainty between exploration and exploitation, information-processing theory and Galbraith's (1973, 1977) observations with respect to uncertainty will predict more investments in information-processing capacity in an exploration context than in an exploitation context.

In addition to uncertainty, the information-processing requirements of an exploitation or exploration strategic orientation are also influenced by the type of learning required. Ample evidence is available in the literature that exploitation and exploration are related to different types of learning (Benner and Tushman, 2003; Lubatkin et al., 2006; March, 1991). Exploitation is related to the ability to refine existing knowledge, skills and processes, whereas exploration is related to the ability to generate entirely new knowledge, skills and processes (March, 1991). Exploitation refers to small improvements or extensions to existing products or services that build on the existing technological trajectory and require relatively minor changes, while exploration requires more fundamental changes and often involves a shift to a different technological trajectory (Benner and Tushman, 2003). Consequently, in contrast to exploitation innovation, exploration innovation is defined as a search for new knowledge that exceeds existing knowledge (Jansen et al., 2006; Jansen et al., 2009). Accordingly, researchers have either implicitly or explicitly noted that exploitation and exploration entail contradictory knowledge processes (e.g., Lubatkin et al., 2006). As prior studies argue that managers primarily use accounting information to develop knowledge of their work environment (Hall, 2010) and indicate that information systems are useful in the facilitation of exploration and exploitation learning (e.g., Lee and Widener, 2016; March, 1991), we focus on a firm's cost information-processing capacity, captured by its costing system design choices and study how a firm's strategic orientation relates to these costing system design choices, given the intended usage of cost information to support the firm's chosen strategy implementation.

2.2. Costing systems as part of a firm's or business unit's information-processing capacity

Information processing is generally defined as including the gathering of data, the transformation of data into information and the communication and storage of information in the firm (Galbraith, 1973; Tushman and Nadler, 1978). Information systems are of a very broad nature and encompass different streams of data, such as a firm's financial and management accounting data, including cost accounting data. A costing system collects cost data, stores cost data and transforms the data into cost information useful for communication.

A firm's or business unit's cost information-processing capacity may be captured by its costing system design choices. To comply with financial reporting requirements and inventory valuation, usually a traditional, volume-based costing system is sufficient (e.g., Henri and Wouters, 2020). However, these simple costing systems do not always generate relevant and sufficient insights to support decisions and, as a result, firms may decide to invest in their cost information-processing capacity. The most prominent costing system design choice that has been investigated in prior costing research is the level of costing system complexity. In contrast to a broad term like costing system sophistication, costing system complexity specifically refers to the allocation of overhead costs to cost objects (Brierley, 2008; Drury and Tayles, 2005; Schoute and Budding, 2017). A costing system with a high level of complexity allocates overheads using many different cost pools and many different cost allocation bases (Abernethy et al., 2001; Schoute, 2009). As such, a more complex costing system provides more detailed cost information on input-output relations. The level of costing system complexity is the first costing system design choice we will focus on.

According to Chenhall and Morris (1986), uncertainty (which is an important characteristic of exploration) drives the need for more broad scope cost information. Hall (2010) states that for managers who are engaged in a variety of tasks in complex organizational contexts, information needs are diverse and encompass a wide range of information from various sources, both internal and external to the firm. We therefore examine a second costing system design choice that captures the number of different costing practices in place, i.e. standard costing, variance analysis, contribution margin accounting, target costing and life cycle costing. We label this second design choice costing system diversity. Whereas costing system complexity focuses on the level of cost allocation detail applied to internal cost data, costing system diversity refers to cost information practices collecting and analyzing not only internal current cost information but also external and forward-looking cost and market data. With costing system diversity we thus capture the presence of cost and market information in a firm or business unit from different sources and from different time horizons, like for example in target costing and life cycle costing, in which forward-looking external market information is included. Focusing on these different types of information is in line with studies that have investigated variations in performance measurement diversity (in terms of the number of measures used to assess unit performance) being associated with differences in strategic orientation (e.g., Dekker et al., 2013).

2.3. Hypotheses development

In this section, we will first concentrate on a firm's or business unit's exploration orientation as an antecedent of its costing system design choices. Insights from information-processing theory in combination with observations from organizational learning will support our hypotheses development. Second, we will explain how an exploration orientation drives cost information usage choices for decision making and control, for which appropriate costing system design choices are needed. To develop those hypotheses, we also build on insights from analytical accounting studies and the normative costing literature (cf. Schoute, 2009). Third, we will focus on the relationship between an exploitation orientation and cost information usage choices.

2.3.1. Exploration orientation as an antecedent of costing system design choices

Relying on information-processing theory, we argue that there must be a fit between a firm's or business unit's strategic orientation and its costing system design choices. Hill and Birkinshaw (2014) and O'Reilly and Tushman (2013) state that exploration is associated with uncertainty, inefficiency and cost. As exploration often relates to experimentation and engaging in new business models, inefficiencies take place when exploring new products, services and processes. These experiments might be more costly than the adaptations of existing products, services and processes that take place in an exploitation context. Hence, in order to keep costs of experimentation low, insights into the cost consequences of exploration innovation are needed. From an information-processing theory perspective and based on Galbraith's (1973, 1977) observations with respect to uncertainty, cost information-processing needs are expected to be high in the pursuit of an exploration orientation.

Since internal complex cost data provide detailed cost information on current products, services and processes one might assume that this complex cost information about the current situation is less relevant in an exploration context, which is characterized by the need for new knowledge instead of existing knowledge. However, Richtner and Åhlström (2010) point out that combination, which is the process of combining different kinds of explicit knowledge, leads to the creation of new knowledge. They argue that explicit knowledge can be found in written documents, manuals and databases and that the process of adding, sorting and categorizing explicit knowledge leads to the creation of new knowledge. Accordingly, cost information may be viewed as explicit knowledge that can be combined with other information and thus has the potential to lead to new knowledge. In particular, cost information resulting from more complex costing systems (such as activity-based costing) is useful in the context of exploration since complex costing systems are a superior representation (relative to traditional, volume-based costing systems) of the firm's production function, which allows to better estimate the controllable costs when considering different future actions (Balakrishnan et al., 2012). According to Stouthuysen et al. (2017), complex costing systems allow better understanding of the action-ends relationships of the processes than simpler traditional, volume-based costing systems. This improved understanding of the action-ends relationship is useful when experimenting with deviations from the current business model.

As exploration requires a combination of learning mechanisms (Kane and Alavi, 2007), we also expect an exploration orientation to drive firms' choice to invest in more diverse cost information. For managers who are engaged in a variety of tasks in complex organizational contexts, information needs are diverse and encompass a wide range of information from various sources, both internal and external to the firm (Hall, 2010). In a similar vein, Goodman and Darr (1998) argue that most firms will not use a single information system to support organizational learning but use a combination of mechanisms. As such, firms investing in more diverse costing systems have more opportunity to develop new knowledge since internal cost data and external information (as well as backward-looking and forward-looking information) are combined to generate insights into cost behaviour and performance. More sources of information are combined in firms with diverse costing practices, which creates more potential to develop new knowledge.

Hence, based on the high outcome uncertainty and the need for new knowledge creation (which can be supported by combination according to Richtner and Åhlström, 2010) in the pursuit of an exploration orientation, we hypothesize that firms or business units pursuing an exploration orientation tend to design more complex and diverse costing systems:

H1a. The extent to which a business unit pursues an exploration orientation is positively associated with costing system complexity.

H1b. The extent to which a business unit pursues an exploration orientation is positively associated with costing system diversity.

2.3.2. Exploration orientation and cost information usage choices

After having built hypotheses for a firm's or business unit's strategic orientation as an antecedent of costing system complexity and diversity, we now turn to the consequences of these costing system design choices in terms of resulting usage choices. Management accounting information, of which cost information is a part, has two main purposes or usages: decision facilitating and decision influencing (Demski and Feltham, 1976; see also Zimmerman, 2017). The decision-facilitating or decision-making purpose refers to the provision of information to reduce pre-decision or ex-ante uncertainty (Demski and Feltham, 1976; Tiessen and Waterhouse, 1983). The use of managerial accounting information for decision making is intended to improve employees' and managers' knowledge, thereby enhancing their ability to make better judgments and decisions as well as better informed choices (Sprinkle and Williamson, 2007). In contrast, the decision-influencing purpose of managerial accounting information is intended to reduce ex-post uncertainty (Demski and Feltham, 1976) and to influence, guide and direct behaviour through monitoring, performance evaluation and rewarding (Sprinkle and Williamson, 2007).

Acknowledging that the extent to which cost information is used may depend on its purpose (e.g., Labro, 2019), we consider both cost information usage for decision making and cost information usage for control. As it can be expected that firms design costing systems anticipating the use that managers will make of them, we argue that differences in cost information usage choices guided by strategic orientation require different costing system design choices.

Exploration orientation and cost information usage for decision making. With respect to decision making, we take into account the observation of Demski and Feltham (1976) and Tiessen and Waterhouse (1983) that (cost) accounting information is useful for decision making if it reduces pre-decision or ex-ante uncertainty. As exploration is related to learning unknown technologies or attaining new geographic markets or product domains (Stouthuysen et al., 2017), decisions with respect to the implementation of an exploration strategy are characterized by a high level of ex-ante uncertainty. Since exploration refers to experimentation with or establishing new assets and capabilities (March, 1991) and involves a shift to a different technological trajectory and requires fundamental changes (Benner and Tushman, 2003), one could assume that more complex cost information providing insights into input-output relations of current products, services and processes is not very useful for firms engaging in new capabilities, new products, new customers and new markets. Yet, according to Zimmerman (2017), more complex costing systems are a way to develop more accurate product and product-line costs, whereby accuracy means that changes in product volume, batch size and product design characteristics cause reported cost changes to be more highly correlated with changes in opportunity costs. Hence, complex cost information is useful in the context of decision making when experimenting with different alternatives, closer or further away from current operations.

Cost information can be used to support various decisions: to increase production process and operating efficiencies, to optimize production capacity, in pricing decisions, in product mix decisions and in the context of decisions related to new product development. Because the uncertainty surrounding new product development differs substantially between an exploration context (which requires new knowledge and is characterized by high pre-decision uncertainty) versus an exploitation context (which requires an extension of existing knowledge and is characterized by lower levels of pre-decision uncertainty), the knowledge needed to support new product development is different. More complex cost information, like activity-based costing (ABC), allows managers to track costs more accurately, enable identification of redundant resources, make better resource allocation decisions, and allows more accurate anticipation of the effect of changes in the product mix or the profitability of manufacturing operations (Banker et al., 2008). As such, complex cost information is useful to obtain insight into the cost consequences of new products or new processes that are under development.

In order to support decision making at the product development stage, management accounting information is also provided to R&D managers and managers of sales and marketing departments. One of the strengths of accounting information is its role as a common financial language to facilitate communication among managers from different backgrounds, experiences and knowledges (Hall, 2010). The communication role of cost information is even more important in an exploration context, where managers involved in product development, production planning and pricing cannot rely on prior experience with existing products to make decisions, as the newly developed products and related decisions deviate substantially from existing products and processes. Prior costing research suggests that complex costing systems are more suited to provide insights into a firm’s or business unit cost structure, which is according to Shank and Govindarajan (1993) a main goal of cost management and delivers information for (strategic) management purposes (Diefenbach et al., 2018). In addition, more complex costing systems are particularly well-suited to understand the heterogeneity in the cost-to-serve across customers (Labro, 2006).

Although costing systems become more difficult to implement as they become more complex, there is good reason to believe that more complex costing systems provide data that are superior in terms of decision relevance compared to data from less complex systems (Balakrishnan et al., 2012). Complex cost information can be relied upon for various decisions (Al-Omiri and Drury, 2007; Maiga et al., 2014) as it enhances insight into organizational processes and the resources consumed (Bruns and McKinnon, 1993). The operational benefits from more complex costing systems such as ABC emanate from improved visibility into the economics of production processes and causal cost drivers (Banker et al., 2008), while the strategic benefits arise from the availability of better information for product development, product mix and other strategic decisions (Anderson, 1995; Shields, 1995). In addition, Feltham's (1977) analytical model shows that the expected payoff from decisions based upon more detailed information is generally greater than that from decisions based on more aggregate information. As there is much more need for cost information to reduce pre-decision uncertainty when firms or business units have to make decisions pursuing an exploration strategy, building on Gosselin (1997), we argue that this uncertainty raises firms' or business units' demand for more detailed cost information, inciting them to invest in more complex costing systems.

In a similar vein, Gosselin (1997) argues that uncertainty drives firms to adopt costing systems that cover a much broader information range. In the context of new product development, for firms pursuing an exploration strategy, costing practices like target costing or life cycle costing broaden the knowledge about the preferences and needs of customers (Dekker and Smidt, 2003; Woods et al., 2012). In addition, they provide estimates of future revenues and costs with respect to new product development possibilities. Target costing and life cycle costing allow managers to acquire and process information about different future alternatives. These costing techniques help to reduce ex-ante uncertainty, since they allow managers to better predict the variables that will influence future outcomes (Lant and Mezias, 1990). As target costing and life cycle costing contribute to better predictability of the future, they may support decision making in the pursuit of an exploration strategy. The greater the ex-ante uncertainty, the greater the potential for benefits to be realized from employing these different costing systems, which all represent a different perspective on cost behaviour. Information resulting from diverse costing systems thus allows better predictability of the variables involved in decision making with respect to production alternatives, pricing policies and product mix decisions compared to information resulting from a single costing system.

Standing alone, each type of information is incomplete, which increases the relevance of diverse information for decision making (Henri and Wouters, 2020).

The above arguments support that more complex and diverse cost information can be useful to reduce the high ex-ante uncertainty in exploration contexts when decisions have to be taken. Hence, we hypothesize:

H2a. The relationship between a business unit's pursuit of an exploration orientation and cost information usage for decision making is positively mediated by costing system complexity.

H2b. The relationship between a business unit's pursuit of an exploration orientation and cost information usage for decision making is positively mediated by costing system diversity.

Exploration orientation and cost information usage for control. When cost information is used for decision influencing or control, the purpose of management accounting information is to reduce ex-post uncertainty (Demski and Feltham, 1976; Tiessen and Waterhouse, 1983). Managerial accounting information is useful for control as it helps to reduce information asymmetry with respect to hidden actions and hidden information (Baiman, 1982). For instance, the use of cost information in performance measurement could motivate employees to control costs (Sprinkle and Williamson, 2007). Firms may also use cost allocations to motivate mutual monitoring, co-operation or the efficient use of resources.

Although we expect more complex cost information to be used to a greater extent for decision making by firms or business units pursuing an exploration strategy, we argue that more complex cost information will not be used to a greater extent for control purposes. When information is used for control purposes, it is meant to reduce ex-post uncertainty, which implies that information asymmetry about agents' behaviour is reduced and the available information can be used for feedback purposes. Ex-post uncertainty relates to uncertainty about which actions were taken and which outcomes were realized (Lant and Mezias, 1990). Although overall, disaggregation of cost pools usually enhances the accuracy of reported product costs (Labro and Vanhoucke, 2007), it also induces greater measurement error (Cardinaels and Labro, 2008). As more complex costing systems may produce data that contain more noisy information about agents' effort (cf. Pizzini, 2006), they may not lead to efficient performance measurement or efficient compensation of agents. Since a more complex costing system may not provide better information on how costs are incurred as a result of agents' actions and decisions, we expect that more complex cost information will not be useful to reduce ex-post uncertainty in an exploration context. Hence, we do not put forward a hypothesis that costing system complexity acts as a channel on the relationship between a firm's or business unit's exploration orientation and the usage of cost information for control purposes.

Analytical accounting research on the economic benefits of greater measurement diversity shows that more measures are preferred if the additional measures provide incremental information on dimensions of the agent's actions (Feltham and Xie, 1994; Holmström, 1979). More diverse costing systems can thus provide additional cost information, which may reduce the information asymmetry between the principal and the agent and subsequently facilitate the monitoring and rewarding of agents' actions. More diverse cost information facilitates monitoring since it provides a more comprehensive view of the situation (Henri and Wouters, 2020). In addition, more diverse costing systems and their resulting information create more cost transparency throughout the firm by providing more information on the appropriateness of the level and volatility of costs as compared to organizational goals (Anderson, 2007). On the one hand, managers can use diverse costing practices like standard costing, variance analysis and contribution margin accounting to evaluate their unit's activities as well as subordinate managers' and employees' behaviour in order to align it with the organizational goals (e.g., Bedford et al., 2016). On the other hand, cost targets provided by target costing and life cycle costing can serve as benchmarks for evaluation purposes in later years. Target costing indicates how decisions made during product development affect product costs (e.g., Anderson and Sedatole, 1998). Actual cost figures can then be compared to allowable costs and decisions made in the development phase (Ansari et al., 2007). Hence, more diverse cost information helps to reduce information-based problems related to information asymmetry on the actions of the agent and the amount of private information possessed by the agent. Consequently, diverse cost information reduces ex-post uncertainty since it provides more transparency on hidden actions and hidden information. As such, it is useful for control purposes, especially performance measurement and compensation. Hence, we hypothesize that costing system diversity will mediate the relationship between a firm's or business unit's pursuit of an exploration orientation and cost information usage for control purposes:

H2c. The relationship between a business unit's pursuit of an exploration orientation and cost information usage for control is positively mediated by costing system diversity.

2.3.3. Exploitation orientation and cost information usage choices

Exploitation requires the ability to refine and extend existing knowledge (March, 1991), as exploitation innovations extend existing products and services for existing customers and build on existing local knowledge (Benner and Tushman, 2003). Levinthal and March (1993, p. 105) state that exploitation involves “the use and development of things already known”. Consequently, exploitation is much less related to outcome uncertainty than exploration. In more stable environments, visibility, analytics and information-processing capacity are likely less important determinants of performance, as decision-making is more a routine (Srinivasan and Swink, 2018). Hence, from an information-processing theory perspective, there is less need for investment in cost-information processing capacity since the outcome uncertainty is much smaller and the future is more predictable when an exploitation strategy is pursued.

As (cost) accounting is just one part of a manager’s information set (apart from direct observation, informational reports, etc.), its strengths and weaknesses are not determined in isolation but relative to other sources of information at managers’ disposal. From an organizational learning perspective, existing local knowledge, which refers to an operational understanding that originates from organizational members’ involvement in certain practices, routines and events in their specific functional niches (Vaivio, 2004), can become an important source of knowledge to support exploitation activities. Local knowledge can remain unverbalized or take tacit forms (Nonaka, 1994). As tacit knowledge is primarily developed through social interactions and inference from actions and behaviour in certain situations (Johnson and Proctor, 2016), it can be a substitute for formal information bases. Past experiences and accumulated tacit knowledge can be sufficient to pursue an exploitation type of innovation mode, since exploitation results more in new products that are not substantially different from the existing ones (e.g., Xie and O'Neill, 2014). Since an exploitation orientation is related to improving current capabilities, it merely requires existing knowledge on current products, services and processes, whereby tacit knowledge, which is knowledge derived from experience (Grant, 1996), can be an important source of knowledge on current products, services and processes. Hence, we expect that an exploitation orientation will not drive the design of more complex or diverse costing systems, since past experiences and tacit knowledge can substitute for insights into input-output relationships provided by more complex costing systems. Moreover, according to Lant and Mezias (1990), a learning model suggests that the acquisition and processing of information about alternatives takes place in a relatively costly process of search. Since exploitation opportunities can be discovered based on experience with the current products, services and processes, the cost-benefit trade-off for investments in complex costing or diverse systems is less beneficial for firms or business units pursuing an exploitation strategy than for firms or business units pursuing an exploration strategy. Likewise, because informational needs become smaller and more focused in an exploitation context (Henri and Wouters, 2020), the advantage of having more complex and diverse information becomes smaller relative to the disadvantage of information overload.

Given that firms or business units pursuing an exploitation strategy face less pre-decision uncertainty, there is less need for information resulting from complex and diverse costing systems to reduce ex-ante uncertainty and support their decision making. In an exploitation context, managers' working environment is more predictable since new products, new services and new processes are incremental adaptations of the existing ones. With respect to those existing products, services and processes, a lot of knowledge has been accumulated based on prior experiences. As such, firms or business units pursuing an exploitation strategy can support decisions based on insights from past experiences and routines. On the one hand, having more diverse information might be helpful, because the decision maker gains a more comprehensive picture of how product development is being carried out and what is achieved. On the other hand, having information that can be incommensurable and potentially conflicting may cause problems of information overload (Henri and Wouters, 2020). As unpredictability increases and informational needs become greater and more diverse, the benefits of having more information outweigh the cost of producing that information. However, when unpredictability decreases and information needs become smaller and more focused, having more information is less beneficial relative to the problems that arise from having to deal with more and often incommensurable information (Henri and Wouters, 2020).

Since exploitation represents an adaptation of existing products, services and processes, existing knowledge based on past experience and tacit knowledge can provide the necessary insights for exploitation innovation. Hence, in an exploitation context, there is less need for costing systems that could produce highly complex and diverse cost information. Consequently, we do not expect significant associations between the pursuit of an exploitation orientation and the level of costing system complexity and diversity. Since management accounting information is used by managers to acquire knowledge on their working environment, we do predict that in an exploitation context, cost information will be used to support decisions regarding, for instance, optimizing production capacity, product mix and pricing. However, available cost information can fulfil the information requirements since the working environment is more predictable as there is less outcome uncertainty and decisions can be informed by managers' past experiences and tacit knowledge. In addition, available cost information can serve as a communication mechanism in an exploitation context between managers from different backgrounds.

Since cost information also has a communication role with respect to past performance, we expect that available cost information will also be used for control purposes in an exploitation context. Because firms or business units pursuing an exploitation orientation can support decisions with traditional, volume-based costing systems, less measurement error will be present in cost data such that they are more suitable to be used for control purposes. Similarly, we expect that more diverse cost information will not be needed to reduce information asymmetry as managers are engaged in a smaller a variety of tasks in exploitation contexts, which are characterized by lower uncertainty. We therefore predict that available cost information will be used for control purposes in firms or business units pursuing an exploitation orientation.

Hence, because reduced information-processing requirements in business units pursuing an exploitation orientation do not warrant investments in costly systems, we do not predict mediation hypotheses but instead predict two direct effects:

H3a. The extent to which a business unit pursues an exploitation orientation is positively associated with cost information usage for decision making.

H3b. The extent to which a business unit pursues an exploitation orientation is positively associated with cost information usage for control.

Fig. 1 provides an overview of all hypotheses in a graphical way.

- Insert Fig. 1 here -

3. Research method

3.1. Research population

We collected data from business units of Thai medium- and large-sized firms in 2017. While many costing system surveys focus on manufacturing firms (e.g., Al-Sayed and Dugdale, 2016; Banker et al., 2008; Schoute, 2009, 2011), surveys in the service industry are scarce (Drury and Tayles, 2005), particularly in innovation studies (Chenhall and Moers, 2015). We therefore take a broader industry focus and include service firms in our sample.

The Thai economy is mainly based on exports (>75% of GDP in 2015; Bank of Thailand, 2015). As a result, Thai firms are subject to global competition, such that exploitation and exploration are necessary to support Thai firms' objectives in order to survive and grow. Therefore, Thailand provides an appropriate research environment to study the relationships between exploitation and exploration and the purposes of cost information use.

From the database of the Ministry of Commerce, we selected large manufacturing and service firms with annual assets exceeding 200 million Baht (5.6 million euros), and medium manufacturing and service firms with annual assets between 50 million Baht (1.4 million euros) and 200 million Baht (5.6 million euro; Thailand's Department of Business Development Ministry of Commerce, 2015).[1] These size criteria led to a population of 7,555 firms (3,273 large-size manufacturing firms; 3,377 medium-size manufacturing firms; 417 large-size service firms and 488 medium-size service firms). We used a stratified sampling method to randomly select 2,000 out of these 7,555 firms to assure that the sample reflects the population regarding the industry and size categories.

3.2. Data collection

The data were collected using a survey with measures based on prior research. The survey was first developed in English and afterwards translated into Thai. The Thai version of the English survey was developed and validated by Thai professional language translators (Behling and Law, 2000). It was then translated back into English to check whether the measures still had the same initial information content (Brislin, 1970). The survey was pre-tested with four accountants, one accounting professor and five managers from different industries (food, metal, construction, banking and other manufacturing). The cover letter, the survey, and pre-paid return envelopes were sent by post from January 2017 to April 2017 to business unit managers in the 2,000 randomly selected firms. The initial survey was followed-up by two reminder surveys as well as reminder calls. Following Kruis et al. (2016), we targeted business unit managers because studying business units should reveal a more homogeneous sample than examining strategic orientations and the purposes of cost information use at the firm level. Hence, our units of analysis are business units. In addition, firm age was collected from the website of each firm and the presence of foreign ownership as well as additional measures of firm size (i.e. total assets and total sales) were collected from the Orbis database.

We received 276 returned surveys in total, of which 216 were fully completed, 24 had missing values and 36 came back uncompleted due to incorrect addresses. This results in a response rate of 12%[2], which is in line with prior costing system surveys in other countries, such as the United Kingdom (Al-Sayed and Dugdale, 2016; 11%) and China (Fei and Isa, 2010; 12.30%). We omitted financial firms (15) due to the concern that they may be subject to

[1] Amounts in euros are calculated based on the conversion rate on 29 January 2021.
[2] The response rate is calculated by (276-36)/2,000.

regulation regarding their cost calculations (cf. Du et al., 2013). After excluding multiple observations from the same unit (10), the final sample for our analyses is 191 business units.

We tested whether the sample of respondents is representative of the population. First, we tested whether the random sample of 2,000 firms was representative of the total population of 7,555 firms. *T*-tests did not reveal any differences with respect to size criteria. That is, the results indicate that there are no differences between the original population (7,555) and the 2,000 randomly selected firms regarding total assets in the manufacturing industry ($p = 0.439$) and the service industry ($p = 0.757$), or regarding total sales in the manufacturing industry ($p = 0.465$) and the service industry ($p = 0.082$). A Pearson χ^2 test reveals that the population and the survey sample also have a similar percentage of manufacturing and service firms ($p = 0.317$). Second, we tested whether the sample of 191 responses was representative of the original population of 7,555 firms. *T*-tests again confirm that this is the case. That is, we do not observe significant differences between the original population of 7,555 firms and the sample of 191 responses regarding total assets in the manufacturing industry ($p = 0.112$) and the service industry ($p = 0.276$), or regarding total sales in the manufacturing industry ($p = 0.107$) and the service industry ($p = 0.164$). A Pearson χ^2 test again reveals that the population and the survey sample have a similar percentage of manufacturing and service firms ($p = 0.831$).

We also tested for non-response bias by comparing the means of all variables in our study between early and late respondents using *T*-tests and Pearson χ^2 tests (Kanuk and Berenson, 1975). First, we define early respondents as respondents who returned the survey before the reminders were sent (69) and late respondents as the ones who returned the survey after the reminders (122). The results reveal no significant differences for any of the variables (all $p \geq 0.104$). Second, we define early respondents as the first 30% (57) of surveys that were returned and late respondents as the last 30% (57) of surveys that were returned. The results reveal no significant differences for any of the variables (all $p \geq 0.156$). Thus, we conclude that our sample is not affected by non-response bias.

3.3. Variable measurement

3.3.1. Independent variables: exploitation and exploration

We measured exploitation and exploration through the 12-item scale developed by Lubatkin et al. (2006). Respondents were asked twelve questions to assess their business unit's pursuit of an exploitation and exploration orientation during the past three years by using a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). As such, we measure a business unit's intention to invest in exploitation and exploration over the previous three years as opposed to the achievement of incremental and radical innovations (e.g., Bedford et al., 2019).[3] We performed an exploratory factor analysis with an oblique rotation (Direct Oblimin) on these items to allow for correlations among factors (Fabrigar et al., 1999). This resulted in two factors with eigenvalues greater than 1. Table 1 presents the results of this analysis. Based on our sample size, item loadings above 0.40 are identified as significant (Hair et al., 2010, p. 117). Both factors have an adequate reliability with Cronbach's alpha values of 0.914 (exploitation) and 0.910 (exploration).

- Insert Table 1 here -

3.3.2. Dependent variables: cost information usage for decision making and control

The measure to capture cost information usage for decision making and control is based on instruments used in prior studies (Chenhall, 2004; Foster and Swenson, 1997; Innes and Mitchell, 1995; Pike et al., 2011; Schoute, 2009). It includes twelve questions asking respondents to rate the extent to which cost information is used for each area, using 7-point Likert scales ranging from 1 (strongly disagree) to 7 (strongly agree). In order to identify underlying dimensions of the purposes of cost information use (decision making versus control), an exploratory factor analysis with an oblique rotation (Direct Oblimin) was conducted in order to permit correlations among factors (Fabrigar et al., 1999). Table 2 presents the results of the analysis, leading to the separation of the twelve items into two factors. The first factor includes seven items: capacity management and capacity investment decisions, identification of opportunities for improvement, process/operations management, product/service management decisions, pricing decisions, new product/service development decisions, and budgeting, planning and forecasting. The second factor includes the following three items: outsourcing decisions, compensation and rewarding, and performance evaluation. Since the first factor is related to the extent of using cost information to facilitate decisions, we label this factor as *cost information usage for decision making*. As the second factor is related to the extent of using cost information to influence decisions, we label it as *cost information usage for control*. We deleted two items (6 and 12) because of cross-loadings. The reliability of the two factors is adequate with Cronbach's alpha values of 0.953 and 0.887, respectively.

- Insert Table 2 here -

[3] Moreover, the directionality of the relationships in our model is in line with Luft and Shields (2003), who highlight that choices of directionality are related to the time length for which evidence is collected. Accordingly, respondents assessed the exploitation/exploration orientation over the past three years and provided information on current costing system design choices.

3.3.3. Mediating variables: costing system complexity and costing system diversity

The two costing system design choices that we investigate in this study are costing system complexity and costing system diversity. Costing system complexity refers to the allocation of overhead costs to cost objects (Brierley, 2008; Drury and Tayles, 2005). Appendix A presents an overview of related concepts and operationalizations used in prior costing studies. First, to ascertain whether only variable or also absorption costing systems were used, respondents were asked to indicate whether or not their costing systems allocates indirect costs to cost objects (Al-Omiri and Drury, 2007). Next, in line with prior research, our measure of costing system complexity also includes the number of cost pools and cost allocation bases (e.g., Drury and Tayles, 2005; Schoute and Budding, 2017). Finally, following Abernethy et al. (2001) and Schoute (2009), respondents had to indicate the type of cost pools (i.e. (a) functionally-oriented (e.g., departmental) cost pools, (b) functionally- and process-oriented cost pools, or (c) process-oriented (e.g., activity) cost pools) and the type of cost allocation bases (i.e. (a) only unit-level allocation bases, (b) both unit-level and batch-level allocation bases, or (c) both unit-level, batch-level and product-level allocation bases). Hence, costing system complexity measures (1) whether only variable costing or also absorption costing is used, and (2) when absorption costing is used, it represents the number and type of cost pools as well as the number and type of cost allocation bases.

Apart from costing system complexity in terms of the applied overhead absorption procedures, we also measure costing system diversity. In the context of performance measurement, Ittner et al. (2003) consider measurement diversity as “supplementing traditional financial measures with a diverse mix of non-financial measures that are expected to capture key strategic performance dimensions that are not accurately reflected in short-term accounting measures” (p. 717). Appendix B presents an overview of diversity measures used in prior management accounting and control studies. Overall, diversity refers to a broader set of measures/systems/practices. Accordingly, we use eight items to measure diversity in costing practices. They capture the diversity of cost information in practice (IMA, 2019): diversity in the allocation of costs of support departments (item 5; cf. Drury and Tayles, 2005); standard costing (items 6, 7 and 8), variance analysis (item 9), contribution margin accounting (item 10), life cycle costing (item 11) and target costing (item 12).

Appendix C presents the survey questions and explains the scoring system for the costing system design choices. Overall, we capture differences in costing system design choices with respect to 15 different items, of which seven items relate to costing system complexity and eight items relate to costing system diversity. The scores obtained for the level of costing system complexity range from 0 to 18. The scores obtained for costing system diversity range from 0 to 8.[4]

We validate our instrument with exploratory factor analysis,[5] using an oblique rotation (Direct Oblimin). As shown in Table 3, the first factor includes variable costing (item 1), absorption costing (items 2 and 3), the number and type of cost pools (items 4.1 and 4.2) and the number and type of cost allocation bases (items 4.3 and 4.4). The second factor includes all items we used to measure diversity in costing practices. Cronbach's alpha of the two factors is 0.907 and 0.732, respectively. We label the first factor as *costing system complexity* and the second factor as *costing system diversity*.

- Insert Table 3 here -

3.3.4. Control variables

Prior studies revealed that product diversity, product customization, firm age, firm size, perceived environmental uncertainty, international sales, foreign owner and industry are also associated with design characteristics of costing systems or other control systems. As these variables may also influence subsequent usage choices, we control for the influence of these variables on costing system design choices and cost information usage for decision making and control.

Product diversity refers to conditions under which products put different demands on an organization's activities, which place different demands on its resources. It is considered to be the most important cause of distorted product costs by a traditional costing system (e.g., Abernethy et al., 2001; Al-Omiri and Drury, 2007; Al-Sayed and Dugdale, 2016; Bjørnenak, 1997; Drury and Tayles, 2005; Malmi, 1999; Schoute, 2011). The introduction of complex costing systems, which provide multiple cost pools and cost drivers, will reduce this error as an increasing number of cost pools and cost drivers can better capture diversity in resource consumption patterns (Labro and Vanhoucke, 2007). As increasing product diversity may impede the decision usefulness of less complex cost information (e.g., Baird et al., 2004), we control for the influence of product diversity on cost information usage for both decision

[4] Our choice to use dummy variables for the scoring of costing system diversity is in line with other diversity measures used in prior innovation studies (e.g., Davila and Foster, 2005).

[5] Since the items we used to measure costing system design choices are ordinal and dichotomous variables, the exploratory factor analysis relies upon the polychoric correlation matrix. This analysis was performed in the statistical package R.

making and control. Product diversity is measured as the number of different products/services present in the business unit, using an ordinal scale (Kallunki and Silvola, 2008).

Product customization stimulates the development of more complex costing systems (Bjørnenak, 1997; Drury and Tayles, 2005; Schoute, 2011). Levels of customization cause non-repetitive production activities, such that costs are difficult to standardize. Consequently, the tracking of actual costs is required (Drury and Tayles, 2005), stimulating the need to adopt complex costing systems (Bjørnenak, 1997; Drury and Tayles, 2005; Schoute, 2011). Using an ordinal scale, product customization is measured by the level of standardization versus customization, which is applied to the whole range of products/services in the business unit. This measurement is adopted from Kallunki and Silvola (2008).

Firm age. Older firms have greater accumulated experience (e.g., Bedford, 2015), allowing for the use of less complex costing systems. Firm age is measured as the number of years the firm has been operating since its establishment.

Firm size. Larger firms have more available resources to implement more complex costing systems than smaller firms (e.g., Abdel-Kader and Luther, 2008; Al-Sayed and Dugdale, 2016). The demand for complex costing systems for planning, control and coordination of activities may also be greater in larger firms (Baird et al., 2004). Hence, we expect that more complex costing systems will be more useful in larger firms. Firm size is measured by the number of full-time employees (Hoozée and Ngo, 2018) as an ordinal variable that ranges from 1 (less than 100) to 5 (more than 1,000).[6]

Perceived environmental uncertainty is related to managers' perceived inability to accurately predict an organization's external environment (Al-Sayed and Dugdale, 2016). High environmental uncertainty makes it difficult for managers to appropriately predict the normal working processes or schedules. Consequently, they need more complex cost information to reduce this uncertainty (cf. Galbraith, 1973), increasing the demand to design a more complex costing system. The measurement of perceived environmental uncertainty is adopted from Schoute (2009). It is measured by eight items. The respondents were asked to indicate the business unit's operating environment using a 7-point Likert scale ranging from 1 (very unpredictable) to 7 (very predictable). We reversed these items before calculating the average perceived environmental uncertainty score.

[6] We performed a robustness check in which we measured firm size as the natural logarithm of total assets of the firm, obtained from the Orbis database. This alternative measure does not impact our results (qualitatively or inferentially).

International sales refer to the sales of products from the home country to a foreign market (Gupta and Govindarajan, 1991). Export firms are faced with higher global competition and more complex transactions than non-exporting firms. Consequently, they need more complex costing systems (Drury, 2018). International sales are measured by asking the respondents to identify whether their business unit's sales are international (scored as 3) or domestic (scored as 1) or both (scored as 2).

Foreign owner. This variable relates to whether or not the activities and outcomes of a foreign subsidiary are influenced by the actions of headquarters in other countries (O'Donnell, 2000). Foreign subsidiaries can be expected to design complex and diverse costing systems if headquarters have also done so. Foreign owner is measured as a categorical variable which is set equal to 0 if a firm is owned by Thai owners, 1 if it is owned by Japanese owners (> 50 % of global ultimate owner shares; Du et al., 2013), 2 if it is owned by Chinese owners, and 3 if the firm is owned by US or European owners. In the structural models, we introduce three dummy variables with Thai owners as the benchmark category to capture this control variable.

Industry. We control for industry based on the firm's International Standard Industrial Classification (ISIC) code (Thailand's Department of Business Development Ministry of Commerce, 2013). Industry is a dummy variable set equal to 1 if a firm is a manufacturing firm (ISIC codes 10-33 (manufacturing) and codes 41-43 (construction)) and 0 if it is a service firm (ISIC codes 55-56). As costing system surveys in the service industry are scarce (Drury and Tayles, 2005), we believe these two broad categories are appropriate.

The measurement of all control variables can be found in Appendix C.

3.4. Common method bias

In order to avoid common method bias, two remedies were introduced: the study's procedures design and statistical controls (Podsakoff et al., 2003). Regarding the study's procedures design, the survey items were designed in different response formats, for instance binary choices, different Likert scales (strongly disagree/agree, very unpredictable/predictable, not at all/to a great extent) and negative wording (reverse-coded items). We also guaranteed respondent anonymity and confidentiality to instigate respondents to answer in a truthful way (Chang et al., 2010). Moreover, our questions do not induce mood states, and we tried to avoid ambiguity as well as complicated syntax. Lastly, we did not use bipolar numerical scale values (e.g., -3 to +3) and provided verbal labels for the midpoints of 7-point Likert scales (Tourangeau et al., 2000).

Regarding statistical controls, we used Harman's single-factor test to test for the possible presence of common method bias (Harman, 1967). We loaded all the variables in our study into an exploratory factor analysis and examined the unrotated factor solution to determine the number of factors that were necessary to account for the variance in the variables (Podsakoff et al., 2003). The principal component factor analysis shows that the variance explained by the first component (35.11%) is below half of the total explained variance (75.18%), suggesting that there is no single component that can be extracted (Bedford et al., 2019; Bedford et al., 2016). Therefore, we conclude that our sample does not suffer from common method bias.

4. Results

4.1. Descriptive statistics

The main descriptive statistics are presented in Table 4 and the correlations in Table 5. The independent (exploitation and exploration) and dependent variables (cost information usage for decision making and control) are measured by multiple items. Their minimum value is 1 and their maximum value is 7.

Regarding the first mediating variable, costing system complexity, 72.8% of our sample firms have identified direct and indirect costs and then allocated both to cost objects. Within this proportion, 47.1% use 1-10 cost pools, 9.4% use 11-20 cost pools, 5.2% use 21-30 cost pools and 11% use more than 30 cost pools. The most common type of cost pools used is functionally and process-oriented (e.g., departmental and activities) (30.9%). With respect to cost allocation bases, 57.6% of our sample firms use 1-5 cost drivers, 8.4% use 6-10 cost drivers and 6.8% use 10 or more cost drivers. The type of cost drivers used include only unit-level allocation bases (31.4%), both unit-level and batch-level allocation bases (8.9%), and both unit-level, batch-level and product-level allocation bases (32.5%). Regarding the second mediating variable, costing system diversity, 65.4% of our sample firms indicate that they allocate support departments' costs, 22.5% use standard costs, 36.1% calculate idle capacity costs, 53.9% allocate capacity costs to cost objects, 74.3% use variance analysis, 41.4% use contribution margin accounting, 39.8% use life cycle costing and 53.9% use target costing.

With respect to firm characteristics, the majority of respondents come from the manufacturing industry (86.9%). The other firms operate in the service industry (13.1%). The average firm age is 23 years. Most of our sample firms have more than 250 full-time employees. In addition, 55.5% of our sample firms are owned by Thai nationals, while 2.1% are owned by Chinese nationals, 30.9% are owned by Japanese nationals and 11.5% are owned by US or

European nationals. The large majority of responding firms are selling their products and services both internationally and domestically (71.7%). With respect to respondent information, 29.3% classify themselves as accountants or controllers, 59.7% as business unit managers and 11% as other positions.[7] The respondents' average tenure within the firm is 10 years.

Since we rely on a specific scoring system for our costing system complexity measure, we provide some evidence of criterion validity for this measure based on the correlation table (Table 5). To assess the criterion validity of our costing system complexity measure, we evaluate the correlations between this measure and some control variables, which are expected to show or not show a significant correlation with our costing system complexity measure (cf. Fullerton et al., 2013). Based on prior research on costing system complexity (see Appendix A), we selected the control variables firm size, perceived environmental uncertainty, product customization and product diversity to evaluate their correlation with our measure of costing system complexity. First, we observe a positive correlation with firm size (r = 0.144, p = 0.047), which is in line with Al-Omiri and Drury (2007), Drury and Tayles (2005) and Schoute (2009). Second, we observe a marginally significant correlation with perceived environmental uncertainty (r = -0.130, p = 0.074). However, Schoute (2009) did not find a significant correlation. Third, we observe a positive correlation with product customization (r = 0.192, p = 0.008), which contradicts Drury and Tayles (2005), who observed a negative correlation. Fourth, in line with Al-Omiri and Drury (2007), we observe a positive non-significant correlation with product diversity (r = 0.072, p = 0.320). However, this contradicts some other studies that show a positive significant association (Drury and Tayles, 2005; Schoute, 2009). In sum, two of the four examined correlations are in line with prior research on costing system complexity, which provides some evidence of criterion validity.

The correlation table also reveals that the two purposes of cost information use are strongly correlated (r = 0.735, p < 0.001). We will come back to this issue when we discuss the measurement model results in the next section.

- Insert Table 4 and Table 5 here -

4.2. Measurement model results

[7] Although we targeted business unit managers, we noticed that a number of them transferred the survey, mostly to accountants. In Section 4.4.1, we re-performed our analyses on the subsample of business unit managers only.

We first discuss the results of the measurement model, in which the latent variables (unobservable constructs) are captured by the indicating items (Hair et al., 2010). In our study, all multi-item constructs are reflective. The measurement model is estimated in Amos.[8] Measurement model fit was evaluated using multiple fit indices. We selected the comparative fit index (CFI) and χ^2/df (degrees of freedom) as goodness-of-fit indices, and the root mean square error approximation (RMSEA) and the standardized root mean square residuals (SRMR) as badness-of-fit indices (Hair et al., 2010). We did not use the goodness-of-fit index (GFI) because this measure would underestimate the fit of the model as it is sensitive to the number of items included in the model (Dekker and Van den Abbeele, 2010). Instead of the GFI, an incremental fit index such as the CFI is preferable. The model (see Fig. 2) shows an adequate model fit, as a CFI of 0.941 is combined with a SRMR of 0.065 and a RMSEA of 0.078 (Hair et al., 2010, p. 672). In behavioural research, a χ^2/df < 3 indicates a good fit (Iacobucci, 2010). Hence, a χ^2/df of 2.157 (414.206/192) indicates that the model fits the data well. Before analyzing the relations between the latent variables, we investigated their internal consistency reliability, convergent validity and discriminant validity.

First, regarding internal consistency reliability, Table 6 shows the Cronbach's alpha and composite reliability of the multi-item constructs. We find that they are all above 0.88, which is acceptable (Hair et al., 2010).

Second, to assess convergent validity, item loadings and average variance extracted (AVE) values were examined through confirmatory factor analysis. We find in Fig. 2 that all items load significantly onto their respective construct (all $p < 0.001$). These loadings exceed the threshold value of 0.50 and most of them even exceed the ideal value of 0.70 (Hair et al., 2010). Table 6 shows that the AVE for each multi-item construct exceeds 0.50, which indicates that the variance shared between a construct and its indicators is larger than the measurement error variance (Hair et al., 2010). Therefore, convergent validity is satisfactory.

Third, regarding discriminant validity, Table 5 reveals that the square root of each construct's AVE is greater than its highest correlation with any other construct (Fornell-Larcker criterion), which shows that each construct is distinct from other constructs (Fornell and Larcker, 1981). Although the exploratory factor analysis on the items measuring cost information usage for decision making and cost information usage for control resulted in a two-

[8] Costing system complexity and costing system diversity are not included in the measurement model, because for these measures we have to rely upon polychoric correlations and a specific scoring system. Therefore, we will include these variables as measured variables (i.e. calculated variables as explained in the scoring system in Appendix C) in the structural model.

factor solution (see Table 2), given the high correlation between both variables, we will acknowledge the amount of overlap between them by allowing their error terms to co-vary in the structural model (cf. Groen, 2018).

Overall, we are able to conclude that the measurement of the variables in our model is reliable and valid.

- Insert Fig. 2 and Table 6 here -

4.3. Structural models results

Table 7 (Panel A) and Fig. 3 present the results of the structural model, which estimates the relationships between the variables. As recommended by Preacher and Hayes (2004) and Hayes (2009), we ran a bootstrapping procedure in Amos with 5,000 bootstrap samples and a 95% confidence interval to estimate indirect and total effects in order to test for mediation. The fit statistics (CFI = 0.927, RMSEA = 0.062, SRMR = 0.052, $\chi^2/df = 1.719$) indicate that this model reproduces the sample data well.

First, we focus on the relationship between a business unit's exploration orientation and its costing system design choices. An exploration orientation is significantly positively related to both costing system complexity ($\beta = 0.223$, $p = 0.016$) and costing system diversity ($\beta = 0.330$, $p < 0.001$). As such, business units pursuing an exploration orientation design more complex and more diverse costing systems, which supports H1a and H1b.

Second, using a bootstrapping procedure, we estimate indirect and total effects to perform mediation analyses. Since we have a multiple mediator model, we calculate specific indirect effects using Gaskin's (2016) estimand in Amos 22, in which the products of the regression coefficients are automatically calculated as well as their significance to formally test our mediation hypotheses (Burt and Hampton, 2017; Hayes, 2009). We find significant overall indirect effects of an exploration orientation on cost information usage for decision making ($\beta = 0.064$, $p = 0.021$) and control ($\beta = 0.076$, $p = 0.007$). Since the direct effects of an exploration orientation on cost information usage for decision making ($\beta = 0.086$, $p = 0.380$) and control ($\beta = 0.072$, $p = 0.563$) are non-significant in the structural model, costing system design choices mediate this relationship. Specific indirect effects (displayed at the bottom of Table 7, Panel A) show that, on the one hand, the indirect relationship between an exploration orientation and cost information usage for decision making is marginally significantly explained by both costing system complexity ($\beta = 0.023$, $p = 0.065$) and costing system diversity ($\beta = 0.031$, $p = 0.082$), which is in line with H2a and H2b. On the other hand, the indirect relationship between an exploration orientation and cost information usage for control is primarily explained by costing system diversity ($\beta = 0.053$, $p = 0.010$), which supports H2c.

Third, as predicted by H3a and H3b, the direct effects of an exploitation orientation on cost information usage for decision making ($\beta = 0.531$, $p < 0.001$) and control ($\beta = 0.489$, $p < 0.001$) are significant. These effects are not mediated by costing system design choices; that is, we do not find significant indirect effects of an exploitation orientation on cost information usage for decision making ($\beta = -0.022$, $p = 0.284$) or control ($\beta = -0.029$, $p = 0.192$). Moreover, we find that an exploitation orientation is not significantly associated with costing system design choices (both $p \geq 0.139$).

Regarding the control variables, product diversity is negatively associated with cost information usage for control ($\beta = -0.160$, $p = 0.012$). This is in line with Schoute's (2009) study on outcome effects of costing system design and usage choices, who also found that the effect of product diversity differed depending on how effectiveness was measured (purposes of use versus satisfaction).

In addition, we ran a constrained structural model in which we constrain the mediating paths through costing system design choices (i.e. costing system complexity and costing system diversity) to zero. The results of this constrained structural model (see Table 7, Panel B) show that the direct effects of an exploitation orientation on cost information usage for both decision making ($\beta = 0.509$, $p < 0.001$) and control ($\beta = 0.461$, $p < 0.001$) remain significant, whereas the direct effects of an exploration orientation on cost information usage for both decision making ($\beta = 0.146$, $p = 0.059$) and control ($\beta = 0.145$, $p = 0.090$) become marginally significant. Although we only observe marginally significant direct effects of an exploration orientation on both purposes of cost information use in this constrained model, the significant indirect effects provide evidence of costing system design choices being mechanisms in explaining the relations between an exploration orientation and cost information usage for both decision making and control, even in the absence of a significant direct or total effect (Burt and Hampton, 2017, p. 378; Hayes, 2009, p. 414-415; MacKinnon, 2000, p. 143; MacKinnon et al., 2012, p. 10; Mathieu and Taylor, 2006, p. 1037-1039).[9] Moreover, results from the χ^2 difference test show that our mediating structural model (Fig. 3) fits the data better than the

[9] In the absence of a significant total effect (in the unconstrained model) or direct effect (in the constrained model), some methodologists avoid the term "mediation" and refer to an indirect effect through a linking mechanism (e.g., Mathieu and Taylor, 2006; Preacher and Hayes, 2004), while other methodologists argue that even in the absence of a significant total or direct effect, a significant indirect effect represents mediation (e.g., MacKinnon, 2000; MacKinnon et al., 2002). Hayes (2009) concludes that although there is debate about the terminology, it does not affect the empirical outcomes. As such, costing system design choices are linking mechanisms between an exploratory orientation and cost information usage for both decision making and control.

constrained structural model ($\chi^2 = 32.262$, $p < 0.001$). In addition, we observe high correlations between exploitation and cost information usage for decision making ($r = 0.579$, $p < 0.001$) and cost information usage for control ($r = 0.526$, $p < 0.001$) as well as between exploration and cost information usage for decision making ($r = 0.436$, $p < 0.001$) and cost information usage for control ($r = 0.425$, $p < 0.001$), which suggests that associations between these variables do exist.

- Insert Table 7 and Fig. 3 here –

4.4. Robustness checks

We performed several robustness checks. First, we ran the structural equation model on several subsamples. Second, we defined an alternative operationalization of our costing system complexity and costing system diversity measures. The results of these robustness checks are tabulated in Section A1 of the online appendix.

4.4.1. Subsamples

As a first robustness check, we ran the structural equation model again on the subsample of manufacturing firms only ($n = 166$), since a large number of firms in our sample are manufacturing firms. The results are largely consistent with the results obtained for the total sample ($n = 191$; manufacturing and service firms). In addition, we find a marginally significant association ($\beta = -0.165$, $p = 0.083$) between an exploitation orientation and costing system diversity. The indirect effects are also largely consistent with the results obtained for the total sample. More specifically, the indirect effects of an exploitation orientation on cost information usage for decision making ($\beta = -0.025$, $p = 0.304$) and control ($\beta = -0.031$, $p = 0.199$) are non-significant and the indirect effect of an exploration orientation on cost information usage is marginally significant for decision making ($\beta = 0.059$, $p = 0.060$) and is significant for control ($\beta = 0.067$, $p = 0.030$). Specific indirect effect estimates are qualitatively in line with the total sample, but become less significant or non-significant (for the indirect effect of exploration on cost information usage for decision making through costing system diversity in H2b; $p = 0.179$) in this subsample.

As a second robustness check, we ran the structural equation model again on the subsample of business unit managers only ($n = 114$). The results are largely consistent with the results obtained for the total sample ($n = 191$). In addition, we observe a marginally significant association between an exploitation orientation and costing system complexity ($\beta = -0.263$, $p = 0.056$). The indirect effects are also largely consistent with the results obtained for the total sample. More specifically, the indirect effects of an exploitation orientation on cost information usage for decision making (β = -0.027, p = 0.581) and control (β = -0.038, p = 0.515) are non-significant; the indirect effect of an exploration orientation on cost information usage is marginally significant for decision making (β = 0.091, p = 0.051) and is significant for control (β = 0.113, p = 0.042). Specific indirect effect tests are also consistent with the total sample, except for the indirect effect of exploration on cost information usage for decision making through costing system complexity in H2a, which becomes non-significant (p = 0.999) in this subsample.

As a third robustness check, we selected a subsample in which we excluded highly ambidextrous business units. Ambidextrous business units jointly pursue an exploitation and exploration orientation. To calculate the level of ambidexterity in a business unit, we took the sum of all 12 exploitation and exploration items (Lubatkin et al., 2006). Ambidexterity has a Cronbach's alpha value of 0.927. In our sample, the minimum score for ambidexterity amounts to 18.00 and the maximum score amounts to 84.00. On average, business units have an ambidexterity score of 60.513 with a standard deviation of 14.342. We identify business units with an ambidexterity score of 72.00 and higher as highly ambidextrous business units. These business units score, on average, 6 (out of 7) on all 12 exploitation and exploration items. Moreover, this ambidexterity score of 72.00 coincides with the last quartile of the total dataset. Hence, we performed this robustness check on a subsample of 140 business units, i.e. excluding the highly ambidextrous business units.[10] The results are largely consistent with the results obtained for the total sample (n = 191). For this subsample (n = 140), an exploration orientation is not associated with costing system complexity (β = 0.132, p = 0.142), while all other direct effect results are in line with the main results. Indirect effects are also consistent with the main results. More specifically, the indirect effects of an exploitation orientation on cost information usage for decision making (β = -0.022, p = 0.414) and control (β = -0.026, p = 0.336) are non-significant and the indirect effects of an exploration orientation on cost information usage for decision making (β = 0.057, p = 0.053) and control (β = 0.070, p = 0.019) are (marginally) significant. Specific indirect effect tests are also in line with the total sample, except that the marginally significant results for indirect effects of exploration on cost information usage for decision making in H2a and H2b become non-significant in this subsample (both $p \geq 0.131$).

[10] We had to exclude the dummy variables representing the control variable foreign owner due to low cell counts to be able to estimate the model on this subsample in Amos. We included covariances between the error terms of the four different purposes of use choices.

In sum, we find that our results are not merely driven by the highly ambidextrous business units.

Hence, we conclude that our results are largely robust in these three subsamples.

4.4.2. Alternative operationalization of mediating variables

As a fourth robustness check, we defined an alternative operationalization of our mediating variables (i.e. costing system complexity and costing system diversity), since we relied upon a specific scoring system for these measures. More specifically, we standardized the scores on the different items of these measures and then took the average of these standardized scores to calculate the alternative operationalizations of both measures (cf. Schoute, 2009). These alternative operationalizations show a high correlation with their original measures (costing system complexity: $r = 0.955$, $p < 0.001$; costing system diversity: $r = 0.999$, $p < 0.001$). The results of the structural equation model are largely consistent with the results obtained for the original model. More specifically, we find significant direct effects of an exploitation orientation on cost information usage for decision making ($\beta = 0.530$, $p < 0.001$) and control ($\beta = 0.487$, $p < 0.001$). An exploration orientation is marginally significantly associated with costing system complexity ($\beta = 0.167$, $p = 0.072$) and significantly associated with costing system diversity ($\beta = 0.321$, $p < 0.001$). Next, costing system complexity is marginally significantly associated with cost information usage for decision making ($\beta = 0.114$, $p = 0.054$) and not associated with cost information usage for control ($\beta = 0.052$, $p = 0.420$), while costing system diversity is significantly associated with cost information usage for both decision making ($\beta = 0.119$, $p = 0.048$) and control ($\beta = 0.184$, $p = 0.006$). The indirect effects are qualitatively and inferentially in line with the results obtained for the main model. More specifically, the indirect effects of an exploitation orientation on cost information usage for decision making ($\beta = -0.021$, $p = 0.298$) and control ($\beta = -0.027$, $p = 0.213$) are both non-significant, while the indirect effects of an exploration orientation on cost information usage for decision making ($\beta = 0.057$, $p = 0.027$) and control ($\beta = 0.068$, $p = 0.010$) are both significant. Specific indirect effects tests are also consistent with the main model, except that the indirect effect of exploration on cost information usage for decision making through costing system complexity in H2a becomes non-significant ($p = 0.127$). Hence, we conclude that our results are largely robust for these alternative operationalizations.

4.5. Additional analyses

First, we performed additional analyses to get more insight into the specific purposes for which cost information is used. With these additional analyses, we follow up on van Veen-Dirks (2010), who states that it is essential to distinguish between different uses when studying control choices. Second, we make a distinction between backward- and forward-looking cost information diversity. We classify items related to support diversity, standard costing, variance analysis and contribution margin accounting as backward-looking cost information diversity and items related to target costing and life cycle costing as forward-looking cost information diversity. The results of these additional analyses are reported and tabulated in Section A2 of the online appendix.

5. Discussion and conclusion

The purpose of this study was to understand the mechanisms that link strategic orientation to choices regarding the purposes of cost information use. We did so by studying the antecedents and consequences of costing system design choices. Our primary contribution is that we complement prior research on costing system design choices by revealing that firms design costing systems anticipating the use that managers will make of them, as guided by the strategic orientation they pursue. More specifically, we find that costing system design choices are mediating mechanisms only in the context of exploration. For exploitation, we find a significant direct positive effect on cost information usage for decision making as well as for control. These findings respond to a recent call by Hadid and Hamdan (2022) for more research on the puzzling question of why some firms need more complex costing systems and enhance our insight into the strategy-costing link, as advocated by the normative literature (e.g., Kaplan and Norton, 2008; Sharman, 2012). We also follow up on Henri and Wouters (2020) who argue that more research is needed on the costing system as a control practice in its own right in the context of innovation rather than merely as a financial performance indicator.

Our results demonstrate that investments in more complex and diverse costing systems are context-specific. We find a significant positive direct relationship between a business unit's exploration orientation and the level of complexity and diversity of its costing system. These findings confirm our hypotheses based on information-processing theory and organizational learning, linking a business unit's context in terms of its strategic orientation to its costing system design choices. The results are also in line with Galbraith's (1973, 1977) view on the role of uncertainty in a firm, which is defined as the difference between the amount of information required to perform a task and the amount of information already possessed by the firm. As an exploration context is linked to the search for new knowledge and the development of new capabilities, it comes with much more uncertainty, which results in greater demand for information. Consistent with the information characteristics expected by information-processing theory and the organizational learning processes, we find that an exploration context, which is characterized by uncertainty and a high demand for information, is significantly associated with more complex and more diverse costing systems. Cost information generated by more complex costing systems provides more fine-grained insights into resource consumption patterns of products and services. Cost information generated by more diverse costing systems stimulates problem recognition and problem solving (Hall, 2010; McKinnon and Bruns, 1992), which are both mechanisms that foster the creation of new knowledge. Hence, an exploration context drives the design of costing systems that have a higher information-processing capacity, i.e. more complex and diverse costing systems. With this result, our study helps to identify the characteristics of contexts driving costing system design choices. Whereas a significant body of empirical research has already provided evidence that different strategic priorities elicit different performance measurement system designs (Chenhall, 2003; Lillis and van Veen-Dirks, 2008), we add that these different strategic orientations also elicit different costing system designs.

Apart from the antecedents of costing system complexity and diversity, we also examined the consequences of these design choices by studying whether they act as mediators in the relationship between a business unit's strategic orientation and cost information usage for decision making and control. As predicted, we find a significant direct positive relationship between a business unit's exploitation orientation and cost information usage for decision making as well as for control. As exploitation is more linked to adaptation and enhancement of existing products, services and processes (Davila et al., 2009; Ylinen and Gullkvist, 2014), available cost information on existing products, services and processes seems to be used for decision making and control. Consequently, the relationship between exploitation and cost information usage for decision making and control is not mediated by costing system design choices.

In contrast to exploitation, the relationship between a business unit's exploration orientation and cost information usage for decision making and control is mediated by costing system design choices. Whereas costing system complexity only mediates the relationship between exploration and cost information usage for decision making, costing system diversity mediates both the relationship between exploration and cost information usage for decision making as well as the relationship between exploration and cost information usage for control. This finding is in line with Chenhall and Morris (1986), who found that broad scope (i.e. more diverse) management accounting systems are of particular relevance to managers who perceive their operating situation as uncertain. Managers of business units pursuing an exploration orientation will perceive much more uncertainty than managers of business units pursuing an exploitation orientation. Consequently, in exploration contexts, costing system design choices act as mediators in the strategy-cost information usage link.

The two different patterns between the pursuit of a strategic orientation and the cost information usage for decision making and control (i.e. a direct relationship in the case of exploitation and mediated relationships in the case of exploration) indicate that these two strategic orientations are indeed different with respect to information requirements. The different information requirements that we observed are also in line with the different organizational learning modes discussed in the literature (March, 1991). So far, management accounting and control research has shown that different innovation modes require different designs and uses of management control practices (e.g., Bedford, 2015; Bedford et al., 2019; Bisbe and Otley, 2004; Davila, 2000; Dekker et al., 2013; Ylinen and Gullkvist, 2014). Our results illustrate that exploration also results in different costing system design choices and differences in the usage of the subsequent cost information for decision making and control.

Our study has a number of limitations from which further research could be developed. First, our study is survey-based with cross-sectional data. Although we used several methods to guard against common-method bias (Podsakoff et al., 2003), we cannot completely rule out this bias. Second, most of our respondents are business unit managers, who might not be most knowledgeable about costing system design questions. However, at the same time, business unit managers can be expected to be less biased when evaluating questions on purposes of use choices. To address these two limitations, further studies may gather data from multiple respondents in firms, or gather the data by using a time lag (Podsakoff et al., 2003). Third, as exploitation and, in particular, exploration include several sub-processes, such as intelligence gathering, idea recognition, idea selection, execution, transition to manufacturing, commercialization and value capture (Davila et al., 2009, p. 286), it would be interesting to investigate in detail which of these sub-processes benefit most from more complex and/or more diverse cost information. Fourth, given that different studies have captured product diversity in different ways (Drury and Tayles, 2005), we encourage more research on product diversity as an antecedent of costing system design choices. Finally, future research could also elaborate on whether control information based on cost information is used in a diagnostic or interactive way as prior management accounting studies in innovation have done (e.g., Bedford, 2015; Bedford et al., 2019; Bisbe and Otley, 2004).

Overall, this study unravels the strategy-costing link advocated by practitioners by demonstrating that the extent to which strategic orientation affects cost information usage for decision making and control is only mediated by costing system design choices in exploration contexts. This finding has important practical implications as by anticipating cost information usage choices guided by strategic orientation, firms may avoid unnecessary investments in complex and diverse costing systems.

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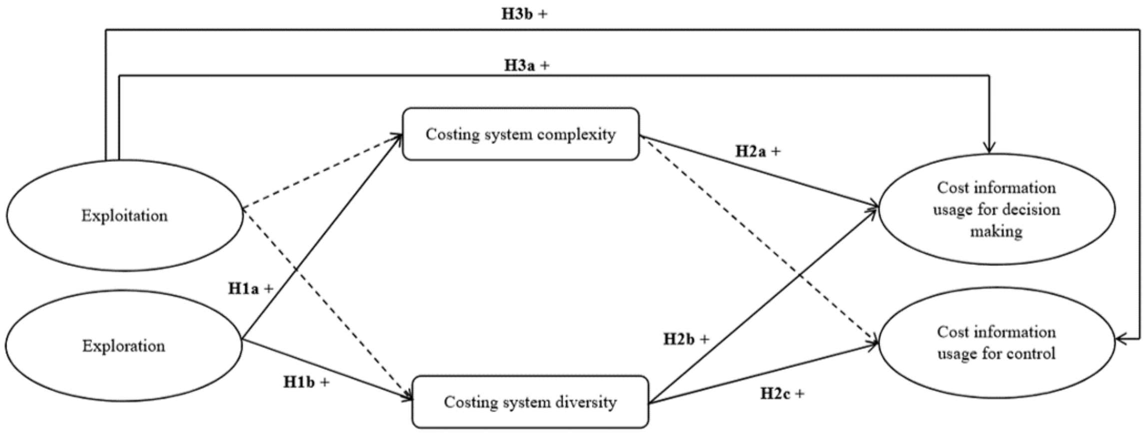
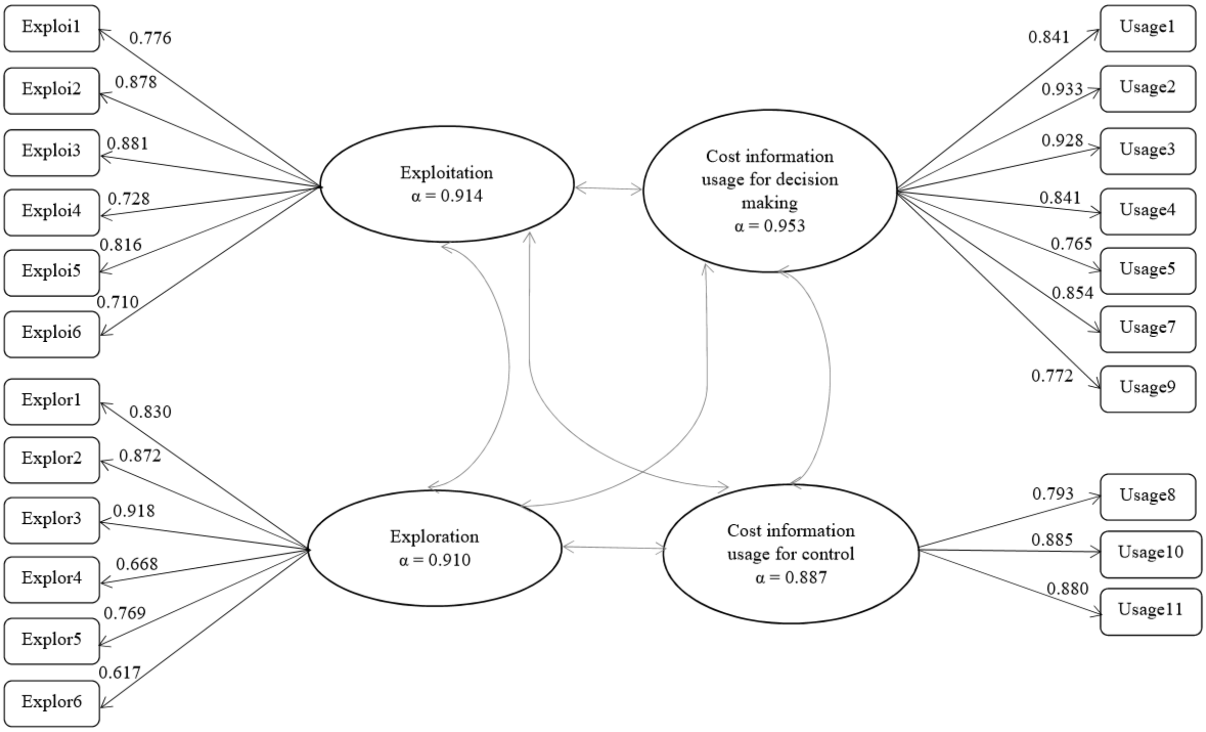


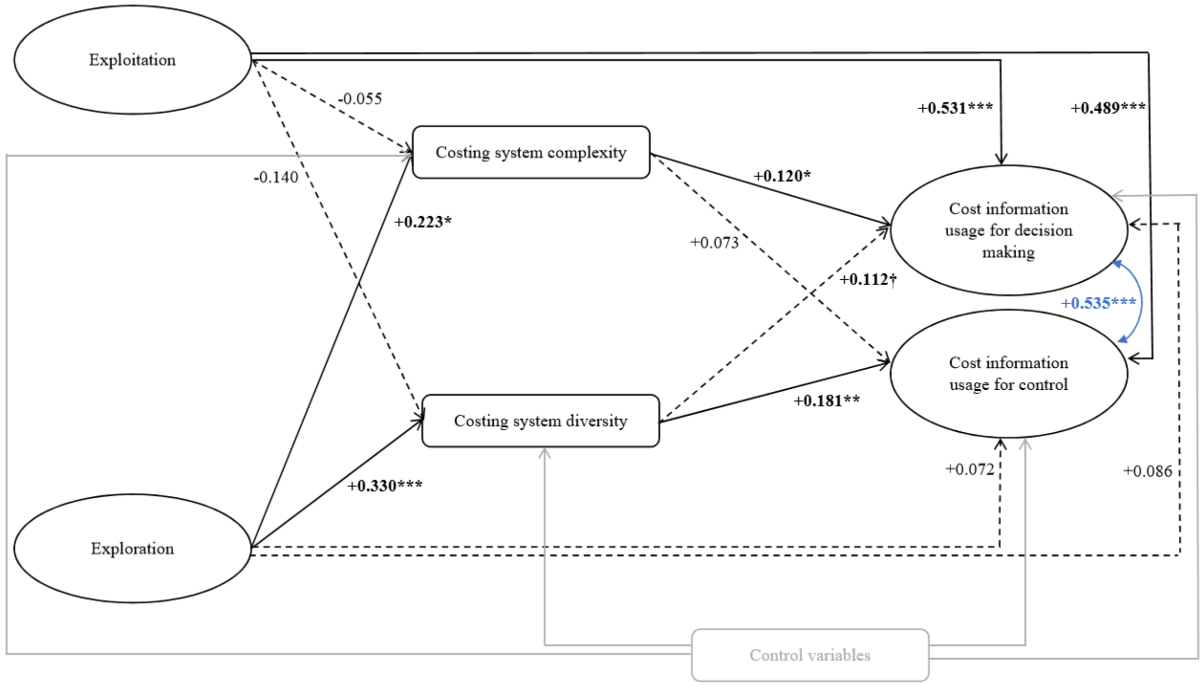
Notes: 1) the path from exploration to cost information usage for decision making through costing system complexity represents H2a; the path from exploration cost information usage for decision making through costing system diversity represents H2b; the path from exploration to cost information usage for control through costing system diversity represents H2c.

Fig. 1. Research model.



Notes: 1) $n = 191$.

Fig. 2. Measurement model.



Notes: 1) n = 191; 2) standardized path coefficient are reported; 3) ***, **, * indicates a p-value of < 0.001, < 0.01, < 0.05 (two-tailed); 4) † indicates a marginally significant p-value of 0.063; 5) control variables are not separately depicted in the figure; 6) solid lines indicate significant paths and dotted lines indicate non-significant paths; 7) the covariance is defined between the error terms of both latent variables (i.e. cost information usage for decision making and cost information usage for control); 8) the indirect paths are not displayed in this figure; these coefficients and their significance may be found in Table 7.

Fig. 3. Structural model.

Table 1
Exploratory factor analysis on strategic orientations.

Label	Items	Oblique rotation	
		Factor 1: Exploitation	Factor 2: Exploration
Exploi1	1. The business unit commits to improve quality and lower cost.	**0.714**	-0.001
Exploi2	2. The business unit continuously improves the reliability of its products and services.	**0.881**	-0.021
Exploi3	3. The business unit increases the levels of automation in its operations.	**0.717**	0.179
Exploi4	4. The business unit constantly surveys existing customers' satisfaction.	**0.687**	0.174
Exploi5	5. The business unit fine-tunes what it offers to keep its current customers satisfied.	**0.989**	-0.109
Exploi6	6. The business unit penetrates more deeply into its existing customer base.	**0.738**	-0.069
Explor1	7. The business unit looks for novel technological ideas by thinking "outside the box".	0.028	**0.797**
Explor2	8. The business unit bases its success on its ability to explore new technologies..	-0.064	**0.888**
Explor3	9. The business unit creates products or services that are innovative to the business unit.	-0.050	**0.957**
Explor4	10. The business unit looks for creative ways to satisfy its customers' needs.	0.374	**0.477**
Explor5	11. The business unit aggressively ventures into new market segments.	0.019	**0.776**
Explor6	12. The business unit actively targets new customer groups.	0.396	**0.446**
Variance explained by each factor		34.50%	31.65%
Cronbach's alpha		0.914	0.910

Notes: 1) *n* = 191; 2) oblique-rotated loadings above 0.40 are in bold.

Table 2
Exploratory factor analysis on cost information usage.

Label	Items	Oblique rotation	
		Factor 1: Cost information usage for decision making	Factor 2: Cost information usage for control
Usage1	1. Cost information is used in capacity management and capacity investment decisions.	**0.931**	-0.088
Usage2	2. Cost information is used to identify opportunities for improvement.	**0.813**	0.119
Usage3	3. Cost information is used in process/operations management.	**0.756**	0.178
Usage4	4. Cost information is used in product/service management decisions (e.g., the range of products/services).	**0.781**	0.089
Usage5	5. Cost information is used in pricing decisions.	**0.990**	-0.188
Usage6	6. Cost information is used in cost restructuring or reorganization decisions.	0.569	0.547
Usage7	7. Cost information is used in new product/service development decisions.	**0.803**	0.122
Usage8	8. Cost information is used in outsourcing decisions.	0.205	**0.631**
Usage9	9. Cost information is used for budgeting, planning and forecasting.	**0.626**	0.225
Usage10	10. Cost information is used for compensation and rewarding.	0.092	**0.792**
Usage11	11. Cost information is used for performance evaluation.	-0.058	**0.946**
Usage12	12. Cost information is used to manage working capital.	0.483	0.427
Variance explained by each factor		40.20%	33.03%
Cronbach’s alpha		0.953	0.887

Notes: 1) n = 191; 2) oblique-rotated loadings above 0.40 are in bold; 3) two items (6 and 12) were deleted because they load across both factors.

Table 3
Exploratory factor analysis on costing system design choices.

Items	Oblique rotation	
	Factor 1: Costing system complexity	Factor 2: Costing system diversity
CS1_VarFix	**0.984**	-0.106
CS2_IdenIndirect	**0.999**	
CS3_AlloIndirect	**0.999**	
CS4.1_Ncostpools	**0.848**	
CS4.2_TypeCostpools	**0.844**	-0.105
CS4.3_Ndrivers	**0.859**	0.122
CS4.4_Typedrivers	**0.878**	
CS5_SupDiv	0.199	**0.523**
CS6_StandardCosts	-0.152	**0.653**
CS7_IdleCapacityCosts	0.153	**0.597**
CS8_CapacityCosts	0.362	**0.545**
CS9_Variances		**0.733**
CS10_ContributionMargin		**0.669**
CS11_LCC		**0.627**
CS12_TargetCosting	-0.163	**0.694**
Variance explained by each factor	41.7%	21.7%
Cronbach’s alpha	0.907	0.732

Notes: 1) *n* = 191; 2) oblique-rotated loadings above 0.40 are in bold; 3) for more details on the different items, see Appendix C.

Table 4
Descriptive statistics.

Variables	*n*	%	Min	Max	Mean	S.D.
Independent variables						
Exploitation			1	7	5.46	1.23
Exploration			1	7	4.62	1.44
Dependent variables						
Cost information usage for decision making			1	7	5.49	1.29
Cost information usage for control			1	7	4.98	1.49
Mediating variables: costing system design choices						
Costing system complexity			0	18	8.08	5.80
Costing system diversity			0	8	4.42	2.24
Control variables						
Product diversity						
Only one	30	15.7				
Several (2-5)	86	45.0				
Numerous (more than 5)	75	39.3				
Product customization						
Fully-standardized	40	20.9				
Mainly fully-standardized, but specializations are available	59	30.9				
Mainly customized	64	33.5				
Only customized	28	14.7				
Firm age (years)			1	115	23.37	14.38
Firm size (full-time employees)						
< 100	37	19.4				
100-249	55	28.8				
250-499	31	16.2				
500-999	35	18.3				
> 1,000	33	17.3				
Perceived environmental uncertainty			1	7	3.39	1.15
International sales						
International	6	3.1				
Domestic	48	25.1				
Both of them	137	71.7				
Foreign owner						
Thai	106	55.5				
Chinese	4	2.1				
Japanese	59	30.9				
US or European	22	11.5				
Industry						
Energy	9	4.7				
Metal	26	13.6				
Media and publishing	2	1.0				
Food	20	10.5				
Construction	15	7.9				
Consumer products	4	2.1				
Telecommunication and electronics	25	13.1				
Chemicals and pharmaceutical	19	9.9				
Textile	7	3.7				
Other manufacturing industries	39	20.4				
Service industries	25	13.1				
Other variables						
Firm size (total assets: billion baht)			0.026	509,981	6,278	53,030
Respondent age						
< 35 years	53	27.7				
35-50 years	106	55.5				
51-60 years	27	14.1				
> 60 years	5	2.6				
Respondent position						

Business unit manager	114	59.7				
Controller	8	4.2				
Accountant	48	25.1				
Other	21	11.0				
Respondent tenure (years)			0.4	33	9.93	8.12

Table 5
Correlation table.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) Cost information usage for decision making	**0.85**															
(2) Cost information usage for control	0.74**	**0.85**														
(3) Costing system complexity	0.22**	0.18*	1.00													
(4) Costing system diversity	0.18*	0.25*	0.29**	1.00												
(5) Exploitation	0.58**	0.53**	0.11	0.09	**0.80**											
(6) Exploration	0.44**	0.43**	0.21**	0.28**	0.60**	**0.79**										
(7) Firm age	-0.04	-0.07	0.08	0.02	0.00	0.04	1.00									
(8) Firm size	0.06	-0.02	0.14*	0.02	0.13†	0.04	0.32**	1.00								
(9) International sales	-0.05	-0.05	0.06	0.00	0.02	0.03	0.15*	0.14†	1.00							
(10) Japanese owner	0.03	0.06	0.11	-0.09	0.04	-0.01	-0.00	0.17*	0.23**	1.00						
(11) Chinese owner	0.10	0.12	-0.04	0.12	0.05	-0.03	-0.12	0.04	-0.12†	-0.10	1.00					
(12) US or European owner	0.05	0.00	0.04	-0.05	-0.01	0.02	-0.04	-0.12	-0.03	-0.24**	-0.05	1.00				
(13) Industry	0.02	0.08	0.17*	-0.04	0.07	0.03	0.09	0.17*	0.18*	0.23**	0.06	-0.01	1.00			
(14) Perceived environmental uncertainty	-0.34**	-0.30**	-0.13†	-0.19*	-0.37**	-0.34**	0.09	-0.03	0.04	-0.06	-0.01	-0.02	-0.00	1.00		
(15) Product customization	-0.07	-0.03	0.19**	0.04	-0.03	0.01	-0.07	-0.04	0.04	0.36**	-0.10	-0.05	0.06	0.07	1.00	
(16) Product diversity	-0.08	-0.12	0.07	0.09	-0.02	0.06	0.09	-0.03	0.12	-0.02	0.00	0.02	0.20**	-0.04	0.05	1.00

Notes: 1) the square root of the AVE of the latent variables included in the measurement model is shown on the diagonal (in bold) to provide evidence of the Fornell-Larcker criterion; 2) off-diagonal elements are the Pearson correlations among the variables; 3) **, * indicates a *p*-value of < 0.01, < 0.05 (two-tailed); 4) † indicates a marginally significant *p*-value between 0.05 and 0.10.

Table 6
Multi-item construct reliability and validity.

Variables	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
Independent variables			
Exploitation	0.914	0.914	0.642
Exploration	0.910	0.905	0.618
Dependent variables			
Cost information usage for decision making	0.953	0.948	0.722
Cost information usage for control	0.887	0.889	0.729

Table 7
Structural model results.

Panel A: Unconstrained structural model (n = 191, χ^2 = 701.275)

	Dependent variables			
	Costing system complexity	Costing system diversity	Cost information usage for decision making	Cost information usage for control
Direct effect estimates				
Exploitation	-0.055 (-0.583)	-0.140 (-1.480)	0.531*** (6.060)	0.489*** (5.180)
Exploration	0.223* (2.400)	0.330*** (3.521)	0.086 (1.065)	0.072 (0.819)
Costing system complexity	-	-	0.120* (2.010)	0.073 (1.122)
Costing system diversity	-	-	0.112† (1.859)	0.181** (2.714)
Firm age	0.033 (0.443)	0.019 (0.256)	-0.018 (-0.295)	-0.012 (-0.180)
Firm size	0.125† (1.667)	0.040 (0.538)	-0.036 (-0.586)	-0.133† (-1.949)
International sales	-0.001 (-0.009)	0.040 (0.560)	-0.079 (-1.342)	-0.067 (-1.039)
Japanese owner	0.005 (0.063)	-0.128 (-1.613)	0.089 (1.356)	0.090 (1.239)
Chinese owner	-0.020 (-0.285)	0.134† (1.921)	0.060 (1.041)	0.064 (1.018)
US or European owner	0.065 (0.923)	-0.071 (-1.015)	0.068 (1.177)	-0.003 (-0.046)
Industry	0.127† (1.749)	-0.056 (-0.775)	-0.033 (-0.557)	0.083 (1.252)
PEU	-0.086 (-1.147)	-0.143† (-1.905)	-0.091 (-1.457)	-0.054 (-0.795)
Product customization	0.188* (2.538)	0.092 (1.252)	-0.078 (-1.261)	-0.046 (-0.672)
Product diversity	0.016 (0.229)	0.054 (0.769)	-0.082 (-1.430)	-0.160* (-2.518)
Indirect effect estimates				
Exploitation	-	-	-0.022 (CI -0.080-0.017)	-0.029 (CI -0.094-0.015)
Exploration	-	-	0.064* (CI 0.008-0.136)	0.076** (CI 0.016-0.151)
Total effect estimates				
Exploitation	-	-	0.509*** (CI 0.318-0.663)	0.459*** (CI 0.234-0.623)
Exploration	-	-	0.150† (CI -0.027-0.343)	0.149 (CI -0.056-0.378)
Specific indirect effect estimates				

Exploitation → Costing system complexity	-	-	-0.006 (CI -0.036-0.018)	-0.004 (CI -0.031-0.015)
Exploitation → Costing system diversity	-	-	-0.013 (CI -0.043-0.005)	-0.026 (CI -0.084-0.010)
Exploration → Costing system complexity	-	-	0.023† (CI -0.001-0.057)	0.015 (CI -0.014-0.050)
Exploration → Costing system diversity	-	-	0.031† (CI -0.004-0.076)	0.053** (CI 0.010-0.117)
R^2	0.140	0.154	0.492	0.437

Panel B: Constrained structural model (n = 191, χ^2 = 733.537)

	Dependent variables			
	Costing system complexity	Costing system diversity	Cost information usage for decision making	Cost information usage for control
Direct effect estimates				
Exploitation	-	-	0.509*** (5.820)	0.461*** (4.885)
Exploration	-	-	0.146† (1.886)	0.145† (1.693)
Costing system complexity	-	-	-	-
Costing system diversity	-	-	-	-
Firm age	0.048 (0.648)	0.044 (0.576)	-0.011 (-0.182)	-0.005 (-0.080)
Firm size	0.120 (1.599)	0.026 (0.336)	-0.017 (-0.271)	-0.117† (-1.687)
International sales	0.003 (0.036)	0.043 (0.582)	-0.074 (-1.238)	-0.059 (-0.901)
Japanese owner	-0.009 (-0.106)	-0.148† (-1.797)	0.075 (1.124)	0.066 (0.903)
Chinese owner	-0.024 (-0.345)	0.124† (1.727)	0.072 (1.240)	0.087 (1.355)
US or European owner	0.061 (0.853)	-0.077 (-1.059)	0.068 (1.154)	-0.011 (-0.164)
Industry	0.130† (1.769)	-0.056 (-0.753)	-0.025 (-0.406)	0.081 (1.211)
PEU	-0.144* (-2.059)	-0.206** (-2.919)	-0.117† (-1.863)	-0.087 (-1.252)
Product customization	0.205** (2.735)	0.118 (1.560)	-0.045 (-0.721)	-0.015 (-0.218)
Product diversity	0.028 (0.399)	0.075 (1.036)	-0.074 (-1.261)	-0.149* (-2.288)
R^2	0.106	0.085	0.467	0.403

Notes: 1) each cell reports the standardized path coefficient (t-value for direct effects and 95 percent confidence interval for indirect and total effects); 2) ***, **, * indicates a p-value of < 0.001, < 0.01, < 0.05 (two-tailed); 3) † indicates a marginally significant p-value between 0.05 and 0.10; 4) PEU is the abbreviation of perceived environmental uncertainty.

Appendix A. Prior costing studies on the measurement of costing system complexity

Reference	Construct	Operationalization
Abernethy et al. (2001)	Cost system sophistication	1. Number of cost pools 2. Nature of the cost pools (responsibility versus activity cost pools) 3. Type of cost pools (unit-level versus hierarchical cost drivers)
Al-Omiri and Drury (2007)	Cost system sophistication	Four different proxies: 1. Stages of ABC implementation (see also Krumwiede, 1998; Krumwiede and Charles, 2014) 2. Number of cost pools 3. Number of cost allocation bases 3. Whether or not the costing system assigns indirect costs to cost objects
Brierley (2008)	Overhead assignment sophistication	1. Assignment of indirect overhead costs to product costs 2. Inclusion of all costs in product costs 3. Ability of directly charge overhead costs to products 4. How frequently standard product costs are updated 5. Whether and how non-manufacturing indirect overhead costs are assigned to product costs 6. Recording a detailed bill of materials 7. Production of accurate product costs 8. Production of accurate actual product costs
Drury and Tayles (2005) Schoute and Budding (2017)	Cost system complexity	1. Number of cost pools 2. Number of cost allocation bases
Schoute (2009)	Cost system complexity	1. Number of cost pools 2. Number of cost allocation bases 3. Type of cost pools: a) functionally-oriented (e.g., departmental) cost pools, (b) functionally- and process-oriented cost pools, or (c) process oriented (e.g., activity) cost pools 4. Type of cost allocation bases: (a) only unit-level allocation bases, (b) both unit-level and batch-level allocation bases, or (c) both unit-level, batch-level and product-sustaining allocation bases

Appendix B. Prior management accounting and control studies on the measurement of diversity

Reference	Construct	Operationalization
Abdel-Kader and Luther (2008)	Management accounting practice sophistication	Emphasis placed on 38 management accounting practices and techniques
Chenhall and Morris (1986) Tillema (2005)	Management accounting system scope	Focus (on events either within or outside the organisation), quantification (either in financial or in non-financial terms) and time horizon (related to either historical or future events)
Davila and Foster (2005)	Management accounting systems' adoption	Eight management accounting systems coded yearly as 1 if the firm reports having adopted the system, and 0 otherwise
Davila and Foster (2007)	Management control systems' intensity	Sum of the percentage of 46 management control systems adopted within each of eight categories
Dekker et al. (2013)	Performance measurement diversity	Number of performance measures considered important to assess the performance of the manager(s) of a unit
Kruis and Widener (2014)	Complexity of the performance measurement system	Number of performance measures used to manage a unit

Appendix C. Survey questions and scoring system for the costing system design choices

1. Exploitation and exploration orientation

How would you assess the business unit's orientation during the past 3 years according to the following statements? ("1 = strongly disagree" to "7 = strongly agree"):

Exploi1 - The business unit commits to improve quality and lower cost.
Exploi2 - The business unit continuously improves the reliability of its products and services.
Exploi3 - The business unit increases the levels of automation in its operations.
Exploi4 - The business unit constantly surveys existing customers' satisfaction.
Exploi5 - The business unit fine-tunes what it offers to keep its current customers satisfied.
Exploi6 - The business unit penetrates more deeply into its existing customer base.

Explor1 - The business unit looks for novel technological ideas by thinking "outside the box".
Explor2 - The business unit bases its success on its ability to explore new technologies.
Explor3 - The business unit creates products or services that are innovative to the business unit.
Explor4 - The business unit looks for creative ways to satisfy its customers' needs.
Explor5 - The business unit aggressively ventures into new market segments.
Explor6 - The business unit actively targets new customer groups.

2. Purposes of cost information use

Please indicate the extent to which you have found your firm's costing system useful in assisting you in the following areas ("1 = strongly disagree" to "7 = strongly agree"):

Factor 1 = Cost information usage for decision making
Usage1 - Cost information is used in capacity management and capacity investment decisions.
Usage2 - Cost information is used to identify opportunities for improvement.
Usage3 - Cost information is used in process/operations management.
Usage4 - Cost information is used in product/service management decisions (e.g., the range of products/services).
Usage5 - Cost information is used in pricing decisions.
Usage7 - Cost information is used in new product/service development decisions.
Usage9 - Cost information is used for budgeting, planning and forecasting.

Factor 2 = Cost information usage for control
Usage8 - Cost information is used in outsourcing decisions.
Usage10 - Cost information is used for compensation and rewarding.
Usage11 - Cost information is used for performance evaluation.

Items deleted
Usage6 - Cost information is used in cost restructuring or reorganization decisions.
Usage12 - Cost information is used to manage working capital.

3. Costing system design choices

Please (√) which of the practices listed below best describe the cost accounting system and the cost information present in the firm.

3a. Costing system complexity
3.1. Only variable costs (i.e. costs that vary with volume of output) are charged to cost objects (e.g., products, services, etc.); that is, there is no allocation of fixed costs to cost objects (i.e. costs that do not vary with volume of output). ***(Coding: CS1_VarFix)***

[ ] Yes [ ] No

Scoring: we give score 1 if the respondent ticks yes and we give 0 if the respondent ticks no.

3.2. Indirect costs are identified separately, but not allocated to cost objects. ***(Coding: CS2_IdenIndirect)***

[ ] Yes [ ] No

Scoring: we give score 1 if the respondent ticks yes and we give 0 if the respondent ticks no.

3.3. Indirect costs are allocated to cost objects. ***(Coding: CS3_AlloIndirect)***

[ ] Yes [ ] No (move to Question 3.5)

Scoring: we give score 1 if the respondent ticks yes and we give 0 if the respondent ticks no.

3.4. If indirect costs are allocated to cost objects
3.4.1 How many cost pools (cost centres) are used? ***(Coding: CS4.1_Ncostpools)***
(*Explanation:* The typical procedure for allocating indirect costs to cost objects involves a two-stage process. In the first stage, overheads are assigned to cost pools (cost centres). In the second stage, overhead allocation rates (or cost driver rates) are established for each cost pool (cost centre) to allocate overheads to cost objects. Please indicate below approximately how many separate cost pools (cost centres) are used to allocate overheads to your chosen cost object. (For example, if your firm has five cost pools (cost centres), all of which use a single allocation rate (such as direct labour hours), please tick five in the box below to indicate that five separate cost pools (cost centres) have been established).

Number of cost pools (cost centres) which have their own overhead allocation (charge out) rate:

[ ] 1	[ ] 2–3	[ ] 4–5	[ ] 6–10
[ ] 11–20	[ ] 21-30	[ ] 31–50	[ ] Over 50

3.4.2 What type of cost pools (cost centres) are used? ***(Coding: CS4.2_TypeCostpools)***
- [ ] Functionally-oriented (e.g., departmental) cost pools (cost centres).
- [ ] Functionally- and process-oriented (e.g., departmental and activities) cost pools (cost centres).
- [ ] Process-oriented (e.g., activity) cost pools (cost centres).

Scoring for 3.4.1 and 3.4.2

Number of cost pools	Functionally-oriented (Volume-based)	Functionally- and process- or process-oriented
1-5	1	4
6-30	2	5
> 31	3	6

For example: if the respondent ticks the number of cost pools in the range of 2-3 and then ticks functionally-oriented, we will give score 1. If the respondent ticks the number of cost pools in the range of 11-20 and then ticks functionally- and process-oriented, we will give score 5. If the respondent ticks the number of cost pools in the range of Over 50 and then ticks process oriented, we will give score 6.

3.4.3 How many cost allocation bases are used (cost drivers)? ***(Coding: CS4.3_Ndrivers)***
(*Explanation:* if your firm has five separate cost pools (cost centres), all using direct labour hours as cost allocation bases, then please tick the first box to indicate that a single base is used. Alternatively, if your firm has five cost pools (cost centres) and uses two cost allocation bases (such as direct labour hours and machine hours), you should tick 2 in the box below.

[ ] 1	[ ] 2	[ ] 3	[ ] 4
[ ] 5	[ ] 6	[ ] 7-10	[ ] Over 10

3.4.4 What type of cost allocation bases are used? ***(Coding: CS4.4_Typedrivers)***
- [ ] Only unit-level allocation bases.
- [ ] Both unit-level and batch-level allocation bases.
- [ ] Both unit-level, batch-level and product-level allocation bases.

Scoring for 3.4.3 and 3.4.4

Number of cost drivers	Only unit-level	Unit-level and batch-level	Unit-level, batch-level and product-level
1-4	1	4	7
5-10	2	5	8
> 10	3	6	9

For example: if the respondent ticks the number of cost drivers 2 and then ticks only unit-level, we will give score 1. If the respondent ticks the number of cost drivers 6 and then ticks both unit-level and batch-level, we will give score 5. If the respondent ticks the number of cost pools in the range of Over 10 and then ticks both unit-level, batch-level and product-level, we will give score 9.

3b. Costing system diversity
3.5. Costs from support departments are transferred to cost pools (cost centres) while maintaining the distinction between fixed and variable costs. ***(Coding: CS5_SupDiv)***
(*Support departments* are defined as those departments that provide essential services to support the provision of your chosen cost object).

[ ] Yes [ ] No

Scoring: we give score 1 if the respondent ticks yes and we give 0 if the respondent ticks no.

3.6. Planned costs (standard costs) are used for most costing purposes. ***(Coding: CS6_StandardCosts)***

[ ] Yes [ ] No

<u>Scoring:</u> we give score 1 if the respondent ticks yes and we give 0 if the respondent ticks no.

3.7. Is the cost of idle capacity identified and computed? ***(Coding: CS7_IdleCapacityCosts)***

[ ] Yes [ ] No

<u>Scoring:</u> we give score 1 if the respondent ticks yes and we give 0 if the respondent ticks no.

3.8. Do you allocate capacity costs to cost objects? **(*Coding: CS8_CapacityCosts)***

(*Capacity cost* is a fixed expense incurred by a firm in order to provide for its ability to conduct business operations.)

[ ] Yes [ ] No (move to Question 3.9)

If yes, it is allocated based on [ ] 1) expected production volume, or
[ ] 2) normal production volume, or
[ ] 3) available capacity.

<u>Scoring:</u> we give score 1 if the respondent ticks yes and we give 0 if the respondent ticks no.

3.9. Are variances between budgeted costs and actual costs calculated and reported by cost pool? ***(Coding: CS9_Variances)***

[ ] Yes [ ] No

<u>Scoring:</u> we give score 1 if the respondent ticks yes and we give 0 if the respondent ticks no.

3.10. Do you use contribution margin accounting extensively? ***(Coding: CS10_ContributionMargin)***

[ ] Yes [ ] No

<u>Scoring:</u> we give score 1 if the respondent ticks yes and we give 0 if the respondent ticks no.

3.11. Do you use life cycle costing? ***(Coding: CS11_LCC)***

(*Life cycle costing* is the estimation of costs based on the length of stages of a product or service's life. These stages may include design, introduction, growth, decline, and ultimately abandonment.)

[ ] Yes [ ] No

<u>Scoring:</u> we give score 1 if the respondent ticks yes and we give 0 if the respondent ticks no.

3.12. Do you use target costing? **(*Coding: CS12_TargetCosting*)**

(*Target costing* is a method used during product and process design that involves estimating a cost calculated by subtracting a desired profit margin from an estimated (or market-based) price to arrive at a desired production, engineering (or marketing) cost.

[ ] Yes [ ] No

<u>Scoring:</u> we give score 1 if the respondent ticks yes and we give 0 if the respondent ticks no.

Scoring summary (summated scores):

1. The measurement for costing system complexity are questions 3.1, 3.2, 3.3, 3.4.1, 3.4.2, 3.4.3, and 3.4.4. The summated scores obtained with respect to costing system complexity range from 0 to 18.
2. The measurement for costing system diversity are questions 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, and 3.12. The summated scores obtained with respect to costing system diversity range from 0 to 8.

Control variables

4. Product diversity

Please indicate the number of different products/services in your business unit:

[ ] Only one [ ] Several (2-5) [ ] Numerous (more than 5)

5. Product customization

Please indicate which classification describes the level of standardization versus customization of the whole range of the products/services in your business unit:

[ ] Fully-standardized products/services.
[ ] Mainly fully-standardized products/services, but specializations are available.
[ ] Mainly customized products/services.
[ ] Only customized products/services.

6. Firm age

Measured by the number of operating years.

7. Firm size

How many “full-time employees” are employed in our firm?

[ ] < 100 [ ] 100-249 [ ] 250-499 [ ] 500-999 [ ] > 1000 employees

8. Perceived environmental uncertainty (PEU)

Please indicate the extent to which your business unit’s operating environment is… (“1 = very unpredictable” to “7 = very predictable”).

PEU_1 - Suppliers’ actions
PEU_2 - Customer demands, tastes and preferences
PEU_3 - Deregulation and globalization
PEU_4 - Market activities of competitors
PEU_5 - Production technologies
PEU_6 - Government regulations and policies
PEU_7 - Economic environment
PEU_8 - Industrial (workplace) relations

After reversing the individual items, a simple average of responses to these eight items was interpreted as an index of the perceived environmental uncertainty.

9. International sales

Are the sales of your business unit international or domestic or both?

[ ] International (3) [ ] Domestic (1) [ ] Both of them (2)

10. Foreign owner

Categorical variable set equal to 0 if the firm is owned by (> 50 % of global ultimate owner shares) Thai owners, 1 if a firm is owned by Japanese owners, 2 if the firm is owned by Chinese owners, and 3 if the firm is owned by US or European owners. In the structural models, we introduce three dummy variables with Thai owners as the benchmark category to capture this control variable.

11. Industry

Dummy variable set equal to 1 if the firm is a manufacturing firm, 0 for service firms.