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Sophistication of performance measurement systems in manufacturing SMEs: Role of interpersonal ties in top management teams

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Abstract

This study explores the informal social relationship among top management teams (TMTs) in relation to the sophistication of the performance measurement system (PMS) in small-and-medium sized manufacturing companies. Drawing on social network theory, I argue that when TMT members network based on interpersonal ties, as this would provide managers with easier excess to information and knowledge exchanges. Hence, informal relationships could facilitate their control over day-to-day activities, thus reducing the need for adopting sophisticated management control practices. Using survey data on 2,058 manufacturing small and medium sized enterprises (SMEs) from World Management Survey project, the negative impact of interpersonal ties in TMTs on PMS sophistication is confirmed. The results also shed light on the key role of CEO in SMEs, and this negative association is larger in TMTs lead by internally promoted CEOs compared to outsider CEOs. Further, interpersonal ties among TMTs moderate the extent to which SMEs adopt sophisticated PMSs due to pursuing differentiation strategic priorities.

Keywords: performance measurement system; TMT interpersonal ties; CEO origin; social network theory; differentiation strategy; manufacturing SMEs

1. Introduction

Small and medium-sized enterprises (SMEs) have been facing increasing pressure to implement management control systems (MCSs) to face competition and expand their operations. However, scare resources and a lack of managerial skills render adopting MCSs by SMEs challenging (Lavia López, & Hiebl, 2015). Therefore, extant studies on management control call for a better understanding of the drivers for introducing formal MCSs in SMEs (e.g., Davila, 2005), especially those that influence the use of a performance measurement system (PMS) (Heinicke, 2018). Over the past two decades, management control literature has emphasized that the degree to which companies use MCSs is dependent upon several organizational and environmental factors. One MCS literature stream investigates the influence of top management team (TMT) characteristics on the adoption of and MCS. According to the upper echelons theory (Hambrick, & Mason, 1984), MCS can be seen as an aspect of organizational structure (Chenhall, 2003) and might thus be influenced by top management characteristics.

In line with this view, prior studies (e.g., Burkert, & Lueg (2013); Naranjo-Gil, Maas, & Hartmann, (2009); Pavlatos, & Kostakis (2018)) have examined the relationship between TMTs' demographic characteristics and the design and use of MCS. However, upper echelon theory researchers (Lawrence (1997); Priem, Lyon, & Dess (1999)) have criticized the overreliance on demographic-based attributes,

since they are not convergent with underlying psychological constructs and cannot account for their impact. This limitation has called for more research to explore intra-TMTs' behavioral and social relationships that influence decision making and information and resource sharing (Hambrick, 2007; Lubatkin et al., 2006) .

In this study, I thus focus on the informal social ties (Oh et al., 2004) among TMT members to explain the design and use of MCS in manufacturing SMEs. While the impact of TMT social ties on strategic choices has received considerable intention in the management literature (e.g., Cao, Simsek, & Zhang (2010); Ensley, Pearson, & Amason (2002)), little is known about how interpersonal ties might affect MCS design. One notable exception is the study of Speckbacher , & Wentges (2012), who examine the relationship between family members involved in TMTs and the use of performance measurement. However, their findings are moderated by company size, leading to the possible confounding effect of company size, a well-documented factor impacts both the sophistication of MCS and social dynamics in teamwork (Lavia López, & Hiebl, 2015; Oh et al., 2004). Hence, our knowledge on informal social ties between TMT members is still fragmented.

Therefore, drawing on social network theory (Kilduff, & Tsai, 2003), this paper examines both the direct and indirect effects of interpersonal ties in TMTs (network density) on PMS sophistication, and whether this relationship differs if social ties are between the TMT members and the CEO (network centrality). I also explore how these informal social ties affect the direct relationship between company strategic priorities and PMS sophistication. Specifically, I focus on the moderating effect of interpersonal ties in TMTs on differentiation strategic priorities as an important driver for the adoption of sophisticated PMS in manufacturing companies (Chenhall, & Langfield-Smith, 1998).

The study uses survey data of 2,058 SMEs manufacturing companies from the World Management Survey (WMS) project. The survey data are collected as part of a larger research project that gathers data on the quality of management practices in different sectors. I conjecture and prove that TMTs in which team members have interpersonal ties are negatively associated with PMS sophistication. Interestingly, this negative association is larger for TMTs lead by an insider CEO than those lead by an outsider CEO. The analysis also confirms the hypothesized interaction effect of interpersonal ties in TMTs on the differentiation strategies of companies.

The remainder of this paper is organized as follows. First, I review the literature on PMS sophistication, upper echelon theory, and social network theory. Second, the research model is developed based on the literature and the research hypotheses discussed. The research method, utilizing data from World Management Survey (WMS), is described. The results based on construct measurement and ordinary least square (OLS) models and analysis of variance (ANOVA) are then presented. Finally, the concluding section discusses the research findings and their implications.

2. Literature review

2.1. Design and sophistication of management control systems

Contemporary management practices and firm structural innovations have driven MCS design (Chenhall, 2003) over the past decade to provide top management with the necessary information for decision making and control (Teemu, 1997). The rise of manufacturing flexibility, total quality management (TQM), and flat and decentralized organizational structures have led to the irrelevance of traditional, efficiency-based MC practices and the emergency of new tools and techniques (Abernethy, & Lillis, 1995; Chenhall, & Langfield-Smith, 1998; Fullerton, & McWatters, 2002). Examples of sophisticated MC practices include ABC (e.g., Teemu (1997)), target costing, non-financial performance measures (e.g., Fullerton, & McWatters, 2002), and value-based management (e.g., Burkert, & Lueg (2013)).[1]

On one hand, as noted by Guenther, & Heinicke (2019, p. 9), "[MCS] sophistication levels should be differentiated from the degree of embeddedness or dissemination within an organization (e.g. how many divisions or departments are using the PMS)." In this regard, prior studies focused on the extent of MCS practices and their determinants (e.g. Davila (2005)). However, this literature stream has been criticized for not informing theory beyond the simple classification of ‘‘adopters versus non-adopters’’ of MCS (Burkert, & Lueg, 2013). On the other hand, a few studies (e.g., Burkert, & Lueg (2013); Naranjo-Gil et al. (2009)) explored sophistication of MCS and the determinants of sophistication level differences. The difference between the two streams is that the former investigated the use of some dimensions of MCS, without focusing on what has been used, while the latter addressed specific innovative MC tools or techniques and explored the differences among adopters. This stream is germane to the scope of this study, so I will elaborate further on it.

In the literature, there is considerable interest in PMS sophistication as a part of MCSs. To better understand the concept of PMS sophistication, I define PMS, sophistication, and their uses in the following.

A PMS is a set of metrics that tracks and monitors performance, enables communication and influences behavior, and is linked to the company strategy (Franco-Santos et al., 2007). Simons (1995) distinguished between the diagnostic and interactive use of PMS. The diagnostic use links PMS to a reward system for monitoring and goal achievement. The interactive use encourages the involvement of the various managerial levels in the decision making process. Moreover, prior studies (e.g., Speklé, & Verbeeten (2014)) have also classified the uses of PMSs into three categories: (1) incentive-oriented use or the use of performance measures in the reward system; (2) operational use, which includes monitoring, measuring and evaluating performance; and (3) exploratory use, which helps with strategy formation, communication of goals, and setting strategic priorities.

The PMS sophistication level can be broadly defined as "the extent of development of essential design features, functions or processes of a specific PMS within a firm" (Guenther, & Heinicke, 2019; p. 3). In examining the relationship between organizational culture and PMS sophistication, Henri (2006)

[1] For a review on MCS innovation, see Zawawi & Hoque (2011).

referred to sophistication as the diversity of financial and non-financial performance measures used by top managers. Further, Guenther, & Heinicke (2019) highlighted the importance of linking these diverse performance measures to reward, strategy, and planning systems.

Since measuring performance and rewarding and compensating behavior are among the most important functions of PMSs (Franco-Santos et al., 2007), I define a "sophisticated PMS" as a multi-perspective system (Speckbacher, & Wentges, 2012) that employs financial and non-financial measures for performance evaluation and promotion. This definition is in-line with previous studies that have selectively investigated specific PMS purposes. For example, Abernethy, Bouwens, & van Lent (2010) studied the impact of leadership style on the use of PMSs for compensation. Further, Speckbacher, & Wentges (2012) investigated the relationship between TMT composition and their use of PMS in incentive contracts and strategic settings.

2.2. Upper echelon theory : Impact of TMT characteristics on MCS design

The seminal work of Hambrick, & Mason (1984) became the core theoretical framework for researchers interested in the impact of CEO and/or TMTs on organizational outcomes (Carpenter et al., 2004). The premise of the theory is that TMTs' values, cognition, and perception influence their interactions with the organizational environment, which in turn led to strategic choices that ultimately impact organizational performance.

Upper echelon demographic-based studies used the external and observable characteristics of TMT, such as gender, tenure, education, functional background, and experience (Bromiley, & Rau, 2016; Smith et al., 1994). These demographic characteristics have served as a proxy for the psychological construct of the upper echelon theory by capturing the differences in upper-level managers' values, cognition, and perceptions (Carpenter et al., 2004). However, the findings of demographic-based research are divergent, inconsistent, and have various impacts (Lawrence, 1997; Priem et al., 1999). As Priem et al. (1999) noted, the overreliance on demographic attributes sacrifices construct validity, explanatory power, and prescriptive practicality. Further, demographic variables lack the hypothesized convergence with the subjective psychological constructs theorized to influence organizational outcomes (Lawrence, 1997).

These limitations of demographic-based studies have provided the impetus for research employing more psychological theories to explore what Lawrence (1997) labeled as the "black box" of organizational demography. As such, a new literature stream examined TMT behavioral integration (Simsek et al., 2005), social relationships (Cao et al., 2010), and personality traits (Peterson et al., 2003).

Therefore, prior MC studies have examined the link between TMTs' demographic characteristics, and the design and use of MCS. Their findings show that younger (e.g. Pavlatos (2012)), short-tenured (e.g. Naranjo-Gil et al. (2009)), and business educated (e.g. (Morelli, & Lecci (2014)) TMTs are associated with

more sophisticated MC practices. However, these relationships are inconsistent and their results mixed (Hiebl, 2014).

Fewer studies investigated the CEO–TMT relationship and the effect of the social relationships between TMTs and of CEO personal traits. The literature also studied how leadership (e.g., Abernethy, Bouwens, & van Lent (2010)), creativity (Pavlatos, & Kostakis (2018)), and interaction with other TMTs ((Lee et al., 2014) may impact MCS design.

2.3. Social network theory : Team dynamics and MCS use

Social network theory seeks to understand whether certain patterns of network relationships among team members or business units affects the decision making patterns (Kilduff, & Tsai, 2003). The theory helps in understanding how interpersonal ties (i.e., network density) among team members and leaders (i.e., network centrality) can lead to advantages (i.e., social capital) that may impact the team's strategic decisions.

Two main factors are important here to understand the impact of network ties, structure, and content of relationships between team members that determine the flow of resources (e.g., task-related information) between them (Balkundi & Harrison, 2006). Network structure is concerned with the pattern of connections among social parties. When the network is dense, team members have many connections for example, through friendship or kinship ties, and the members are more inclined to share information with their peers and trust each other. The theory also sheds light on the centrality of team connections around one actor (Kilduff & Tsai, 2003). In this regard, if this actor is the team leader, the centrality can help improve team performance by providing the leader greater access for information and social support from the team members, which facilitate control and decision making (Balkundi, & Harrison, 2006).

Network structure can also determine the nature of resources that flow through the network, in other words, the social network content, which leads to the classification of networks in instrumental and expressive (Balkundi, & Harrison, 2006). In expressive networks, when the relationship between team members is more informal, members are more likely to show higher levels of collaboration, interaction, and expertise and information sharing beyond relevant team tasks. By contrast, instrumental networks are formal structures, where members only share acceptable and necessary work-related knowledge.

The impact of social ties on organizational outcomes has been widely investigated in management literature. Related studies explored how the interpersonal relationship between CEO and TMT members affect strategic choices. For instance, Cao, Simsek, & Zhang (2010) found that CEO network density and centrality positively influences organizational ambidexterity. They also found that CEOs with wide internal and external networks can gain access to rich and timely information about their firms' environments and a deeper understanding of the firms' exploitative and exploratory options. However, the impact of this informational advantage on ambidexterity is hinging upon the richness of communication between the

CEO and TMT through discussions and analyses. Westphal (1999) found that CEOs with social ties with board members are more willing to seek directors' advice on strategic decisions. The study also found that CEOs are more likely to take the professional and social risk associated with this advice. since they trust their board members.

However, few existing MCS studies have hitherto explored the relationship between the social ties among team members and MCS design. For example, Towry (2003) examined the impact of social ties in teamwork on the effectiveness of two monitoring and incentives systems. She found that, when team identity is strong, team members are more likely to behave cooperatively in ways that are best for their team. However, the directional effect of their cooperative behaviors on effort depends on whether the monitoring and incentive system is vertical or horizontal. Coordination behavior thus undermines the effectiveness of a vertical incentive system, in which members report the observations of their teammates' efforts to the leader. Conversely, a strong team identity can enhance the effectiveness of a horizontal incentive system, in which members directly control the actions of other members.

3. Hypotheses development

Here, I first elaborate on the hypotheses related to the effect of interpersonal ties in TMT, on the sophistication of PMS and their interaction with strategy. Then, we explore the impact of considering CEO origin on PMS sophistication.

3.1. Interpersonal ties in TMTs and PMS sophistication

We argue that interpersonal ties in TMTs are negatively related to PMS sophistication. This conjecture is supported social network theory and the recent literature on MCS. According to social network theory, informal or social ties between team members are indicators of high network density, that is, members are well connected to each other in their work environment (Balkundi & Harrison, 2006). This richness in communication will facilitate the information flow within the team (Cao et al., 2010), which may compensate for the need of maintaining or establishing an advanced MCS.

This argument has been further corroborated by recent MCS studies on the involvement of family members in top management. This literature stream concluded that family-dominant TMTs are less likely to use formal MCS practices, since loyalty, trust, and a shared vision between team members lowers the need for these practices (Helsen et al., 2017). In this regard, Hiebl, Feldbauer-Durstmüller, & Duller (2013) explored the drivers of MC institutionalization, in terms of hiring management accountants, establishing management accounting departments, and the use of strategic and operational management control practices, in family firms. They concluded that the presence of family members in TMTs is negatively associated with MC institutionalization. In a similar vein, Speckbacher, & Wentges (2012) reported that

family-dominant TMTs are using PMSs and incentive contracts to a lower extent. Accordingly, I hypothesize that:

H1: There exists a negative relationship between interpersonal ties among TMTs and PMS sophistication.

3.2. Differentiation strategy and PMS sophistication

In line with prior management control studies, this study adopts Porter 's typology (1985) and conceptualizes strategic priorities as an organizational choice between cost-leadership and differentiation strategies. Manufacturing companies with differentiation strategic priorities are characterized by seeking new markets, high quality, product uniqueness, fast delivery, and flexibility. However, cost leadership companies face reeducation cost and compete primarily on price and operational efficiency. Any of these manufacturing strategic priorities require employing different management techniques (Chenhall, & Langfield-Smith, 1998), and thus different PMSs.

There exists a discussion in the literature on the relationship between manufacturing strategic priorities and the characteristics of PMSs (Langfield-Smith, 1997). The empirical evidence suggests that manufacturing strategic priorities (i.e., differentiation strategy) that emphasize team-based structures, just-in-time techniques, TQM management, and cross-integrated information systems require more advanced PMSs (Chenhall, & Langfield-Smith, 1998). As such, a differentiation strategy renders efficiency-based performance measures irrelevant and requires the inclusion of operational and non-financial performance measures to provide more insights than aggregated financial reports (Fullerton, & McWatters, 2002; Naranjo-Gil, & Hartmann, 2006). This discussion yields the following hypothesis:

H2: There exists a positive relationship between pursuing a differentiation strategy and PMS sophistication.

3.3. Interaction effect of interpersonal ties in TMTs

I expect that interpersonal ties in TMTs as an upper echelon characteristic moderate the effect of strategy on the use of sophisticated PMSs. It hypothesize that, while a differentiation strategy requires the adoption of a sophisticated PMS, TMT interpersonal ties may provide managers with an alternative, informal way for information exchange and process control, making them more likely to perceive advanced performance measures as unnecessary.

This argument reflects the substantial evidence from the upper echelon literature on the interaction between TMT characteristics and the organizational contingencies impact managers' strategic choices (Naranjo-Gil et al., 2009). According to Ensley, Pearson, & Amason (2002), while complex and ambiguous strategies may give rise to a cognitive and affective conflict between TMT members in decision making, the interpersonal ties between the team members promote mutual understanding, trust,

better communication, and interaction that overcome any cognitive conflict. This conclusion was corroborated by Carpenter (2002), who found that TMT social relationships moderate the impact of team heterogeneity on firm performance in complex strategic environments. (Lubatkin et al., 2006) further reported that behaviorally integrated TMTs promote the open exchange of contradictory opinions, thus sharing explicit and implicit knowledge and discussing market opportunities that facilitate the adoption of ambidexterity.

Several MC studies provided evidence on the interaction effect between TMT characteristics and the strategy–MCS relationship. For instance, de Harlez, & Malagueño (2016) studied how TMT personal background can impact the effectiveness of using a PMS for supporting hospital strategies. They found that top managers with a clinical background can better align the use of PMS with the hospital's strategic operational priority than their peers with an administrative background. Naranjo-Gil et al. (2009) reported that the positive effect of strategy on innovative MCS is more pronounced for younger, less-tenured, and business oriented CFOs. This discussion leads to the following hypothesis:

H3: The interpersonal ties in TMTs moderate the effect of differentiation strategies on PMS sophistication.

3.4. CEO origin and PMS sophistication

I predict that the impact of interpersonal ties among TMTs differs based on CEO origin. I hypothesize that the negative impact of TMTs' interpersonal ties on PMS sophistication is more pronounced in teams with insider CEOs than in those with outsider CEOs. This argument is supported by two literature streams. In the first, strategic management studies on CEO origin as a predictor of strategy formulation and organizational performance argue that insider and outsider CEOs have different characteristics. While insider CEOs have a deep knowledge of company operations and accumulated experience on its markets, customers, and products (Chung, 1987), they may fail to adopt innovation strategies or cope with uncertainties, since they might lack the experience or required skills (Fondas, & Wiersema, 1997) compared to outsider CEOs. The reason for this is insider CEOs are more constrained by their past experience within the firm, while outsider CEOs are more likely to bring relatively novel practices and knowledge that have a disruptive effect (Zhang et al., 2016). Insider CEOs are thus more likely developed social ties with their subordinates and senior managers, which might facilitate their control through better access to information (Chung, 1987).

The second literature stream studied how the interpersonal ties between the CEO and TMT members may hinder the formalization and introduction of MC practices in organizations. In this regard, insider CEOs can rely on their social ties to compensate the role of MCS. For example, El Masri, Tekathen, Magnan, & Boulianne (2017) reported that family CEOs are relying on pragmatic management practices, gut-feeling, trust, people, and familial relationships within the firm as alternatives to formal MC tools.

Even when their businesses grow, they focus on the survival and prosperity of the family through financial performance aspects (Dello Sbarba, & Marelli, 2018) and do not embrace advanced MC practices. This discussion suggests the following hypothesis:

H4: The negative impact of TMT interpersonal ties on PMS sophistication is larger in TMTs with insider CEOs than those with outsider CEOs.

4. Research method

4.1. Survey data

This study uses data from WMS, which is an international initiative to collect data on the quality of management practices across countries and industry sectors. The survey instrument and its methodology are reported by Bloom, & Van Reenen (2007). The WMS uses an innovating survey approach that reduces respondent and interviewer bias (Bloom, & Van Reenen, 2010). First, the survey collects data from plant senior managers over the phone using a double-blind methodology, where managers are not being told they are scored and interviewers have no prior knowledge of the organization's performance. Second, the survey asks open questions and managers are asked to support their answers with real practices inside their companies. Third, to reduce interview bias, the survey collects data on the interview day, time, and duration. The interviewers are also asked to grade the degree of cooperation of the interviewee to measure interview reliability.

This paper uses a dataset of 7,094 observations of randomly sampled medium-sized firms (employing between 50 and 5,000 workers) in the manufacturing sectors of 17 countries. For the purpose of this study, SMEs are defined using the dominant definition in MC literature, that is, companies with fewer than 500 (Heinicke, 2018). In total, 2,058 SMEs are used in the analysis. Table 1 summarizes the profiles of respondent companies by country, industry sector, and number of employees.

4.2. Variable measures

Measures for each construct were chosen from the literature, and Table 2 reports the descriptive statistics of the survey items used in this study. To select survey items that assess PMS sophistication, prior studies on PMS sophistication (Guenther, & Heinicke (2019); Henri (2006); Speklé, & Verbeeten (2014)) were examined. This resulted in the selection of seven survey items, representing two dimensions of PMS, namely performance evaluation and reward system.

For the independent variable, familial ties are used to construct interpersonal ties in TMTs. I followed Speckbacher, & Wentges (2012) in defining family involvement in TMTs as the dominance of family members on the control and management of the firm, which represents 20% of the sample. Then, I defined CEO origin, based on whether the CEO is a family (insider CEO) member or non-family member (outsider CEO).

The measurements items for the differentiation strategy are adopted from the studies of Chenhall, & Langfield-Smith (1998), and Fullerton, & McWatters (2002). Three survey items assessing the adoption of lean manufacturing practices were selected as indicators of pursuing a differentiation strategy.

Table 1 Respondent profiles

Panel A: Countries		**Panel B: Industry**	
Argentina	2	Construction trade	4
Australia	3	Food And Kindred Products	286
Brazil	2	Textile Mill Products	70
Chile	1	Apparel and Other Fabrics	52
China	129	Lumber and Wood Products	48
France	239	Furniture and Fixtures	43
Germany	61	Paper and Allied Products	92
Great Britain	550	Printing, and Publishing	71
Greece	145	Petroleum Refining	11
Italy	143	Rubber and Plastics Products	124
Japan	68	Leather Products	31
Northern Ireland	82	Stone, Clay, Glass, and Concrete Products	84
Poland	150	Primary Metal Industries	84
Portugal	150	Fabricated Metal Products	206
Republic of Ireland	85	Industrial and Commercial Machinery	195
Sweden	176	Electronic and Other Electrical Equipment	176
United States	72	Transportation Equipment	84
	2058	Measuring, Analyzing Instruments	93
		Miscellaneous Manufacturing Industries	71
		Wholesale Trade—Durable Goods	19
		Wholesale Trade—Non-Durable Goods	19
		Real Estate	7
		Holding and Other Investment Offices	9
		Business Services	12
		Miscellaneous Repair Services	6
Panel C: Firm size			
1–150	773		
151–300	833		
301–450	377		
< 500	75		
	2058		

I also included control variables for the effect of size, country, industry, and interview bias. Prior studies (Hiebl et al., 2013; Speckbacher, & Wentges, 2012) found that the influence of interpersonal ties in

TMTs diminishes in large and medium-sized companies and an increase in size leads to professionalization and the adoption of sophisticated MC practices. Therefore, this study controls for firm size, measured by the number of employees. Since SMEs managers in developing countries may have lower educational level and limited knowledge of MC practices (Lavia López, & Hiebl, 2015), country dummies are included in the analysis. Finally, to control for interview bias, the interview reliability scores are also included.

Table 2 Descriptive statistics

Constructs and indicators	Theoretical range	Practical range	Mean	Median	SD
Performance evaluation					
Track performance using meaningful metrics	1–5	1–5	3.36	3.00	0.97
Key measures are reviewed regularly	1–5	1–5	3.32	3.25	0.95
Use a balance of financial and non-financial measures	1–5	1–5	2.88	3.00	1.07
Results are discussed in meetings for feedback	1–5	1–5	3.13	3.00	0.96
Reward system					
Reward employees based on their performance	1–5	1–5	2.45	2.00	0.96
Identify and remove bad performers	1–5	1–5	3.08	3.00	0.96
Promote employees based on their performance	1–5	1–5	2.98	3.00	0.89
Differentiation strategy					
Introduce and apply lean manufacturing techniques	1–5	1–5	2.79	3.00	1.08
Utilize lean techniques to meet business goals	1– 5	1– 5	2.86	3.00	1.13
Control variables					
Firm size	–	–	208.51	184	113.96
Interview reliability score	1–10	4–10	7.88	8.00	1.59

Following the selection of survey items, exploratory factor analysis (EFA) is conducted using R 3.6.0. The method employed is principal component analysis (PCA) with varimax rotation across nine items using the full dataset of SMEs (n = 2,058). Factor loadings greater than an absolute value of 0.60 are considered for further analysis. The PCA extracted three factors that explain 68% of the variance and one item was removed due to cross-loading greater than 0.40. See Table 3 for factors loadings, percentage of variance explained, and the Cronbach alpha of each construct. Cronbach's alphas are between 0.63 and 0.86, thus supporting construct reliability.

4.3. Data analysis

To test hypotheses H1–H3, an OLS regression model is estimated as follows:

$$PMS_i = \beta_0 + \beta_1 INTP-TMT_{it} + \beta_2 DIFF-STRATEGY_{it} + \beta_3 (DIFF-STRATEGY_{it} * INTP-TMT_{it}) + \beta_4 SIZE_{it} + \beta_5 COUNTRY_{it} + \beta_6 INDST_{it} + \beta_7 RELIABILTY_{it} + \varepsilon_{it}$$

where PMS_i is a measure of the PMS sophistication level and *INTP-TMT* and *DIFF-STRATEGY* are constructs for interpersonal ties in TMTs and differentiation strategy, respectively. The interaction term in the model tests for the moderating effect of the interpersonal ties in TMTs on the differentiation strategy. The remaining four variables are proxies for the control variables.

ANOVA was also conducted to explore the impact of CEO origin on the sophistication level of PMS to test H4. The TMT group included in the prior analysis (INTP-TMT) was divided into two groups according to their CEOs' origin: family affiliated CEO (insider CEO), and externally hired CEO (outsider CEO). Additionally, the analysis included the two PMS sub-constructs—performance evaluation and reward system—for a more refined analysis.

Table 3 Exploratory factor analysis, loadings, reliability, and validity

	Factor 1	Factor 2	Factor 3
Performance evaluation (four items)			
Track performance using meaningful metrics	0.73		
Key measures are reviewed regularly	0.83		
Use a balance of financial and non-financial measures	0.63		
Results are discussed in meetings for feedback	0.80		
Reward system (three items)			
Reward employees based on their performance		0.74	
Identify and remove bad performers		0.74	
Promote employees based on their performance		0.66	
Differentiation strategy (two items)			
Introduce and apply lean manufacturing techniques			0.90
Utilize lean techniques to meet business goals			0.83
Factor loading	2.59	1.77	1.80
Percentage of variance explained	42%	29%	29%
Cronbach's alpha (α)	0.82	0.63	0.86

5. Results

Table 4 shows the Pearson correlation matrix for the dependent, independent, and control variables. The table shows that interpersonal ties in TMTs (INTP-TMT) are negatively correlated with the sophistication of PMS (PMS) and both of its two components—performance evaluation (PERF_EVL) and reward system (REWARD). The existence of a differentiation strategy (DIFF-STRATEGY) is

positively correlated with PMS sophistication (PMS). For the control variables, firm size (SIZE) is positively correlated with the sophistication of PMS (PMS) and all its sub-constructs. None of the pair-wise correlations among the variables is substantially higher than 0.6 and the variance inflation factor (VIF) ranges from 1.01 to 1.11, suggesting no evidence of multicollinearity.

Table 5 depicts the regression results for the dependent variable, PMS sophistication (PMS). Model 1 includes the control variables and main effect constructs to test H1 (INTP-TMT) and H2 (DIFF-STRATEGY). Model 2 shows the control variables and the two main effects and interaction term (INTP-TMT* DIFF-STRATEGY) to test H3. VIF ranges from 1.375 to 1.380, meaning multicollinearity is not a problem.

Table 4 Pearson correlation matrix

	1	2	3	4	5	6	7
1. PMS							
2. PERF_EVL	0.82						
3. REWARD	0.85	0.52					
4. INTP-TMT	-0.11	-0.08	-0.13				
5. DIFF-STRATEGY	0.36	0.62	0.42	-0.06			
6. SIZE (LN)	0.15	0.17	0.13	-0.02	0.15		
7. RELIABILITY	0.24	0.30	0.16	0.04	0.24	0.05	

Correlations with an absolute value of 0.06 or higher are significant at $p < 0.05$.

H1 predicts that the interpersonal ties in TMTs are negatively associated with the adoption of sophisticated PMSs. In Model 1, as shown in Table 5, INTP-TMT is negative and significant ($t = -3.057$; $p < 0.01$). This result supports H1. H2 presumes a positive effect of pursuing a differentiation strategy on PMS sophistication. Model 1 shows that DIFF-STRATEGY is positive and significant ($t = 12.33$; $p < 0.001$). This result provides support for H2.

Regarding the interaction hypothesis, H3 predicts that the positive relationship between a differentiation strategy and PMS sophistication is moderated by the effect of interpersonal ties in TMTs. The results of Model 2, as shown in Table 5, support H3. The interaction term (INTP-TMT × DIFF-STRATEGY) is negative and significant ($t = 12.33$; $p < 0.001$). The adjusted R^2 for Model 2 with the interaction term (0.197; $p < 0.001$) is significantly higher than adjusted R^2 for Model 1 (0.195; $p < 0.001$) without the interaction term ($\Delta R^2 = 0.001$; $p < 0.05$).

In testing for the proposed impact of CEO origin, Table 6 shows the results of ANOVA for comparing the mean value of PMS sophistication between two subsets of TMTs—TMTs with insider CEO ($n = 350$) and TMTs with outsider CEO ($n = 71$). H4 predicts that when TMT members have social

ties with their CEO (insider CEO), this would more negatively impact the adoption of a sophisticated PMS compared to teams with an outsider CEO. ANOVA shows that the two subsets show a significantly different mean for PMS ($F = 12.03$; $p = 0.000$). This result is also significant for the two sub-dimensions of PMS—performance evaluation ($F = 21.51$; $p = 0.000$) and reward system ($F = 6.31$; $p = 0.000$)—for the two sub-groups of CEOs. Therefore, H4 is supported.

Table 5 Regression results for Hypotheses 1–3

	Dependent variable: PMS			
	Model (1)		**Model (2)**	
Independent variables	β	(t-stat)	β	(t-stat)
Main effects:				
INTP-TMT	-0.278**	-3.057	0.089	0.402
DIFF-STRATEGY	0.410***	12.331	0.441***	12.035
Interaction :				
INTP-TMT × DIFF-STRATEGY			- 0.151*	0.074
Control				
SIZE	0.143**	3.025	0.143**	3.093
RELIABILITY	0.132***	6.449	0.132***	6.467
COUNT	YES		YES	
INDUST	YES		YES	
R^2	0.265		0.266	
Adjusted R^2	0.187		0.188	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

6. Discussion and conclusions

This study seeks to understand the factors that support or impede the introduction of advanced MC techniques in SMEs, particularly the use of sophisticated PMSs in manufacturing companies. I predict and demonstrate that the adoption of a sophisticated PMS would be influenced by two factors: the interpersonal relationships between TMT members and organizational strategic priorities, namely a differentiation strategy. The analysis of the survey data reveals that the need for sophisticated PMS is negatively associated with TMTs whose social networks are dense due to interpersonal links. I also show that manufacturing companies pursuing differentiation strategic priorities are more likely to use sophisticated PMSs. Additionally, the extent to which the use of a differentiation strategy impacts sophistication is moderated by the interpersonal ties in TMTs.

Furthermore, the study highlights the key role of CEOs in SMEs' top management by examining whether having interpersonal ties between TMT members and CEO could predict any difference in adopting sophisticated PMS. The analysis supported the hypothesis that the sophistication of PMS is significantly different between TMTs with insider CEO, and outsider CEO.

Table 6 Analysis of variance between TMTs with insider and outsider CEOs

	PMS	**Performance evaluation**	**Reward system**
Mean			
INSIDER_CEO (n = 350)	-0.390	2.98	2.84
OUTSIDER_CEO (n = 71)	0.231	3.44	2.61
Total (n = 421)			
ANOVA			
Sum of squares			
Between groups	21.8	12.45	2.96
Within groups	710.8	238.59	194.55
Total	732.6	251.04	197.51
d.f.			
Between groups	1	1	1
Within groups	393	412	415
Total	394	413	416
Mean square			
Between groups	21.756	12.454	2.9584
Within groups	1.809	0.579	0.4688
F statistic	12.03	21.51	6.31
Significance	0.00	0.00	0.05

The findings of this study contribute to the management control literature by pointing out the importance of considering social relationships between TMTs and not relying only on demographic characteristics in studying the effect of TMTs on MCS use and design. In this regard, the study also contributes to the discussion on the social and personal traits of the CEO–TMT relationship on MCS use (Abernethy et al., 2010; Hartmann et al., 2010; Lee et al., 2014) by explaining the importance of the CEO's origin in understanding the effects of TMT social relationships. Specifically, I show that the impact of interpersonal ties in TMTs is more pronounced when the CEO is appointed internally than when an outsider CEO is recruited. Therefore, the study supports and refines the conclusions of Speckbacher, & Wentges (2012) and provide further explanations for their mixed results.

Several studies (de Harlez, & Malagueño, 2016; Naranjo-Gil, & Hartmann, 2007; Naranjo-Gil et al., 2009) explored how TMT characteristics affects the strategy–MCS relationship. This paper also contributes to this literature stream by reporting the negative interaction effect of interpersonal ties in TMTs on the relationship between differentiation strategies and PMS sophistication.

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