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Management control systems in high-tech start-ups: An empirical investigation

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ABSTRACT

The literature on management control systems (MCS) has challenged the traditional belief that their use restrains the entrepreneurial posture of start-ups. This literature relates the adoption of these systems by start-ups to internal and external contingency factors. The aims of this study are twofold: i) to explore how different causal conditions related to these factors combine in explaining the use of MCS, and ii) how these combinations of causal conditions differ when comparing the MCS that relate to planning with those that relate to evaluation.

Based on survey data from a sample of high-tech start-ups, this study seeks to meet these objectives through quantitative and qualitative research methods.

The findings contribute to a better understanding of the adoption of MCS by start-ups. The findings demonstrate the relevance of the configurational analytical technique when simultaneously exploring the internal and external factors that lead to adoption.

1. Introduction

The life cycle theory of the firm (Miller & Friesen, 1983, 1984) identifies five successive phases: birth, growth, maturity, revival, and decline. The birth phase is the period in which a new firm tries to become viable. In this stage, the research characterizes firms as being small; having owner-managers; and being simple, centralized, and informal structures. Therefore, firms, called start-ups in the birth stage, mainly use simple control mechanisms and few or even no formal management control systems (MCS) (Churchill & Lewis, 1983; Grainer, 1972; Miller & Friesen, 1983, 1984). In line with Aldrich, Kalleberg, Marsden, and Cassell (1989), this study defines a start-up as an entity that coherently organizes itself for the first time.

Simons (2000, p.4) defines MCS as "formal, information based routines and procedures used by managers to maintain or alter patterns in organizational activities." The MCS provide financial and non-financial information that managers can use for several purposes, such as decision-making, control, signaling, external learning, education, and communication (Simons, 2000). However, the success of start-ups depends, among other factors (such as human resources practices, Bendickson, Muldoon, Liguori, & Midgett, 2017), on the introduction of MCS that fit the firm's growth phase and its organizational characteristics. According to Grainer (1972), the adoption of MCS allows young firms with fast growth to cope with the increasing need for information. In Grainer's (1998) opinion, a lack of MCS partly causes the failure of firms because of growth restrictions. In the same vein, Lin, Chen, and Lin (2017) find that operational and strategic control are positively and negatively related, respectively, to a new venture's performance. Therefore, MCS adoption is probably an important event in a startup's life (Davila & Foster, 2005, 2007).

Despite the hypothetical contribution of MCS to the success of start-ups, few studies focus on this phenomenon (Foster & Young, 1997). For instance, Davila and Foster (2005) find that although studies widely examine the budgeting of mature firms, the scientific knowledge about the use of this instrument in start-ups is quite low. The interest in start-ups by researchers of management control is a recent phenomenon (Davila & Foster, 2009), as evidenced by the literature (e.g., Davila & Foster, 2005, 2007; Davila, Foster, & Jia, 2010, 2015; Granlund & Taipaleenmäki, 2005; Lin et al., 2017; Moores & Yuen, 2001; Sandino, 2007).

The contingency theory posits that a firm's performance derives from the alignment between the characteristics of the organization and its contingencies (Donaldson, 2001). Applied to organizational control, this theory posits that none of MCS is universally appropriate for all firms and that MCS should not be equally applied across all firms and in all circumstances (Merchant & Van der Stede, 2007; Otley, 1980). The

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best MCS are those which help managers to achieve their organizational objectives and therefore should adjust to the context in which they are going to operate (Chenhall, 2007). However, the methods that contingency studies usually use (e.g., King, Clarkson, & Wallace, 2010) are linear. These studies seek statistically significant correlations in the interdependencies between contingency factors and organizational controls in improving performance. This analysis becomes reductionist in explaining the behavior of the constituent parts of the organization (Meyer, Tsui, & Hinings, 1993), since it assumes that there is an optimal organizational configuration (Fiss, 2007). In this sense, the analysis cannot uncover the complexity of the configurational arrangements present in organizations (Bedford & Sandelin, 2015).

Traditional contingency studies have neglected the multifaceted nature of controls and how multiple controls combine, which limits advancement in the control theory (Cardinal, Sitkin, & Long, 2010). Organizational control is in practice a complex and dynamic phenomenon (Cardinal et al., 2010) that results from a package of MCS that interacts in a differentiated and complex way with situational factors. Grabner and Moers (2013) define a package of MCS as a complete set of control practices that the firm implements (interdependently or not). This view has recently become the focus of many studies, as exemplified by Bedford and Malmi (2015) and Bedford, Malmi, and Sandelin (2016) who show the need to undertake studies that examine the interrelationship between the overall MCS that an organization uses and its internal and external contingency factors (Otley, 2016). Two or more organizational configurations could be equally effective in achieving the desired outcomes (Fiss, 2007). This equifinality concept raises interest in the configurational analysis that emphasizes the holistic nature of organizations and their need for coherence among organizational elements (Meyer et al., 1993), including MCS. Gerdin (2005) remarks that an important task for future research is to examine the existence of alternative and functional equivalents of MCS designs.

The purpose of this research is to understand the association between a group of contingency factors that are traditionally found in the contingency-based organizational control research and the adoption of MCS in start-ups. Therefore, this research does not seek to understand how the use of MCS affects the performance of firms, because a great deal of research already exists on that subject (e.g., Davila & Foster, 2005; King & Clarkson, 2015; Lin et al., 2017; Tsamenyi, Sahadev, & Qiao, 2011).

This study simultaneously examines external factors, such as the type of investor and environmental heterogeneity, and internal factors, such as business strategy and structure decentralization. Specifically, the study's objectives are: i) to explore how different causal conditions related to internal and external factors combine in explaining the use of MCS, and ii) how these combinations of causal conditions differ when comparing the MCS that relate to planning with those that relate to evaluation.

Although previous authors (e.g., Davila & Foster, 2005, 2007) do not distinguish between these two types of MCS, planning and evaluation are vital activities for start-ups to become viable and to grow (Karlsson & Honig, 2009; Puhakka, 2007). They both provide the information that managers need to make the right decisions (Silvola, 2008).

This study uses two complementary methods, the cluster analysis and the fuzzy-set qualitative comparative analysis (fsQCA). Although the research uses the cluster analysis more frequently (e.g., Gerdin, 2005; King & Clarkson, 2015; Moores & Yuen, 2001), these two methods show some complementarities that several researchers in different fields have already explored (e.g., Fiss, 2011; Haynes, 2014). Further, both methods are case-based and accept that more than one solution exists to achieve the desired outcome (Haynes, 2014). Nevertheless, this study concludes that the fsQCA presents several advantages over the cluster analysis, and therefore reinforces the arguments of several authors (Fiss, 2011; Haynes, 2014), namely in the management control field (Bedford et al., 2016; Bedford & Sandelin, 2015).

Although the accounting research rarely uses the fsQCA, it is a suitable technique to analyze the conditions for the occurrence of a specific phenomenon (Rihoux & Ragin, 2009), especially to analyze complex causation and nonlinear relationships (Ragin, 2008). Therefore, this research draws on the insights of the configuration or configurational theory, a modern variation of the contingency theory (Donaldson, 2006), by using a cluster analysis and the fsQCA.

Building on a sample of 54 Portuguese high-tech start-ups, the results show the existence of multiple combinations of situational factors and the MCS. These findings offer some support for the idea of a combined effect of internal and external factors in the adoption of MCS by start-ups. This study also contributes to the literature by confirming that organizational control is a complex phenomenon that translates into different organizational configurations.

Following this introductory section, Section 2 provides the literature review. Section 3 presents the research model, the propositions, the measures, and the method. Section 4 presents the empirical results, and Section 5 exhibits the discussion and advances with the conclusions.

2. Literature review

The contingency approach in the organizational control field proposes that a large number of external and internal contingency factors determine the design, implementation, and use of the MCS that a firm adopts (Chenhall, 2007; Luft & Shields, 2007). Even so, the studies that traditionally focus on the contingency theory adhere to the reductionist tenet by seeking linear correlations and an optimal organizational configuration, which is contrary to the principles of configurational theory (Meyer et al., 1993). Conversely, this study applies a configurational analysis (Meyer et al., 1993; Snow, Miles, & Miles, 2006) to examine the interrelationship between planning and evaluation MCS and some of the most frequently identified situational factors in the traditional contingency-based organizational control research. Specifically, environmental heterogeneity and type of investor have been considered as external factors and business strategy and structure decentralization as internal factors. This study argues that these situational factors can have different effects on the use of MCS by start-ups in contrast to other factors in the literature (e.g., size) whose effects might be lower in high-tech startups.

2.1. External factors

2.1.1. Type of investors

According to the agency theory, the investor takes on the main role of managing his or her relationship with the start-up's management team (Jensen & Meckling, 1976). However, this role might depend largely on (1) the weight of financial resources the investor has in the capital structure of the start-up; and (2) whether the financial resources are in the form of debt or equity. Therefore, the type of investor should affect the type of MCS that the start-up uses.

In a relationship between the investor and the manager, conflicts of interest may emerge due to information asymmetry. Bergemann and Hege (1998) mention that a conflict exists between the entrepreneur/manager (agent) and venture capitalist (principal), because the former controls the allocation of funds and investments as well as the flow of information about a project. The manager usually possesses more detailed information and before the investors. According to Baiman (1982), MCS are important in reducing agency costs. The studies by Reid and Smith (2000) and Smith (2005) find that venture capital firms seek to reduce risk and agency problems through MCS, and the improvement of the MCS is sometimes a requirement for the venture capitalists to invest in the start-up (Mitchell, Reid, & Terry, 1997). The professionalization of management, which includes the introduction of MCS, is a part of a package of benefits venture capital firms grant to start-ups (Hellmann & Puri, 2002). This package often includes the evaluations of the quality of the staff and the recruitment of people

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responsible for management control (Mitchell et al., 1997). Venture capitalists possess rights of control over the firm, and they can propose hiring an external manager who will contribute to the professionalization of the firm (Hellmann & Puri, 2002). Due to experience, this new manager could lead to the adoption of MCS by the start-up. Several studies find a positive effect of venture capital on whether a start-up adopts MCS (e.g., Davila & Foster, 2005, 2007; Granlund & Taipaleenmäki, 2005; Silvola, 2008). Davila et al. (2015) also find that equity financiers value MCS in start-ups more than debt financiers. Moreover, King and Clarkson (2015) find that ownership should be a contextual variable in future studies on MCS. In short, external investors induce an additional stimulus to management information in start-ups (Mitchell et al., 1997) that influences the shape, type, quality, and information frequency from the MCS.

2.1.2. Environmental heterogeneity

The external environment is a relevant factor in MCS contingency-based research (Chenhall, 2007), given the effect it has on the MCS' design (King et al., 2010) and the way in which managers' process and benefit from management control information (Gul & Chia, 1994). The literature finds several dimensions in the external environment (Chenhall, 2007): uncertainty, hostility, and heterogeneity (Khandwalla, 1972; Miller & Friesen, 1982). In this study, we focus on environmental heterogeneity, which the theorizing about MCS decisions rarely uses.

Environmental heterogeneity refers to the extent that each segment of the organization's market is distinct (homogeneous-heterogeneous scale) at the input or output end (Khandwalla, 1972). Duncan (1972) uses the simple-complex dimension to characterize the organizational environment. Duncan defines this dimension as a function of the number of internal and external factors that affects the decision unit's environment, which associates a simple dimension to a homogeneous environment and a complex dimension to a heterogeneous environment. Firms operating in many different markets (customers, products, or geographies) are subject to a greater diversity of experiences with competitors and clients (Miller & Friesen, 1982). The environment of high-tech start-ups is more heterogeneous and dynamic (Lin et al., 2017) because their entrepreneurs develop these firms around innovations that they sell in different markets.

Environmental heterogeneity includes the diversities in products, services, and markets, and in consumer's tastes and preferences and the managers' perception of the market's dynamism. As environments grow more heterogeneous, managers must process more information. Thus, Khandwalla (1972) argues that greater environmental heterogeneity is associated with the use of a sophisticated control and information system to integrate activities as well the proliferation of environmental scanning activities. Moreover, Chenhall (2007) points out that in complex environments a need exists for more information within the MCS, and the systems adopted should be sufficient to assist in making and implementing decisions.

2.2. Internal factors

2.2.1. Strategy

Among the various determinants of the MCS, the research considers strategy the most important contingency (Sandino, 2007), because a biunivocal relationship exists between strategy and MCS. While the MCS must align with the business strategy (Abernethy & Guthrie, 1994; Govindarajan & Fisher, 1990), it is also important in formulating and implementing that strategy (Simons, 2000) by helping to strengthen the firm's competitive position in the market and to improve performance (Langfield-Smith, 1997). Some authors (e.g., Gani & Jermias, 2012; Tsamenyi et al., 2011) find that organizations need to align their MCS and business strategy to achieve superior performance.

Considering Porter's typology of business strategy, the literature (e.g., Kaplan & Norton, 2004; Langfield-Smith, 1997; Simons, 1987) shows that mature firms pursuing a cost leadership strategy emphasize the need to have MCS to provide information on the development of operations, such as costs, quality, budgeting. In contrast, firms that follow a differentiation strategy need more information on the customer, competition, and other aspects of the environment. The firms that use cost leadership give traditional MCS greater relevance because of its focus on cost control; specific operating goals and budgeting; and formal, rigid, constrained, and impersonal MCS. But those firms that follow a differentiation strategy have MCS that are informal, loose, flexible, and interpersonal (Auzair & Langfield-Smith, 2005; Chenhall, 2007). Sandino (2007) finds that start-ups who follow a cost leadership strategy prioritize cost-minimizing MCS, while a differentiation strategy leads start-ups to prefer revenue-maximizing MCS.

However, an effective relationship between MCS and business strategy can only exist if firms establish formal information circuits. Strategic formulation is not a simple exercise of management's knowledge but rather an analytical process where MCS is an instrument that provides information for the strategy's formulation and control of its implementation. The study of the role of the MCS in the formulation and implementation of the strategy in start-ups is, according to Davila (2005), poorly explored.

2.2.2. Structure decentralization

The organizational structure represents the pattern of relationships established between the parts of the organization (Kast & Rosenzweig, 1985) through the formal specification of the various roles of organizational individuals or groups in order to ensure that they carry out the organization's policies and activities (Chenhall, 2007). Lawrence and Lorsch (1967) characterize the structure as the level to which operational or divisional managers act as quasi-owners. Decentralization relates to the delegation of decision-making to lower levels of management (Chenhall & Morris, 1986; King et al., 2010) as well as autonomy in planning, controlling, and accessing information (Waterhouse & Tiessen, 1978).

The literature finds that large and decentralized firms with sophisticated technologies and high diversity place greater emphasis on traditional MCS and formal and sophisticated controls in order to minimize the loss of control and to obtain relevant information in the area of planning, controlling, and decision-making (Abdel-Kader & Luther, 2008; Bruns & Waterhouse, 1975; Chenhall, 2007; Khandwalla, 1977). But centralized firms use few formal controls and rely on direct supervision of and interaction with employees (Merchant, 1981).

During their growth, start-ups go through the decentralization of autonomy and increased decision-making by lower level managers. Horngren, Bhimani, Datar, and Foster (2002) report that the essence of decentralization is the freedom that lower level managers have to make decisions. However, the expansion of the market, the hiring of more workers, and the creation of business units can have harmful consequences. According to Kaplan (2006), organizations have a natural tendency to move toward incoherence. Therefore, the challenge of the top managers of start-ups in the growth phase is to stimulate and align the effort of their divisions, so that the value created is clearly higher than the sum of the autonomous efforts of the divisions. The MCS can play a leading role in restoring a balance in organizational and individual trends toward clutter and chaos (Kaplan, 2006) by reconciling managers' personal goals with the firm's strategic goals and its shareholders' goals.

3. Research model and method

3.1. Research model and propositions

The research model explores how different causal conditions related to internal and external factors combine in explaining the use of MCS, and how these combinations of causal conditions differ when comparing MCS related to planning with those related to evaluation (Fig. 1).

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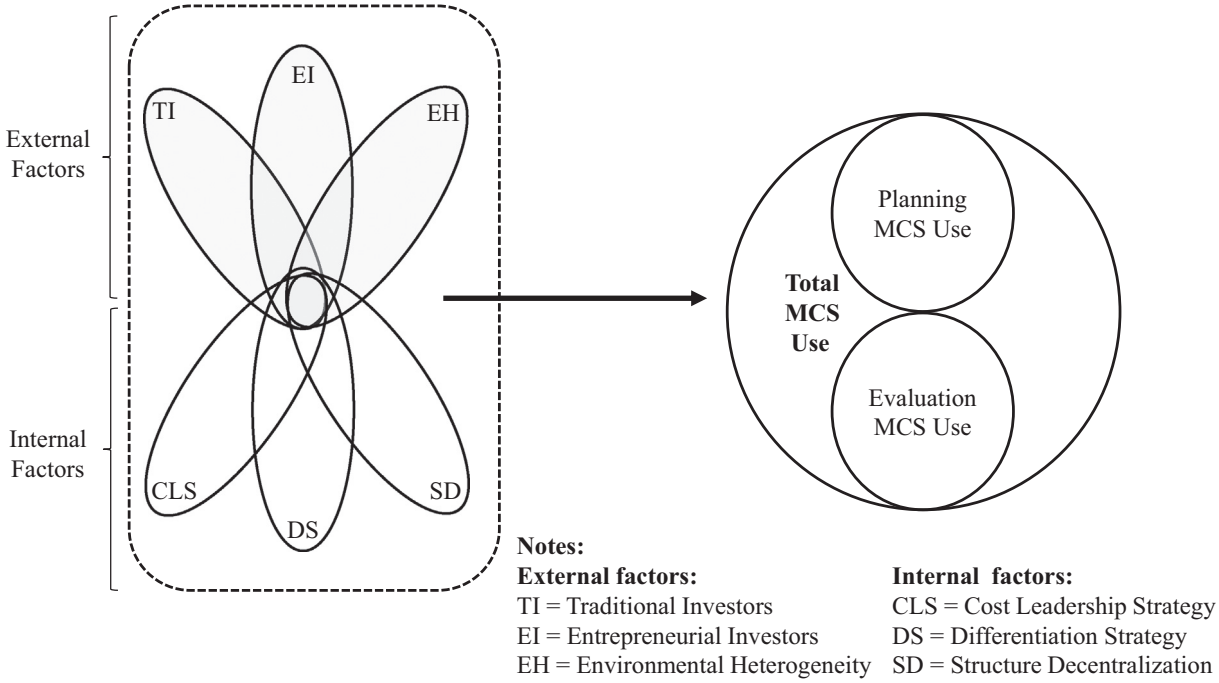

Fig. 1. Research model.

Drawing on the literature review, this study considers the following propositions:

Proposition 1. *The causal conditions allow the identification of different clusters of start-ups that lead to different uses of MCS.*

Proposition 2. *Different configurations of causal conditions are equifinal in achieving greater use of MCS.*

Proposition 3. *The configurations of causal conditions that achieve greater use of MCS comprise both internal and external factors.*

Proposition 4. *The configurations of causal conditions that achieve greater use of MCS for planning differ from the configurations for greater use of MCS for evaluation.*

3.2. Data collection

In line with previous studies (e.g., Davila & Foster, 2005, 2007), this study's population comprises start-ups that are independent, with < 10 years old, and have between 10 and 250 employees. The start-ups are in the high and medium-high technology sectors or in the knowledge-intensive services sector. The sample firms come from Dun&Bradstreet's *eInforma* database and total 539 Portuguese firms.

The empirical data come from an online survey sent by email to the CEOs and CFOs of all firms in the sample. A letter explaining the study's objectives and the investigation process accompanied the questionnaire.

Although the study received a total of 91 questionnaires (response rate of 16.9%), 37 were excluded due to incomplete responses. Therefore, the study comprises 54 usable responses, corresponding to a final response rate of 10%.

3.3. Measures, validity, and reliability

The variables in this study are based on the validated instruments in the literature. The outcome variables deal with the extent that start-ups use MCS. For comparability, the study uses the 34 systems in Davila and Foster (2007). We then divide these systems into six categories: financial planning, financial evaluation, human resource planning, human resource evaluation, strategic planning, and sales management. The Total MCS is the number of all systems but also distinguishes between planning and evaluation systems. The first group (Planning MCS) accounts for the systems involved with financial planning, human resource planning, and strategic planning, while the second group (Evaluation MCS) involves the systems from the other categories.

In line with previous studies (e.g., Davila & Foster, 2007; Sandino, 2007), the type of investor variables (traditional versus entrepreneurial) are computed from the list of different sources of financing used by start-ups, such as business angels, venture capital firms, credit institutions, and government institutes. Both variables are operationalized as dummy variables: entrepreneurial investors are coded as one if the start-up uses business angels or venture capital firms as financing sources, and zero otherwise; traditional investors are coded as one if the start-up uses funding from credit institutions, government institutes, and other external sources, and zero otherwise. Although these two variables are dummies, they are not mutually exclusive; and a firm can simultaneously have both types of investors.

The remaining independent variables, or causal conditions, are constructs that use a seven-point Likert scale with responses ranging from one "strongly disagree" to seven "strongly agree." The strategy variables (differentiation and cost leadership) use a five-item scale obtained from Sandino (2007), while the environmental heterogeneity and structure decentralization variables use a five-item and a six-item scale, respectively, both drawn from King et al. (2010).

This study evaluates the uni-dimensionality, reliability, convergent validity, and discriminant validity of the latent variables (Bagozzi & Yi, 2012; Hair, Black, Babin, & Anderson, 2009) and performs the confirmatory factor analysis to assess if the measurement model fits the data (Anderson & Gerbing, 1988). Table 1 shows detailed information regarding the differentiation strategy, cost leadership strategy, environmental heterogeneity, and the decentralized structure as well as validity and reliability tests and the overall model fit indices.

With regard to the analysis of uni-dimensionality and convergent validity, all of the items load between 0.60 and 0.89, and therefore meet the 0.60 cutoff (Bagozzi & Yi, 2012; Hair et al., 2009). By following an interactive process, the original scales are purified and four items are removed as indicated in Table 1. All constructs have

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Table 1
Measurement items and validity assessment of constructs.

Construct/item	Standardized loadings
Environmental heterogeneity (α = 0.84; CR = 0.84; AVE = 0.52)	
How heterogeneous are the following factors?	
Scale: 1 = "very homogeneous" to 7 = "very heterogeneous"	
Price Products/services offered by our firm	0.68
Markets covered by our firm	–
Customers' buying habits	0.71
The nature of the competition	0.74
Market dynamism and uncertainty	0.68
Cost leadership strategy (α = 0.83; CR = 0.83; AVE = 0.72)	
To what extent the following factors influence and drive the management of the company?	
Scale: 1 = "no effect" to 7 = "total effect"	
Firm's customers search for lower prices.	0.80
The emphasis the firm places on lower prices and promotions as a way to attract and retain customers.	0.89
Differentiation strategy (α = 0.71; CR = 0.71; AVE = 0.56)	
To what extent the following factors influence and drive the management of the company?	
Scale: 1 = "no effect" to 7 = "total effect"	
The customer's demand for uniqueness.	0.61
The firm offers unique products highly valued by target customers.	0.86
The firm emphasizes service and customization to the customers.[a]	–
Structure decentralization (α = 0.81; CR = 0.84; AVE = 0.51)	
To what extent has authority been delegated to the appropriate senior managers for each of the following classes of decisions?	
Scale: 1 = "no delegation" to 7 = "complete delegation"	
Development of new products/services.[a]	–
The hiring and firing of managerial personnel.	0.74
Selection of large investments.	0.86
Budget allocations.	0.78
Pricing decisions.[a]	–
Other important operational decisions (e.g. purchase materials).	0.60
Overall measurement model fit:	
$\chi^2(95) = 114.08$, $p = 0.09$; $\chi^2/df = 1.20$;	
GFI = 0.82; CFI = 0.94; IFI = 0.94;	
RMSEA = 0.062	

Notes: α = Cronbach's alpha; CR = Composite Reliability; AVE = Average Variance Extracted.
[a] This item was deleted during the scale purification process.

Cronbach's alpha (α) and composite reliability (CR) values that are higher than the 0.70 thresholds that Nunnally (1978) and Hair et al. (2009) suggest. Therefore, they meet the reliability requirements. Additionally, the constructs also meet Fornell and Larcker's (1981) tests for discriminant validity: all measures have values for the average variance extracted (AVE) above the 0.50 cutoff; and the square root of the AVE for each construct is higher than the values of the correlation estimates (r^2) between that particular construct and the other constructs in the model (please see Table 2).

To assess the measurement model's overall fit, several indices are considered: the ratio of the chi-squares to the degrees of freedom (χ^2/df), goodness of fit index (GFI), comparative fit index (CFI), incremental fit index (IFI), and the root mean square error of approximation (RMSEA). The results show a good fit of the measurement model to the data, since the values for each index are good despite the sample dimension: $\chi^2/df = 1.20$; GFI = 0.82; CFI = 0.94; IFI = 0.94; RMSEA = 0.062.

3.4. Cluster analysis

Cluster analysis is essential in determining taxonomies, configurations, and strategic groups (Fiss, 2011; Haynes, 2014; Hotho, 2014). This analysis assumes that within a sample, similar and different objects or cases exist. Thus, it computes algorithms to classify objects into different groups or clusters based on their values in a set of variables (Pastor, 2010). The objective of this analysis is to organize the cases in a way that objects or cases within groups present similar values in the set of variables used to define the groups, and the ones in different clusters present divergent values (Hotho, 2014; Pastor, 2010).

Following Fiss (2011), the study uses a two-step cluster analysis with two dummy variables (Hair et al., 2009). In the first step, several hierarchical cluster analyses are performed that use standardized measures, Ward's minimum variance method and the squared Euclidian distance, that result in a solution of four clusters based on the dendograms and the cutoff values. The second step performs a K-means cluster analysis by using the centroid values of previous hierarchical analysis as seeds (Hair et al., 2009).

Afterwards, significance tests that use the Kruskal-Wallis test are performed by using the variables related to the use of MCS. The objective of this procedure is to validate the cluster solution.

3.5. FsQCA analysis

In addition to the cluster analysis, this study also uses a qualitative comparative analysis (QCA). This approach explicitly analyzes cases as combinations of several features and, therefore, theorizes the configuration of patterns between cases that identifies similarities and divisions between them (Ragin, 1987; Rihoux & Ragin, 2009). Even though this approach appeared in social sciences in the late 1980s (Ragin, 1987), the application of QCA, and particularly the fuzzy-set qualitative comparative analysis (fsQCA), has become progressively more accepted in business and management research fields (Roig-Tierno, Gonzalez-Cruz, & Llopis-Martinez, 2017; Seny Kan, Adegbite, El Omari, & Abdellatif, 2016). By using Boolean algebra and fuzzy-set theory, each case is a combination of several causal and outcome conditions, and therefore can identify specific causal pathways that lead to specific

Table 2
Correlation matrix.

	1	2	3	4	5	6	7	8
1. Environmental heterogeneity	**0.72**							
2. Cost leadership strategy	0.28	**0.85**						
3. Differentiation strategy	0.21	0.05	**0.75**					
4. Structure decentralization	− 0.43	− 0.13	0.08	**0.72**				
5. Traditional investors	0.18	0.05	− 0.07	− 0.01	-[a]			
6. Entrepreneurial investors	− 0.07	0.08	0.04	0.00	0.07	-[a]		
7. Planning MCS	− 0.03	− 0.17	0.16	0.08	− 0.13	0.20	-[a]	
8. Evaluation MCS	− 0.12	− 0.15	0.14	0.18	− 0.20	0.16	0.71**	-[a]
Mean	4.30	3.83	5.86	3.99	–	–	6.56	6.50
Standard deviation	1.18	1.47	0.92	1.32	–	–	3.39	4.03

Notes: The boldface scores on the diagonal are the square root of AVE.
** $p < 0.01$ ($n = 54$).
[a] Single-item measures.

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Table 3
Statistics and calibration values for the conditions and outcome variables.

	Descriptive statistics				Calibration criteria		
	Mean	SD	Min	Max	95%	50%	5%
Outcomes							
Total MCS	13.06	6.86	3.00	29.00	23.0	13.5	4.0
Planning MCS	6.56	3.39	1.00	13.00	12.0	6.0	2.0
Evaluation MCS	6.50	4.03	0.00	18.00	12.7	6.5	1.0
Conditions:							
Traditional investors	–	–	0.000	1.000	1.000	–	0.000
Entrepreneurial investors	–	–	0.000	1.000	1.000	–	0.000
Environmental heterogeneity	4.300	1.175	1.000	7.000	6.200	4.400	2.060
Cost leadership strategy	3.833	1.469	1.000	7.000	6.175	4.000	1.000
Differentiation strategy	5.855	0.916	3.333	7.000	7.000	6.000	4.333
Structure decentralization	3.985	1.323	1.5	7.000	6.058	4.000	1.804

outcomes (Woodside, 2013).

The fsQCA approach presents some advantages. For instance, cluster techniques obtain several groups of cases but classify each group as a black box because the contribution of each variable is difficult to measure in order to distinguish between clusters (Fiss, 2007). The fsQCA is a more robust and clear method for identifying how specific variables influence the construction of clusters, and for theorizing about the distinction between clusters (Haynes, 2014).

This study uses the fs/QCA 2.5 software (Ragin, 2000, 2006) and conducts three analyses to test the propositions. The first analysis explores the conditions that lead to a high extent of total MCS use, and the other analyses investigate the conditions that lead specifically to a high extent of MCS use for planning or evaluation. Hence, the models are:

Total MCS = f(TI, EI, EH, CLS, DS, SD).

Planning MCS = f(TI, EI, EH, CLS, DS, SD).

Evaluation MCS = f(TI, EI, EH, CLS, DS, SD).

To perform the fsQCA, the original data for the causal conditions and the outcomes needs to be calibrated into fuzzy membership scores (Ragin, 2008). Because most of the causal conditions in this study are multi-item measures, their scale items are turned into average scores. The outcome variables (Total MCS, Planning MCS, and Evaluation MCS) account for the number of MCS that firms use. Both types of variables need to be calibrated into fuzzy sets with values ranging from zero to one, which denotes full nonmembership or full membership, respectively (Ragin, 2008). To perform the direct calibration method, three anchors are established (Ragin, 2008; Woodside, 2013): one that represents full membership (fuzzy score = 0.95), one that represents full nonmembership (fuzzy score = 0.05), and one that represents the crossover point (fuzzy score = 0.50). The causal conditions about the type of investors that support the funding process of start-ups are transformed into a crisp set where one represents the existence of that type of investor and zero for its inexistence. Table 3 presents the statistics as well as the calibration values for all of the variables.

4. Empirical results

4.1. Results of cluster analysis

Panel A of Table 4 presents the final results of the cluster analysis. The solution includes four clusters, three of them with similar dimensions (between 15 and 17). Cluster 1 (n = 6) embraces firms that entrepreneurial investors finance and that follow a strong differentiation strategy and a medium cost leadership strategy. We label these start-ups Risk-Funded Differentiators. Cluster 2 (n = 15) is labeled as Traditional Decentralized and comprises start-ups with traditional investors that use a structure highly decentralized with low levels of strategy implementation. Cluster 3 (n = 17) comprises firms that are not funded by external investors, operate in highly heterogeneous environments, present a centralized structure, and follow a differentiation strategy. We label these firms as Solo Differentiators. Cluster 4 (n = 16) is labeled as Traditional Strategizer and contains start-ups funded by traditional investors. These start-ups show high scores in both strategies and also present a highly decentralized structure.

This study uses Kruskal-Wallis tests to investigate whether the cluster analysis identifies the possible differences between the clusters on the use of MCS. The results for the three variables that measure the MCS use are presented in Panel B of Table 4. The results show that this clustering procedure does differentiate between the groups in their use of MCS for planning, but cannot explain the different levels of total use and evaluation use. These results highlight an important weakness in a cluster analysis: if the objective is to relate groups of firms with a set of characteristics to a specific outcome, then the cluster analysis cannot help because the clusters represent a group of variables or

Table 4
Cluster analysis results.

A	Risk-funded differentiators (Cluster 1)	Traditional decentralized (Cluster 2)	Solo differentiators (Cluster 3)	Traditional strategizer (Cluster 4)	ANOVA F-value
External factors					
Traditional investors	0.20932	0.28468	− 0.87669	0.58610	10.134***
Entrepreneurial investors	2.80212	− 0.35026	− 0.35026	− 0.35026	–
Environmental heterogeneity	− 0.19673	− 0.26417	0.41164	− 0.11593	1.499$^{n.s.}$
Internal factors					
Cost leadership strategy	0.22483	− 0.49463	− 0.12564	0.51289	3.161*
Differentiation strategy	0.44490	− 1.25097	0.40769	0.57249	26.922***
Structure decentralization	0.1040	0.50243	− 0.84342	0.42120	9.101***
n	6	15	17	16	

B	Risk-funded differentiators (Cluster 1)	Traditional decentralized (Cluster 2)	Solo differentiators (Cluster 3)	Traditional strategizer (Cluster 4)	Kruskal-Wallis test chi-square (d.f. = 3)
Total MCS	36.75	29.63	25.09	24.59	3.307$^{n.s.}$
Planning MCS	12.17	24.23	32.56	30.94	8.957*
Evaluation MCS	19.33	26.13	30.06	29.13	2.372$^{n.s.}$

Notes: $^{n.s.}$ - non significant; *p < 0.05; **p < 0.01; ***p < 0.001.

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characteristics that are not relevant to the outcome. The QCA provides more insights into that relationship (Haynes, 2014).

4.2. Results for the fsQCA

4.2.1. Analysis of necessary conditions

The analysis of the fsQCA results starts with evaluating whether any of the causal conditions are necessary when the outcome occurs (Schneider & Wagemann, 2010). As Rihoux and Ragin (2009) point out, a causal condition is necessary if that condition is always present (or absent) when the outcome is present (or absent). The measure used to identify the necessary conditions is the consistency score (Ragin, 2006). A condition is necessary if the consistency score is above 0.90, and is "almost always necessary" if the score is between 0.80 and 0.90 (Ragin, 2000). Table 5 presents the results of this analysis for Total MCS, Planning MCS, and Evaluation MCS.

The differentiation strategy is a necessary condition to achieve the three outcomes because its consistency scores are all above the 0.90 threshold. Further, the absence of entrepreneurial investors is "almost always necessary" for the use of the total MCS, but this absence is a necessary condition for the use of MCS for planning or evaluation.

4.2.2. Analysis of sufficient conditions

The analysis of the sufficient conditions requires the construction, distillation, and examination of truth tables for each outcome (Ragin, 2008). The initial truth table for each outcome has 64 rows where each one represents a possible configuration of the different causal conditions.

Afterwards, to distill each truth table, it is necessary to define two criteria: a frequency value and a consistency threshold (Ragin, 2006, 2008; Rihoux & Ragin, 2009). The frequency value is fixed in one case because this study uses a small-n sample, and the consistency thresholds are above the minimum of 0.75 suggested by Ragin (2006, 2008): 0.84 for Total MCS use and 0.82 for both Planning MCS use and Evaluation MCS use.

The fsQCA generates three different solutions: complex, parsimonious, and intermediate (Ragin, 2008; Rihoux & Ragin, 2009). This study only uses the parsimonious and intermediate solutions. To simplify the presentation and readability (see Table 6), the study uses, as Fiss (2011), the following notation: black circles (●) indicate the presence of a condition, circles with a cross-out (⊗) indicate the absence of a condition, and the blank spaces indicate a situation where a condition is not relevant for the configuration. The dimension of the circles is also important: large circles identify core conditions (conditions that are part of both parsimonious and intermediate solutions), and small circles identify peripheral conditions (conditions that are only part of intermediate solution).

Further, each column characterizes a different configuration, Total MCS, Planning MCS, and Evaluation MCS, according to the following labels after the number of the configuration: label "T" for configurations that lead to Total MCS use; label "P" for configurations that lead to Planning MCS; and label "E" for configurations that lead to Evaluation MCS.

The solutions for the high uses of Total MCS, Planning MCS, and Evaluation MCS show consistencies > 0.75 and coverages > 0.25, which exceed the threshold values of informative solutions (Ragin, 2008; Woodside, 2013). The consistency of each solution shows the degree to which the firms in this study share the configurations in each solution to achieve a specific outcome (Ragin, 2008; Schneider & Wagemann, 2012), while the solution coverage identifies what part of the outcome a set of configurations represents in the solution (Schneider & Wagemann, 2012). The intermediate solution for Total MCS has a consistency of 0.85 and a coverage of 0.49, the solution for Planning MCS has a consistency of 0.80 and a coverage of 0.51, and the solution for Evaluation MCS has a consistency of 0.78 and a coverage of 0.25. Further, the three analyses show equifinal solutions, that is, there are several alternative and equally effective solutions to achieve high uses of Total MCS and Planning and Evaluation MCS.

Regarding the solution for Total MCS, the results show four different configurations that are sufficient for achieving high usage, even though configurations 2Ta and 2Tb are neutral permutations of the same solution: they present the same core conditions and swap peripheral conditions. All configurations present consistency levels above the threshold of 0.80 recommended by Ragin (2008), and combine five or six causal conditions. The sufficient configurations for achieving high use of Total MCS include both core and peripheral conditions and combine external and internal factors as causal antecedents. The first configuration (1T) shows that start-ups with traditional investors that operate in homogeneous environments, use a differentiation strategy, and that have a decentralized organizational structure also have high use of Total MCS. This configuration presents a consistency of 0.83 that means 83% of the firms with those conditions achieve high Total MCS. This configuration also shows higher coverage (Cov. = 0.30), which means that 30% of the cases that achieve high MCS show this combination of causal conditions.

The second configuration (2Ta) shows that start-ups without traditional investors that operate in heterogeneous environments, simultaneously implement cost leadership and differentiation strategies, and that have a decentralized structure reach high Total MCS. The neutral permutation (2 Tb) presents a similar combination of causal conditions but swaps environment heterogeneity for the presence of entrepreneurial investors. Both of these permutations present high

Table 5
Summary of necessary conditions.

	Total MCS		Planning MCS		Evaluation MCS	
Causal condition	Presence		Presence		Presence	
	Consistency	Coverage	Consistency	Coverage	Consistency	Coverage
Traditional investors	0.69	0.44	0.70	0.47	0.71	0.47
~Traditional investors	0.31	0.57	0.30	0.58	0.29	0.55
Entrepreneurial investors	0.16	0.67	0.05	0.20	0.07	0.30
~Entrepreneurial investors	0.84	0.45	0.95	0.53	0.93	0.51
Environmental heterogeneity	0.68	0.56	0.76	0.64	0.75	0.62
~Environmental heterogeneity	0.57	0.66	0.51	0.62	0.52	0.61
Cost leadership strategy	0.55	0.55	0.63	0.65	0.60	0.61
~Cost leadership strategy	0.68	0.63	0.65	0.62	0.66	0.61
Differentiation strategy	0.93	0.51	0.98	0.56	0.97	0.54
~Differentiation strategy	0.22	0.81	0.19	0.73	0.20	0.76
Structure decentralization	0.67	0.64	0.59	0.60	0.60	0.59
~Structure decentralization	0.59	0.55	0.65	0.64	0.64	0.62

Note: The tilde symbol (~) before the causal condition represents the absence of the condition.

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Table 6
Configurations for presenting high MCS.

	Total MCS				Planning MCS			Evaluation MCS		
	1T	2Ta	2Tb	3T	1P	2P	3P	1Ea	1Eb	2E
EXTERNAL FACTORS										
Traditional Investors	●	⊗	⊗	●	⊗	●		⊗	⊗	⊗
Entrepreneurial Investors			●	●	⊗	⊗	⊗		●	⊗
Environmental Heterogeneity	⊗	●		●	●		⊗	●		
INTERNAL FACTORS										
Cost Leadership Strategy	⊗	●	●	●	●	●		●	●	⊗
Differentiation Strategy	●	●	●	●	●	●	●	●	●	●
Structure Decentralization	●	●	●	⊗	●	⊗	⊗	●	●	
Consistency	0.83	0.84	1.00	0.93	0.84	0.82	0.82	0.89	0.82	0.76
Raw Coverage	0.30	0.11	0.03	0.06	0.10	0.30	0.38	0.11	0.02	0.19
Unique Coverage	0.29	0.11	0.02	0.05	0.05	0.09	0.12	0.02	0.02	0.10
Overall Solution Consistency		0.85				0.80			0.78	
Overall Solution Coverage		0.49				0.51			0.25	

Note: Black circles indicate the presence of a condition and the circles with "x" indicate its absence. Large circles indicate core conditions and small circles peripheral ones. Blank spaces indicate "not important".

consistency levels (2Ta: Cons. = 0.84; 2 Tb: Cons. = 1.00), but the first explains a higher amount of cases (2Ta: Cov. = 0.11; 2 Tb:Cov. = 0.03).

Configuration 3 T has a level of consistency at 0.93 and a coverage of 0.06, but even so is responsible for explaining 5% of the cases that present high Total MCS (U.Cov. = 0.05). In this configuration, all causal conditions are in the configuration and all but structure decentralization, are present.

The analysis on high Planning MCS shows totally different configurations, and therefore the causal conditions present or absent in start-ups with high Total MCS are not the same. The first configuration (1P) is highly consistent (Cons. = 0.84) but only explains about 10% of the cases (Cov. = 0.10). This configuration comprises firms that do not have traditional or entrepreneurial investors, operate in heterogeneous environments, follow both strategies, and that have a decentralized structure.

The second configuration (2P) indicates that the simultaneous presence of traditional investors and entrepreneurial investors, the implementation of cost leadership and differentiation strategies, and the implementation of a centralized structure also results in high Planning MCS. This configuration is also highly consistent (Cons. = 0.82) and explains a large amount of cases (Cov. = 0.30).

The third configuration (3P) is based on the absence of several conditions: the entrepreneurial investors, a homogeneous environment, and a centralized structure combined with the implementation of a differentiation strategy. This configuration is highly consistent (Cons. = 0.82), and explains about 38% (Cov. = 0.38) of the cases with high Planning MCS.

The analysis of the use of Evaluation MCS as an outcome presents configurations quite different than those for the Planning MCS. Even so, the first two configurations have neutral permutations (1Ea and 1Eb) that are similar to configurations 2Ta and 2 Tb that lead to high Total MCS. These configurations present high consistency levels (1Ea:Cons. = 0.89; 1Eb:Cons. = 0.82), but low coverage (1Ea:Cov. = 0.11; 1Eb:Cov. = 0.02).

The third configuration indicates that start-ups that do not have traditional investors or entrepreneurial investors and implement a differentiation strategy have high Evaluation MCS. This configuration presents a consistency level of 0.76 and a coverage level of 0.19.

An interesting result is the evidence that implementation of a differentiation strategy is a condition in all of the configurations that lead to high Total MCS, or when distinguishing between Planning and Evaluation MCS. However, all of the other causal conditions combine into different configurations but show diverse values. In some configurations, they are present (i.e., high values), while in others they are absent (i.e., low values).

5. Discussion and conclusions

The main objective of this study is to investigate the causal complexity behind the use of MCS by examining how internal and external factors influence firms on the high use of MCS. The study also explores how these combinations differ for planning and evaluation MCS. This study also extends the research (e.g., Davila et al., 2015; Reid & Smith, 2000) on the impact of contingency characteristics on the adoption of MCS by SMEs or start-ups.

The research in this field mainly uses regression-based techniques. The application of the cluster analysis and the fsQCA better explains how these factors combine in firms with high MCS. Instead of a single solution that is generalizable for all firms, both techniques identify several groups of firms.

The cluster analysis identifies different groups of firms using the six factors considered in this study. All variables are significant in the cluster analysis except for environmental heterogeneity that does not present a significant F-value. Even so, Proposition 1 does not hold because the different clusters explain different levels of planning MCS, but not different levels of total MCS and evaluation MCS. Environmental heterogeneity requires more information from the MCS (Chenhall, 2007). However, although the sample of start-ups comes from a well delimited sector of activity in the same country, they show that environmental heterogeneity is not important to clustering the different firms and that the defined clusters give more emphasis to differences in the adoption of planning MCS than to the adoption of evaluation and total MCS.

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These results illustrate the limitations of the cluster analysis and justify the implementation of the fsQCA. The fsQCA helps to identify alternative equifinal configurations that lead to the outcomes. The results show that four combinations of the six causal conditions are sufficient to predict high total MCS, which explains 49% of this outcome. This finding confirms Proposition 2. However, all of the configurations have internal and external causal conditions, which confirms Proposition 3.

Three configurations explain 51% and 25% of the outcomes for planning MCS and evaluation MCS respectively. Nevertheless, none of the configurations is analogous between these two outcomes, which supports Proposition 4.

Overall, the results confirm the complexity behind the use of MCS (Bedford & Sandelin, 2015), since there are several combinations that lead to high total MCS, which are quite different from the combinations that lead to high planning or evaluation MCS. There are only two exceptions that lead simultaneously to high total MCS and evaluation MCS. With the exception of differentiation strategy (that only shows high values), all of the other causal conditions combine with others to show opposite values in different configurations. Another important result is the absence of traditional investors and entrepreneurial investors in all configurations for the use of evaluation and planning MCS, respectively. The absence of traditional investors occurs when there is a high use of evaluation MCS, while the absence of entrepreneurial investors occurs when there is a high use of planning MCS. This is a relevant finding regarding the entrepreneurial finance literature.

In opposition to regression-based techniques that present uniform causal effects for each condition, the fsQCA allows the specification of causal conditions with opposite causal effects that can integrate equifinal solutions (Fiss, 2007). This finding challenges the majority of the literature that examines the relationship between those contingency factors and the use of MCS (e.g., Chenhall, 2007; Mitchell et al., 1997; Silvola, 2008). The literature already recognizes this duality in terms of organizational structure (Kaplan, 2006) and type of strategy (Chenhall, 2007; Kaplan & Norton, 2004), but it is quite a new result for the other variables studied. For example, a decentralized structure is always a core condition that integrates nine of the ten configurations obtained. Although in the majority of the configurations, a high decentralized structure combines with other conditions for achieving high use of the MCS); in three of the configurations (one for Total MCS and two for Planning MCS), the absence of a decentralized structure is a core condition.

These findings may also be helpful for practitioners, especially those in young high-tech firms trying to assess the conditions to succeed in their entrepreneurial projects in an extremely competitive industry. Considering that start-ups normally have scarce financial resources, the identified combinations may assist entrepreneurs to make strategic decisions about the investment in MCS which, as noted by Davila and Foster (2005, 2007), may be a crucial decision for their growth.

5.1. Limitations and future research

This study presents several limitations. First this study only relies in a small group of contingency factors, here classified as internal and external. Other variables can also be applicable to achieving high use of MCS: the external environment or internal characteristics, such as CEO professionalization, debt to equity ratio and the firm's age, size, and international experience. However, this study only uses outcome measures that relate to the use of MCS. A natural extension is to explore the intensity and the relevance of the use of MCS.

Finally, this study only focuses on high-tech start-ups. The comparison of results with different start-ups in traditional industries or with older high-tech firms might be an interesting research avenue.

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